Republic of Uzbekistan
SJSC UZBEKENERGO

Republic of Uzbekistan
Preparatory Survey on Navoi Thermal Power Station Modernization Project

Final Report

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Abbreviations

ADB	Asian Development Bank
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
C/P	Counterpart
CCCGP	Combined Cycle Cogeneration Plant
CCPP	Combined Cycle Power Plant
CDM	Clean Development Mechanism
Df/R	Draft Final Report
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ES	Engineering Stage
EPC	Engineering, Procurement and Construction Contract
FIRR	Financial Internal Rate of Return
F/R	Final Report
F/S	Feasibility Study
GT	Gas Turbine
GTW	Gas Turbine World
HHV	Higher Heating Value
HP	High Pressure
HRSG	Heat Recovery Steam Generator
I&C	Instrumentation and Control
Ic/R	Inception Report
IP	Intermediate Pressure
IFC	International Finance Corporation
IPP	Independent Power Producer
ISO	International Standard Organization
JICA	Japan International Cooperation Agency
JSC	Joint Stock Company
LHV	Lower Heating Value
LP	Low Pressure
MW	Mega Watt

NOx	Nitrogen Oxide
NG	Natural Gas
NGO	Non-Governmental Organization
NHC	National Holding Company
O&M	Operation and Maintenance
ODA	Official Development Assistance
OEM	Original Equipment Manufacturer
PSS/E	Power System Simulator for Engineering
SJSC	State Join Stock Company
SOx	Sulfur Oxide
ST	Steam Turbine
TOR	Terms of Reference
TPP	Thermal Power Plant
USD	United States Dollar
VAT	Value Added Tax
W/S	Work Shop
WB	World Bank

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^{3}N : milligram per normal cubic meter
g/m^{3}N : 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^{2}h : kilocalorie per square meter hour
Btu/ft^{2}H : 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 : Uzbekisutan Sum
US$: US Dollar
¥ : Japanese Yen

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Summary

1. Preface

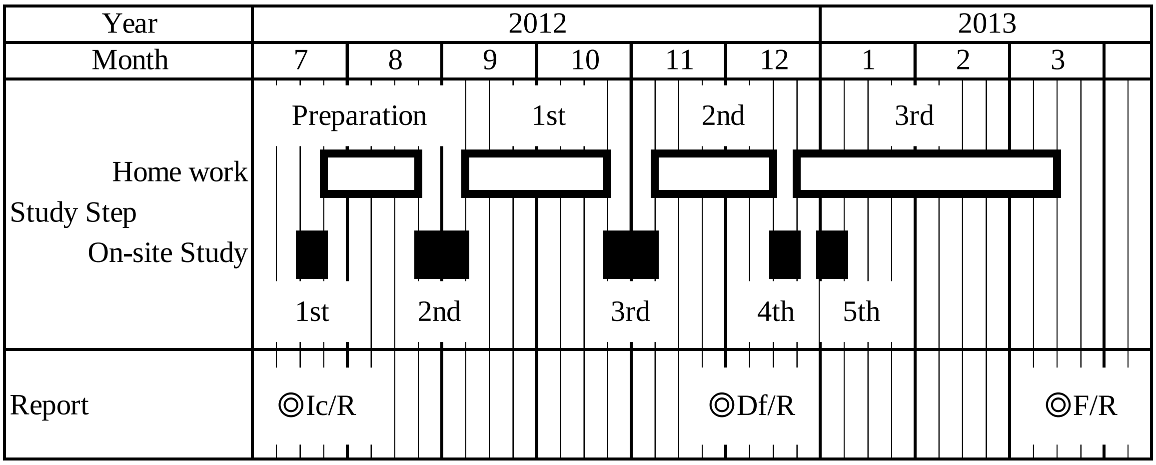
1.1 Purpose of Survey and Scope of Survey

1.1.1 Purpose of Survey

The purpose of survey consists in to carry out studies necessary for judging whether the introduction of "Navoi Thermal Power Plant Modernization Project (CCCGP No.2)", for which the Government of Uzbekistan requests as an object of the yen loan is viable as an ODA project. The studies include the necessity of introduction, conceptual design, construction cost, implementation schedule, implementation (procurement and construction) methods, implementation structure, management and operation and maintenance systems and environmental and social considerations of the project.

1.1.2 Duration of the Study

Schedule of the Study is shown in Figure 1.1.2-1.



Source: Study Team

Figure 1.1.2-1 Schedule of the Study

2. Socio Economic Situation in Uzbekistan

2.1 Socio-economic Conditions

The mixture of mild population growth and urbanization characterizes the demography of Uzbekistan. The population of Uzbekistan reached 28 million in 2011. The total population grew at approximately 1% annually during the 2000's. The country has the highest population density in Central Asia. The State Committee of the Republic of Uzbekistan on Statistics estimates that urban dwellers accounted for 51.4% of total population in 2011. In tandem with the growth of overall population, the labor force has been growing consistently.

2.2 Macroeconomic Conditions

A boom of international commodity markets such as cotton, gold and natural gas is one of the major factors behind strong economic growth in Uzbekistan. The GDP growth has exceeded 8%

since 2008. In addition to the boom in the commodity markets, the Uzbekistan government has supported investment in infrastructure for the recent years and this effort alleviates negative effects of a slowdown of the global economy. Based on the official figures, inflationary pressure has been tamed. An increase of consumer price was 6-8% per annum in the period from 2006 to 2010, more stable than in the early-2000s when inflation surpassed 20% annually. A rapid increase of the merchandize export in the 2000's was mainly due to the appreciation of commodity prices. As major export items in Uzbekistan are global commodities such as natural gas, cotton, and gold, the commodity boom in the last decade provided favorable terms of trade for export. Both the current account balance and the overall balance had been positive in the period from 2006 to 2010.

2.3 Government Finance and External debt

Strong economic growth, a boom in global commodity markets and tax reform contributed to the better performance of government revenue in recent years. Based on the official figures, the Uzbekistan government effectively controlled government expenditure within its revenue and maintained state budget surplus in the period from 2006 to 2010. The total debt outstanding and disbursed almost doubled from 2006 to 2010. Nevertheless, the external debt over GNI decreased in the same period. Uzbekistan has the second lowest external debt over GNI in Central Asia after Turkmenistan. Balance of payment data suggested that debt service accounted for 5.6% of the merchandize export and 23.9% of the trade surplus in 2010. This suggests that debt service is remained at a manageable level.

3. Overview of the power sector in Republic of Uzbekistan

3.1 Overview of power sector in the Republic of Uzbekistan

3.1.1 Overview of existing power generation facilities

In 2010, SJSC Uzbekenergo produced 50.158 GWh of electric power, of which 799.2 GWh was exported. In the same year, the SJSC Uzbekenergo imported 898.5 GWh of electric power.

The generation capacity of all the power generation facilities in the Republic of Uzbekistan exceeds 12,400 MW. The thermal power plants accounting for 85.1% and the hydraulic power plant accounting for 11.4% are run by the SJSC Uzbekenergo, and the remaining power generation facilities accounting for 3.5% are run by other organizations.

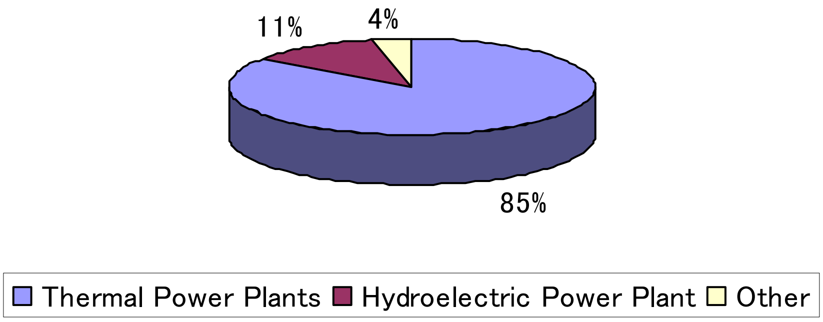


Figure 3.1.1-1 Share of Each Power Generation Capacity

The SJSC Uzbekenergo anticipates a substantial increase (around 1 to 2%) in electricity demand. To meet this growing demand, the company is planning to maintain the capacity of self support through introduction of new facilities, to improve the reliability and quality of power supply, to save power, and to enhance operation efficiency of fuel and power.

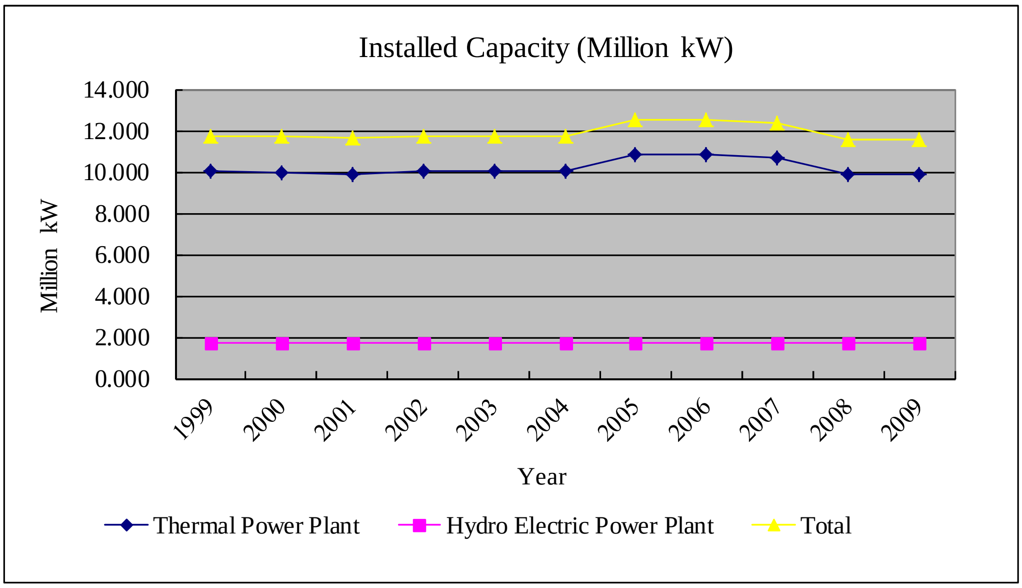
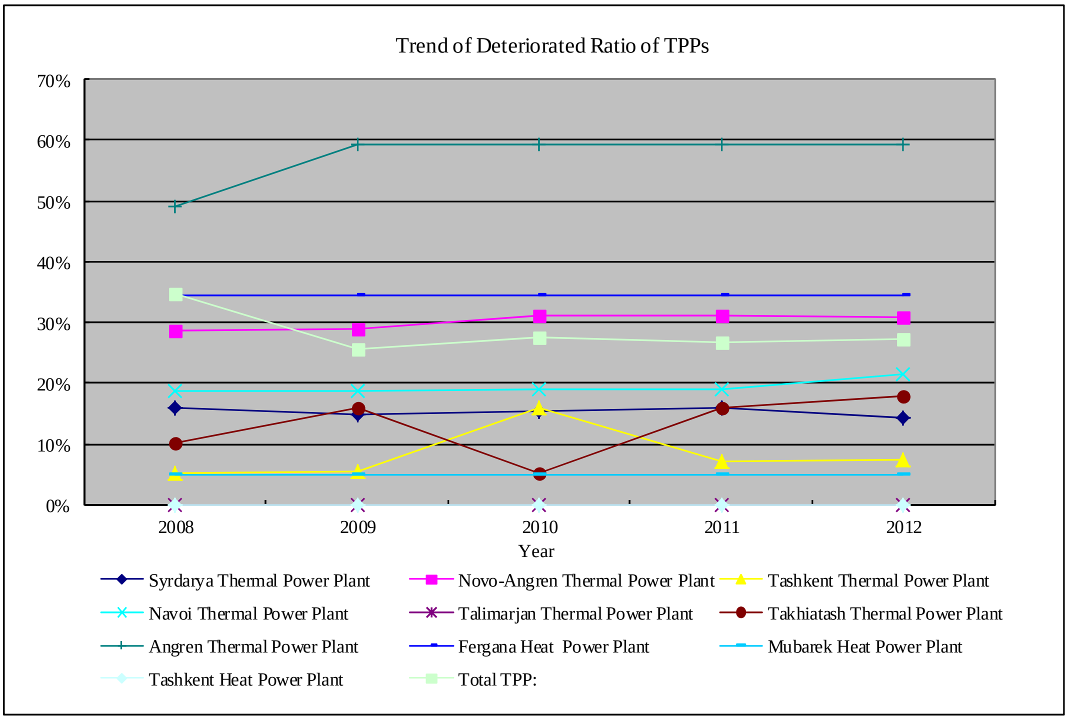


Figure 3.1.1-2 Transition of installed capacity of thermal and hydroelectric power plants

As shown in Figure 3.1.1-3, average deteriorated ratio (= (Installed capacity – Available capacity)/Installed capacity x 100) shows around 30%, that is, one third of installed capacity was lost. Largest deteriorated thermal power plant is Angren thermal power plant which shows around 60% of deteriorated ratio, that is, more than half of installed capacity was lost. Recovery of this lost capacity is urgent issue in power sector in Uzbekistan.



Source: SJSC Uzbekenergo

Figure 3.1.1-3 Transition of Deteriorated Ratio of the Existing TPPs

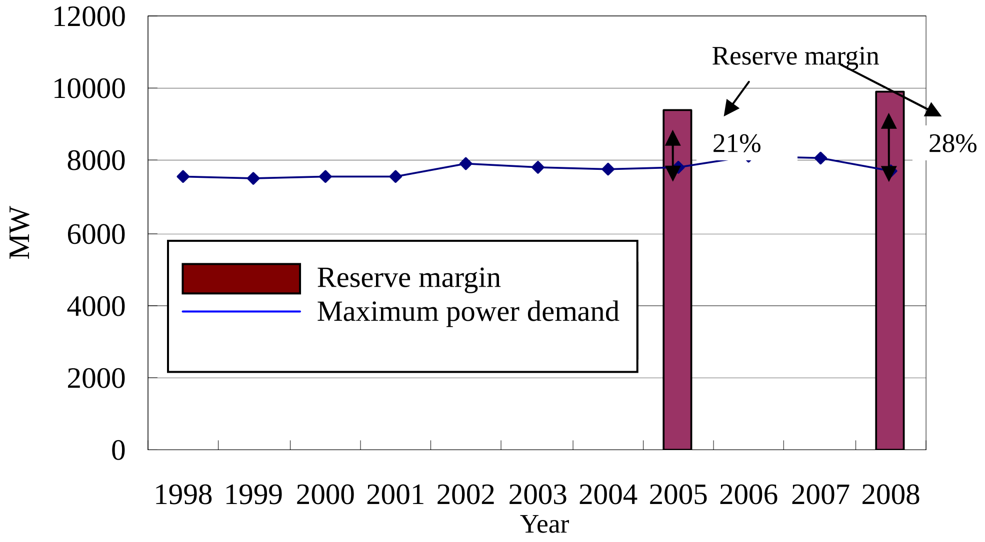
3.1.2 Overview of power transmission facilities

(1) Power grid system

The power grid system in the Republic of Uzbekistan was constructed at the time of the former Soviet Union, where five countries including Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan were assumed as constituting one integral area. Thus, after independence of each country, the power grid system constitutes an international linkage system. The 500 kV transmission line is also linked to Russia via Kyrgyzstan and Kazakhstan. Thus, the power grid system is characterized by a large scale system and operation of stable frequency. The 500 kV and 220 kV lines are used in the trunk network, and the 110 kV lines serve for local supply systems. The vast majority of the trunk network consists of one-circuit transmission lines. The outage at the time of transmission line trouble is minimized by parallel operation of the 500 kV and 220 kV circuits.

3.1.3 Power demand

Figure 3.1.3-1 shows the transition of the generation and consumption of power in the last 5 years. The overall demand for electric power in the Republic of Uzbekistan had exhibited annual reduction for ten years after independence in 1991 due to economic confusion and stagnation of industrial activities. However, economy has been on an upward trend after that, and the overall demand for electric power is also on an upward trend, even though this trend is very slow.



Source: SJSC Uzbekenergo

Figure 3.1.3-3 Transition of the imported and exported electric power in the last ten years

3.1.4 Power generation development plan

According to Power Generation Development Plan up to 2015 made by SJSC Uzbekenergo; expansion of the Talimarjan thermal power plant, expansion of the Navoi thermal power plant, expansion of the Novo-Angren thermal power plant and modernization of the Tashkent heat supply power plant are approved as the important projects for electric power development in that time period. For the funds of these projects, the SJSC Uzbekenergo depends mainly on the loans from JICA and other international cooperation agencies.

Table 3.1.4-1 Power generation development plan up to 2015

No.	Name of plants	Type of plants	Installed capacity, MW	Type of fuel	Year of launching
1	Construction of CCGT at Navoi TPP	Combined cycle gas turbine	478	Natural gas	2012
2	Construction of gas turbine plant at Tashkent Heat Power Plant	Gas turbine plant	3x27	Natural gas	2013-2015
3	Construction of two CCGT at Talimarjan TPP	Combined cycle gas turbine	2x450	Natural gas	2014
4	Construction of power generating unit at Angren TPP	Thermal power plant	150	Coal	2014
5	Construction of CCGT at Tashkent TPP	Combined cycle gas turbine	370	Natural gas	2014
6	Expansion of Mubarek Heat Power Plant with installation	Gas turbine plant	140	Natural gas	2014

No.	Name of plants	Type of plants	Installed capacity, MW	Type of fuel	Year of launching
	of GTP				
7	Expansion of Navoi TPP with installation of second CCGT unit	Combined cycle gas turbine	450	Natural gas	2015

(Note) TPP: Thermal Power Plant, CHP: Combined Heat and Power
Source: SJSC Uzbekenergo

3.1.5 Power demand forecast

SJSC Uzbekenergo planned power generation by their Thermal Power Plant from 2012 to 2020 is shown in Table 3.1.6-1. During the term its growth rate will be around 1.0% per year.
As described in item 3.1.2, the available capacity of the existing thermal power plants is reduced to 70% of their installed capacity in 2012. Therefore, new installation or modernization of power plant is necessary to cover such gap between maximum power demand and available capacity. On the other hand, 2,569MW generation capacity is planned to be developed, as shown in Table 3.1.5-1. This figure includes the capacity by replacement of the existing power plants. Therefore, to keep the stability of power supply to correspond to increasing power demand, it is necessary to implement said power generation development plan steadily.

Table 3.1.5-1 Power Demand Forecast up to 2020

Unit: Billion kWh

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Electric Power Demand	50.5	50.7	51.2	51.7	52.2	52.7	53.3	53.8	54.4
Growth Ratio (vs. previous year)	-	0.40%	0.99%	0.98%	0.97%	0.96%	1.14%	0.94%	1.12%

Source: SJSC Uzbekenergo

3.2 Electricity and Heat Tariff

Tariff reform brought a significant reduction of cross-subsidy to the power sector by the mid-2000s. Since then, tariff structure has been economically rational. On retail prices of electricity, Uzbekenergo submits a tariff petition to the Ministry of Finance which reviews and approves electricity tariff. The retail prices of electricity have been revised twice or three time each year during the period of 2010-2012. The data obtained from SJSC Uzbekenergo show that average price of electricity tariffs has margin over production cost which includes fuel cost, maintenance cost, depreciation and interest payment. With the current level of electricity tariff, it is plausible that SJSC Uzbekenergo obtains revenue sufficient for both investment and operation costs for power generation.

On the wholesale and retail prices of heat, tariff is revised every year. Based on the data obtained from SJSC Uzbekenergo, heat revenue surpassed production cost including fuel cost, maintenance cost, depreciation and interest payment. It is concluded that heat tariff is at or above cost recovery level. Navoi TPP, a subsidiary of SJSC Uzbekenergo, submits a tariff petition to the Ministry of Finance with production cost data once a year. Navoi TPP made profit from heat production in the period of 2007-2010. This may imply that heat production covered production costs required directly for its operation.

4. Survey of Navoi Power Plant Facilities

4.1 Site situation

4.1.1 Site selection

The planned candidate construction site for the CCCGP No.2 (450MW) power plant is adjacent to the Navoi thermal power plant approximately 7 km northwest of Navoi city (city hall).
The candidate construction sites selected for a new power plant are two sites (candidate sites A and B) adjacent to the existing Navoi thermal power plant.
Candidate site A is situated in the area adjacent to the west side of the CCCGP No.1 currently under construction in the west of the existing Navoi thermal power plant.
Candidate site B is situated in the area adjacent to the north side of the existing Navoi.
It must be examined which of the candidate construction sites, A or B, are more suited as a candidate site for the CCCGP No.2 (450MW) power plant.
As the result of examining of the candidate construction site, site A is superior to candidate site B as a candidate construction site for a new power plant.
Thus, candidate side A is recommended as a construction site for a new power plant.

4.1.2 Site condition

In the planned construction site for CCCGP No.2 (candidate site A), approximately 9 hectares of the site required for power plant construction has been prepared almost completely.
However, the transmission lines of the four series and their foundations have not been removed.
Thus, the transmission lines of the four series and their foundations must be removed or relocated.

4.2 Existing facilities

4.2.1 Overview of the existing equipment in Navoi Thermal Power Station

(1) Configuration of Power and Heat Supply System

The overview of the existing power and heat supply system of Navoi Thermal Power Station is as shown in Figure 4.2.1-1.

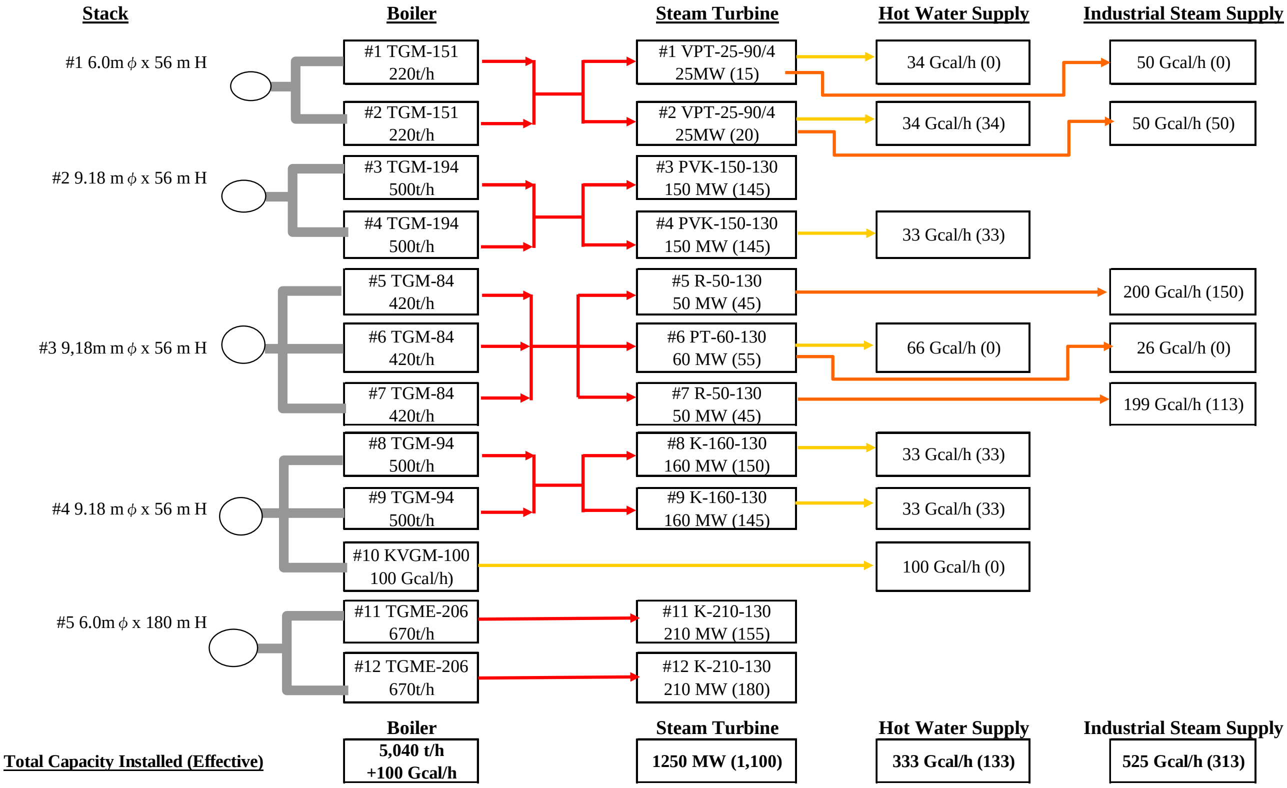


Figure 4.1.2-1 Heat and power supply system of Navoi Thermal Power Station

4.2.2 Situation of the existing equipment

Power generation units of Navoi Thermal Power Station consist of 12 boilers, 11 turbines, and 11 generators, and, the amount of rated generating steam is 5,040t/h and the rated power generation output is 1,250 MW. Operation of Unit No.1 was commenced in 1963 and 49 years have passed. Total operation hours of the units until now are about 220,000 to 360,000 hours, and degradation by operation is also progressing considerably in addition to aged deterioration.

Table 4.2.2-1 Operating Record of Navoi Thermal Power Plants

Unit №	Type of Plant	Installed (Effective) Capacity			Start-up Year	Operating Hours	Service Factor (%)(1)
		Power (MW)	Heat Supply (Gcal/hr)				
			Hot water	Industrial steam			
1	Heat and Power	25 (15)	34 (0)	50 (0)	1963	316,680	73.7
2	Heat and Power	25 (20)	34 (34)	50 (50)	1963	362,468	84.4
3	Power	150 (145)	-	-	1964	349,172	83.0
4	Heat and Power	150 (145)	33 (33)	-	1965	308,577	74.9
5	Heat and Power	50 (45)	-	200 (150)	1966	339,774	84.3
6	Heat and Power	60 (55)	66 (0)	26 (0)	1967	311,919	79.1

Unit №	Type of Plant	Installed (Effective) Capacity			Start-up Year	Operating Hours	Service Factor (%)(1)
		Power (MW)	Heat Supply (Gcal/hr)				
			Hot water	Industrial steam			
7	Heat and Power	50 (45)	-	199 (113)	1971	314,936	87.6
8	Heat and Power	160 (150)	33 (33)	-	1968	326,414	84.6
9	Heat and Power	160 (145)	33 (33)	-	1969	317,604	84.3
10	Heat	-	100 (0)	-	1972	238,353	68.0
11	Power	210 (155)	-	-	1980	231,961	82.7
12	Power	210 (180)	-	-	1981	222,739	82.0
Total	-	1,250 (1,100)	333 (133)	525 (313)	-	-	-

Note (1): Averaged Service Factor (%) = The total operating hours/the total calendar hours from start-up to present time ×100.

5. Fuel Supply Plan

5.1 Natural gas reserves in Uzbekistan

The proven natural gas reserves in Uzbekistan register an abundant figure of 1.603 trillion cubic meters (hereinafter referred to as "Tcm"), as of December 2011. The gas fields are concentrated in the Amu Darya Basin in the southwest of the country and in the Central Ustyurt plateau in the west of Aral Sea.

The following illustrates the transition of the proven natural gas reserves in Uzbekistan:

Table 5.1-1 Amount of proven natural gas reserves in Uzbekistan

Unit: Tcm

	At end 2001	At end 2010	At end 2011
Proved reserves	1.700	1.600	1.603

Source: BP Statistical Review of World Energy 2012

Table 5.1-2 shows the natural gas development projects in Uzbekistan. The development of these gas fields are expected to increase the proven natural gas reserves in Uzbekistan.

Table 5.1-2 Natural gas development projects in Uzbekistan

Field	Target production volume	Target reserves
Southwest Gissar and central Ustyurt region (7 fields)	3 Bcm/year	0.1Tcm
Western Ustyurt region (4 fields)	-	1Tcm
Khauzak and Kandym fields in Bukhara-Khiva and Gissar regions	4 Bcm/year	0.25Tcm
Aral Sea Surgli field	0.08 Bcm/year	-
Surkhandarya region Baisun field	2.2 Bcm/year	-
West Urga / Western Ustyurt region (3 fields)	0.7 Bcm/year	-

Source: Global Insight IEA and trade press

5.2 Possibility of gas supply to CCCGP No.2

An agreement was signed with the JSC Uztransgaz for the supply of the natural gas of the Navoi Thermal Power Plant. The agreement between the Navoi Thermal Power Plant and JSC Uztransgaz for the supply of natural gas is updated every year. The annual contracted volume for 2012 is 2,876.080million m^3N/year.

At present, the Navoi Thermal Power Plant uses two types of natural gas; a natural gas containing sulfur content and a natural gas hardly containing sulfur. CCCGP No.2 is planning to use the natural gas that hardly contains the sulfur contents used in CCCGP No.1. The volume that can be supplied amounts to 419,300m^3N/h (450,000m^3/h at 20 degrees Celsius).

The natural gas is supplied from the Zevarda gas field and the Kultak gas field located in the Amu Darya Basin in the south of Uzbekistan to the Navoi Thermal Power Plant. The natural gas produced in the Zevarda gas field and Kultak gas field is refined in the Mubarek Gas Processing Plant, and then is supplied to the Navoi Thermal Power Plant through the Navoi Gas Distribution Station.

The natural gas used in CCCGP No.1 and CCCGP No.2 can be supplied in the volume of 419,300m^3N/h By contrast, a total of natural gas consumption in CCCGP No.1 and CCCGP No.2 is 189,057m^3N/h. This shows that the natural gas can be supplied to the Navoi Thermal Power Plant.

5.3 Order of priority for gas supply in the event of gas insufficiency at the Navoi Thermal Power Plant

There has been no public disclosure of the proven natural gas reserves and production volume in the Zevarda gas field and Kultak gas field that supply natural gas to the Navoi Thermal Power Plant. Since supply of electricity and hot water is essential to public life, the Government of Uzbekistan is required to ensure that natural gas is supplied to the Navoi Thermal Power Plant on a priority basis. Should there be any shortage of natural gas supply to the Navoi Thermal Power Plant; CCCGP No.2 will be operated on a priority basis as it is characterized by high power generation efficiency and capable of generating a greater volume of heat.

6. Basic Design

6.1 Conceptual Design

6.1.1 Design Conditions

Design conditions shall be specified to complete the feasibility study for this project. However, all the detailed design conditions are still undecided because of less time schedule for discussion and study during the period of preparation of the feasibility study. Some design conditions may be tentatively specified or assumed at this feasibility study stage and will be revised or finalized at the further detailed design stage of this project. As for the design conditions necessary for completion of the feasibility study on Navoi Thermal Power Plant Modernization Project, the table 6.1.1-1 in the body text shall be referred to.

6.1.2 Outline of Cogeneration System

This plant is a combined cycle cogeneration plant (CCCGP) which concurrently produces both heat and power energies. The plant is comprised of main components of a gas turbine, a gas turbine generator, a HRSG with a supplementary duct firing facility, a steam turbine, a steam turbine generator, a fuel gas compressor station, a water pre-treatment facility for export steam, a water pre-treatment facility for export hot water and a hot water production system.

The plant shaft configuration is of multi-shaft type where the gas and steam turbine shafts are separated.

The gas turbine is of a large capacity F class type which is available in the world market with a wealth of commercial operating experience.

The HRSG is of triple-pressure and reheat cycle type. The F class gas turbine is commonly coupled with the triple-pressure and reheat cycle HRSG to elevate the plant thermal efficiency.

The HRSG is equipped with a supplementary duct firing facility to meet the heat and power output requirements of this project.

The steam turbine is of triple-admission, dual-extraction of medium and low pressure steams and condensing type. The medium pressure steam is extracted from the IP steam turbine section and exported to adjacent companies as industrial steam as it is. The low pressure steam from the LP steam turbine section is supplied to the production system of the district hot water.

The hot water production system consists of a water storage tank, water pre-treatment facilities, deaeration facility, steam to water heat exchangers and a hot water storage tank.

The Figure 6.1.2-1 is the simplified schematic diagram of the combined cycle cogeneration plant of this project

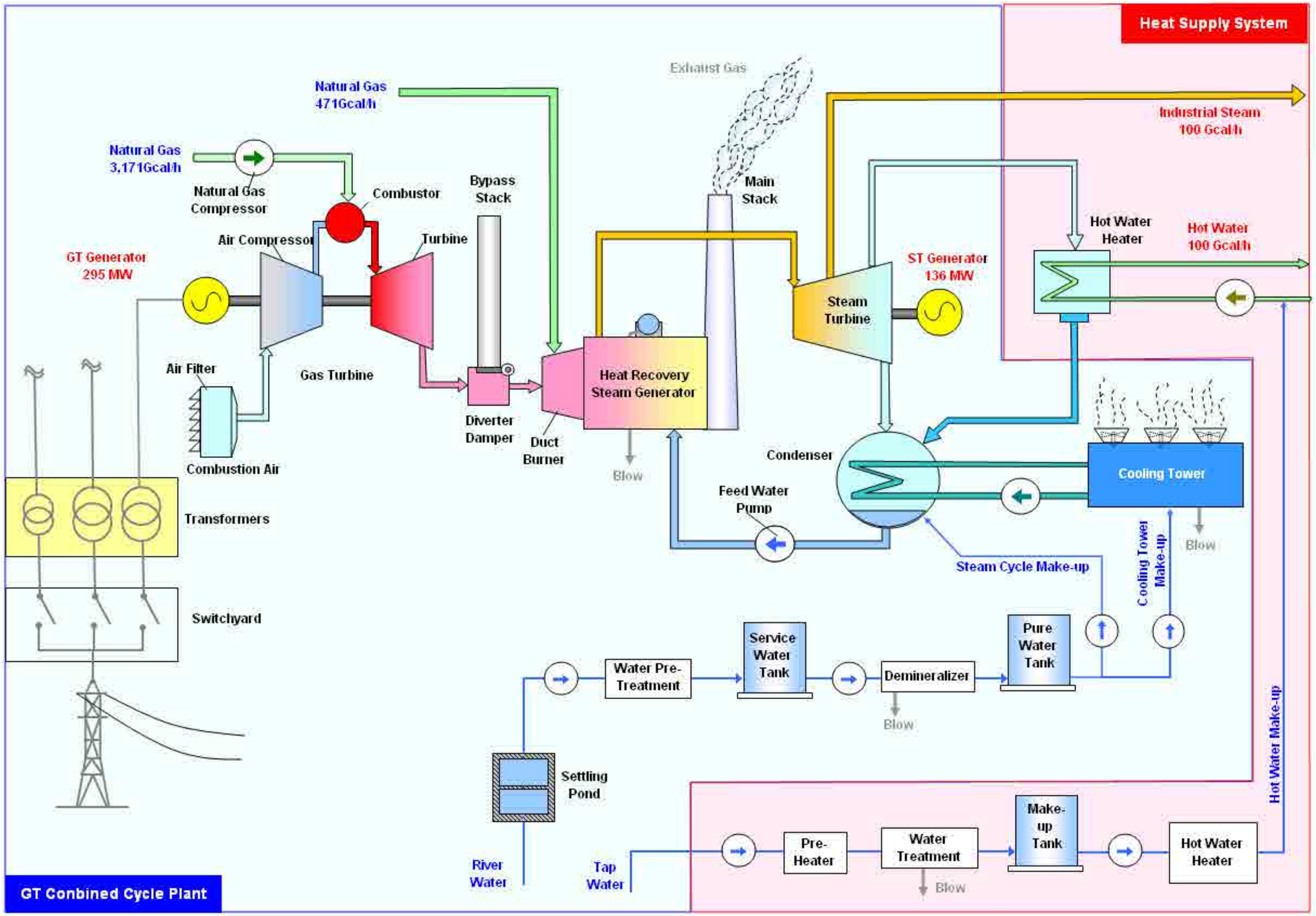


Figure 6.1.2-1 Simplified Schematic Diagram of Total Cogeneration System

6.1.3 Study on Shaft Configuration

The shaft configuration was studied and four (4) types of shaft configurations were compared from various points of view. The details of comparison process and results are described in the final report.

Since the first priority is given to the operational flexibility (simple cycle operation) and operating reliability (hour basis), the multi-shaft CCPP with the bypass system can be recommended.

6.1.4 Candidate Gas Turbine and Performance

The Study Team decided that the models of the gas turbines to be employed for this project shall be of F class as specified in the Gas Turbine Handbook 2010.

The five (5) models of gas turbines shall be eventually selected as candidate models for this project with the performance values shown in the Table 6.1.4-1 on ISO conditions as per the said Handbook:

Table 6.1.4-1 Performance Figures of Five (5) Candidate Models of Gas Turbines

Model of Gas Turbine	GT26 (AQC)	AE94.3A	9FB	M701F4	SGT5-4000F
ISO base rating (MW)	292.1	285.0	288.2	312.1	292.0
Efficiency (%)	38.50	39.57	37.85	39.30	39.83
Pressure ratio	34.7	17.7	18.0	18.0	18.2
Air flow rate (kg/s)	653.2	689.9	655.1	702.6	692.2
Exhaust gas temp (°C)	615.0	572.0	641.7	596.7	577.2

According to the said Handbook, the gas turbine manufacturer(s) of above five (5) models of gas turbines are as tabulated in the following Table 6.1.4-2:

Table 6.1.4-2 OEM Manufacturers of Five (5) Models of Gas Turbines

Model of Gas Turbine	OEM Manufacturer
GT26 (AQC)	Alstom
AE94.3A	Ansaldo
9FB	GE
M701F4	Mitsubishi
SGT5-4000F	Siemens

To make technical supports for sophisticated gas turbine machine possible, the gas turbine shall be supplied by an original equipment manufacturer (OEM) of the gas turbine to be proposed who has developed, designed, manufactured and will be able to technically and substantially support its maintenance.

6.1.5 Plant Performance by Candidate Gas Turbine

The CCCGP No.2 shall be comprised of the candidate gas turbines which are available in the present world market and the bottoming systems suited to them. Therefore, the plant performance shall be naturally changeable depending upon the type of candidate gas turbine which may be employed for this project. This section describes the plant performance calculated every candidate gas turbine. The plant performance is calculated on the conditions specifically defined in the body text. The calculation results are as tabulated in the Table 6.1.5-1.

Table 6.1.5-1 Predicted Plant performance by Candidate Gas Turbine

Type of Model of Gas Turbine	GT26	AE94.3A	9FB	M701F4	SGT5-4000F
Plant Gross Power Output (MW)	393.9	396.0	397.4	431.0	403.2
GT Gross Power Output (MW)	272.3	265.7	273.8	295.1	272.2
ST Gross Power Output (MW)	121.6	130.3	123.6	135.9	131.0
IP Steam Heat Export (Gcal/hr)	100	100	100	100	100
LP Steam Heat Export (Gcal/hr)	100	100	100	100	100
Plant Gross Power Output Efficiency (%)	48.0	47.8	48.8	48.7	48.2
Auxiliary Power Requirement (MW)	14.4	12.8	13.1	14.0	13.1
Plant Net Power Output (MW)	379.5	383.2	384.3	417.0	390.1
Plant Net Power Output Efficiency (%)	46.2	46.3	47.2	47.1	46.6
Plant Gross Thermal Efficiency (%)	75.4	74.9	76.3	74.1	75.0
Plant Net Thermal Efficiency (%)	73.6	73.5	74.7	72.5	73.5

As can be seen in the above table, the plant net power outputs of five (5) CCCGPs are estimated to range from 379.5 MW to 417.0 MW under the heat export of IP steam and LP steam of each 100 Gcal/hr on the specified calculation conditions stated above.

The plant net power output can be fully influenced by the supplementary duct firing temperature. In this case, the said temperature is tentatively specified to be 750 °C that is supposed to be the maximum allowable value. However, this value shall be finally specified by the HRSG manufacturer

The plant net thermal efficiencies of them are predicted to range from 72.5 % to 74.7 %.

6.1.6 Study on Cooling System

Resulting from the technical and economical comparison study between the mechanical draft cooling tower cooling system (MCTCS) and the mechanical draft air cooled condenser system （MACCS）, the mechanical draft cooling tower cooling system (MCTCS) is recommendable in terms of its economy and experience in Uzbekistan. The details of comparison process and results are described in the body text of the final report.

6.2 Scope of the Project

The scope of this Project includes the design, manufacture, transportation and delivery to the Site, construction at the Site, testing and commissioning, and maintenance for a period of one (1) year after Taking Over of the plant herein described.

The combined cycle cogeneration plant to be installed shall be of nominal 450MW highly efficient combined cycle block in a one on one multi-shaft configuration comprising one (1) low-NOx gas turbine, one (1) triple pressure reheat, indoor type heat recovery steam generator (HRSG) equipped with duct firing burners, one (1) reheat, two-extraction, condensing type steam turbine, two (2) electric generators, and miscellaneous auxiliary equipment.

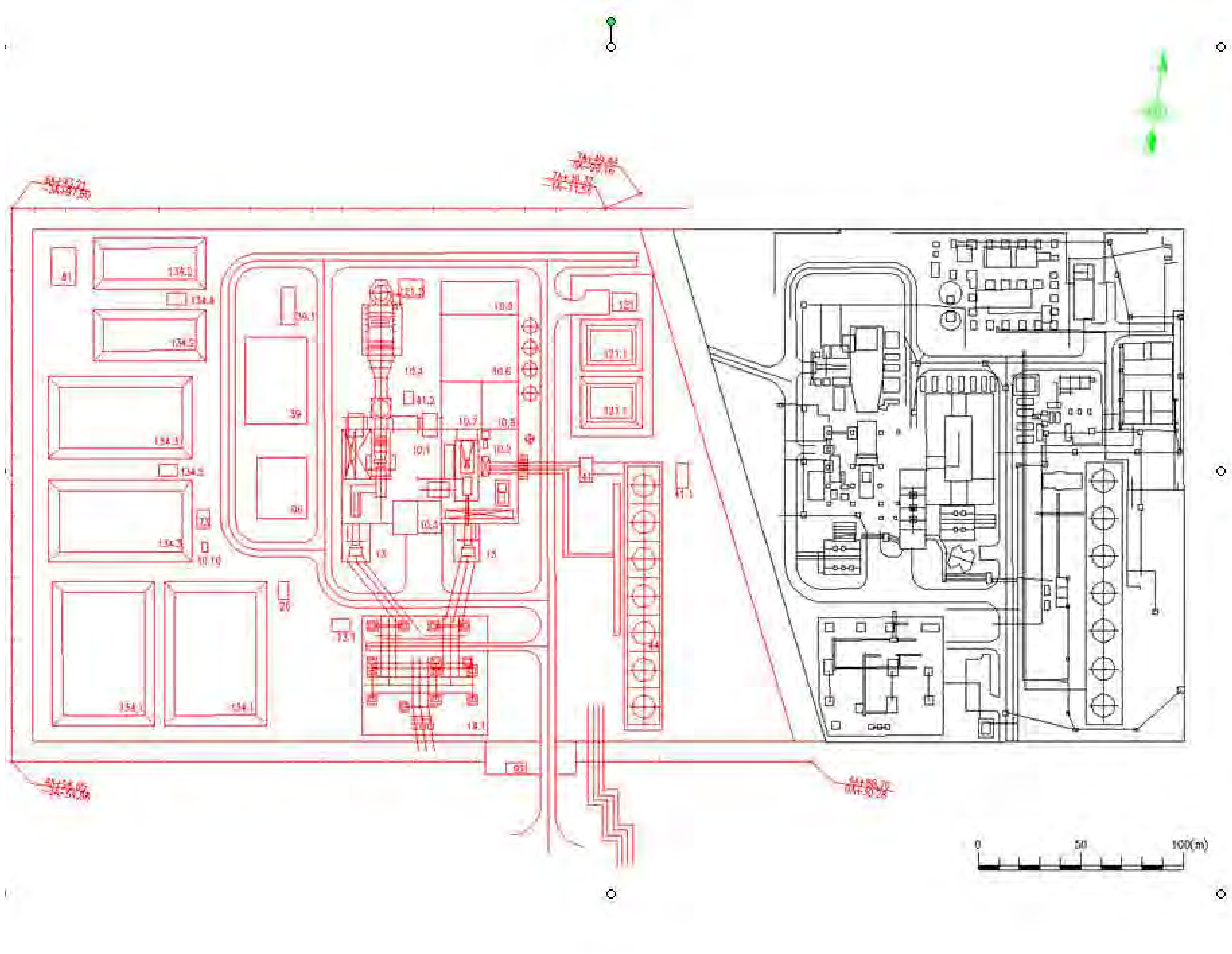
The facility and equipment, as described herein, shall include the following:

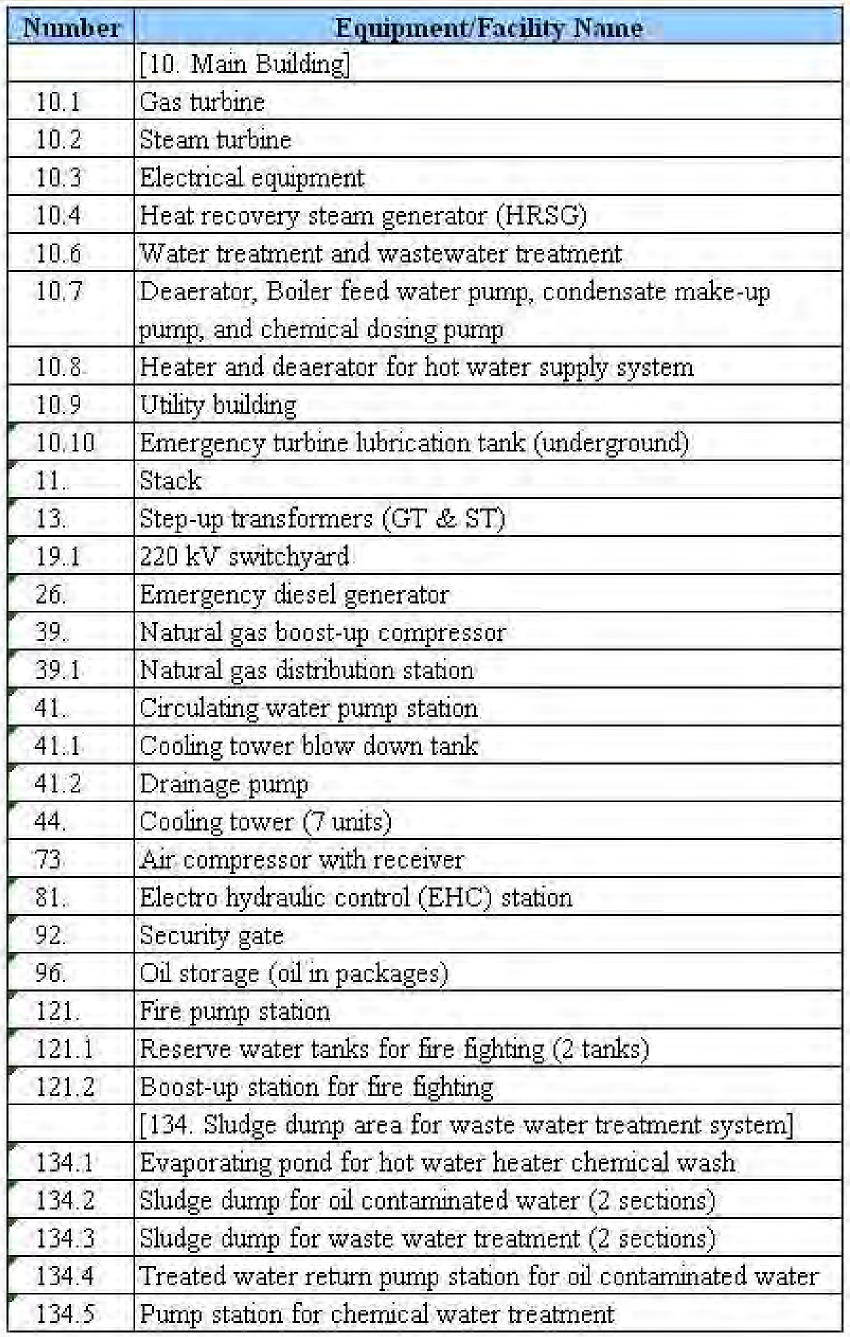
(1) Power generation equipment
(2) Transmission Lines and Substation
(3) Heat supply system
(4) Mechanical Equipment of Auxiliaries and Balance of Plant (BOP)
(5) Electrical Equipment of Auxiliaries and Balance of Plant (BOP)
(6) Civil and Building Works
(7) Environmental
(8) Tools, Spare parts, consumable, etc.

6.3 Plot Plan

Candidate site is situated in the area adjacent to the west side of the CCCGP No.1 in the west of the existing Navoi thermal power plant.

The conceptual arrangement of CCCGP No.2 is as shown in below.





Number	Equipment/Facility Name
	[10. Main Building]
10.1	Gas turbine
10.2	Steam turbine
10.3	Electrical equipment
10.4	Heat recovery steam generator (HRSG)
10.6	Water treatment and wastewater treatment
10.7	Deaerator, Boiler feed water pump, condensate make-up pump, and chemical dosing pump
10.8	Heater and deaerator for hot water supply system
10.9	Utility building
10.10	Emergency turbine lubrication tank (underground)
11.	Stack
13.	Step-up transformers (GT & ST)
19.1	220 kV switchyard
26.	Emergency diesel generator
39.	Natural gas boost-up compressor
39.1	Natural gas distribution station
41.	Circulating water pump station
41.1	Cooling tower blow down tank
41.2	Drainage pump
44.	Cooling tower (7 units)
73	Air compressor with receiver
81.	Electro hydraulic control (EHC) station
92.	Security gate
96.	Oil storage (oil in packages)
121.	Fire pump station
121.1	Reserve water tanks for fire fighting (2 tanks)
121.2	Boost-up station for fire fighting
	[134. Sludge dump area for waste water treatment system]
134.1	Evaporating pond for hot water heater chemical wash
134.2	Sludge dump for oil contaminated water (2 sections)
134.3	Sludge dump for waste water treatment (2 sections)
134.4	Treated water return pump station for oil contaminated water
134.5	Pump station for chemical water treatment

Figure 6.3-1 Plot plan

6.4 Basic Systems for Plant Design

6.4.1 Gas Turbine System

The gas turbines shall be of single shaft configuration, open cycle, heavy duty F class temperature level type with dry low NO_x design suitable for the specified natural gas.

6.4.2 Steam Turbine System

The steam turbine shall be of a reheat, three-admission, two-extraction, two-casing, condensing type directly connected to the generator. The steam shall be downward exhausted to a surface condenser which is cooled by fresh circulating water which is in turn cooled with a mechanical draft wet type cooling tower. The steam turbine shall be of a three (3) pressure-level turbine with HP, IP and LP sections. The medium pressure level of steam may be extracted from the IP section for export to adjacent industrial companies. The low pressure level of steam may be extracted from the LP section for production of hot water for district heating.

6.4.3 Heat Recovery Steam Generators and Auxiliaries

One Heat Recovery Steam Generator (HRSG) associated with one gas turbine generator of combined cycle block will be installed. The HRSG shall be of the fired, three-pressure, natural or forced circulation, reheat type of proven design in accordance with the requirements of internationally recognized codes and standards, where applicable.

The HRSG shall be designed to operate on the exhaust gas of the gas turbine fired with natural gas. Furthermore, the HRSG shall be designed to operate with a duct burning system fired with natural gas.

6.4.4 Heat Supply System

Supply of processing steam for neighboring industries (industrial steam supply) and supply of hot water for district heating (hot water supply) shall be carried out, using two adjustable steam extractions from the steam turbine of CCCGP No. 2.

In accordance with Preliminary Feasibility Study of the project, the capacities of the industrial steam supply and the hot water supply are 230 Gcal/h and 120 Gcal/h respectively. However, the Study Team would like to recommend that the capacities should be 100 Gcal/h and 100 Gcal/h in order to maintain the reliability of the heat supply systems in cooperation with the existing heat supply systems.

6.4.5 Water Treatment Plant

A complete water treatment system comprising water settling ponds, water pre-treatment plant, and demineralized (DM) water plant shall be provided to supply the make-up water required for the steam turbine and HRSG cycle of CCCGP No. 2. Since the industrial steam is extracted from the steam turbine and consumed in the neighboring chemical companies, its make-up water needs to be provided through the demineralized water plant.

On the other hand, the make-up water of hot water, of which water quality is different from of the demineralized water, shall be provided through the other water treatment facilities in the hot water supply system as described in Section 6.4.4 “Heat supply system”.

The consumptions of demineralized water and pre-treated water are estimated as 19,050m^3/day and 20,990m^3/h respectively. The raw water of 20,990m^3/day is supplied from the Zarafshan River. The consumption of city water is 6,045m^3/day, among which 6,000m^3/day is used for the hot water make-up water and 45m^3/day is used for the potable water.

6.4.6 Fuel Gas Supply System

Natural gas is used as the fuel for CCCGP No.2 as well as CCCGP No.1. The natural gas is supplied to the Navoi Thermal Power Plant from the Navoi Gas Distribution Station through two pipeline systems having a diameter of 720 mm.
This required pressure level is approximately 3 through 5MPa although this value differs according to each gas turbine manufacturer. Since the operation of the gas turbine depends on the fuel gas compressor, it is recommended to install a total of two fuel gas compressors including one spare, similar to the case of CCCGP No.1.

6.4.7 Electrical Equipment

The electrical system will be designed on the basis of the multi shaft configuration of the having two (2) generators, Gas Turbine Generator and Steam Turbine Generator and two (2) generator step-up transformers, Gas Turbine Transformer and Steam Turbine Transformer. The voltage of the power output from the gas turbine and steam turbine generators will be stepped up to 220kV via GT step-up transformer and ST step-up transformer. The output from these two GT transformers and ST transformer is merged and transmitted to the 220kV substation. The bus switching arrangement utilizes double bus and one circuit breaker with transfer bus scheme.

6.4.8 I&C Equipment

All control and monitoring functions necessary for startup, normal operation and shutdown of the CCCGP shall be provided in Central Control Room (CCR) The CCR will be normally manned. Operator Workstation with Human Machine Interface (HMI) and a microprocessor based Distributed Control System (DCS) including redundant controllers using a plant-wide redundant communication highway shall be provided to allow the operators to control CCCGP and to receive monitoring and alarm information.

6.4.9 Civil engineering and architectural facilities

The following lists up the planned CCCGP No.2 structures and buildings:

Table 6.4.9-1 List of planned CCCGP No.2 structures and buildings

No.	Names of buildings and structures
10a	Main building consisting of:
10a-1	- gas-turbine unit room
	- steam turbine room
10a-2	- insertion for GCP (general control panel) and electrical devices
10a-3	- stack of electrical devices (under CACI (complex air-cleaning installation))

10a-4	- area for steam boiler-utilizer - chimney - tank farm of CWT (chemical water treatment)
10a-5	- Gas unit
10a-6	- building of Chemical water treatment (CWT) and Integrated industrial effluent treatment (IIET) - area for tank farm Set of washing equipment - tank farm:
10a-7	- deaerator room with feed water pump and chemicals dosing system
10a-8a	- boiler room with heating system deaerator
10a-9a	- engineering and residential building
13a	Open installation of transformers with rerolling ways
	- oil collector (underground based) for collecting accident-related oil from the transformers
	- capacity of accidental discharge of turbine oil
	- network of accidental oil runoffs
19a	ODU-220 kV
19b	Bus-bar assembly
19d	HV-220 kV AC - 3×300, with length of 0.7 km from bus-bar assembly CCGT-450 with installation for gas switch in cell #10A of existing ODU-220 kV.
25a	Cable tunnels and channels
26a	Electrical container with backup diesel
28a	Technological trestles
	- heating networks
	- heating network feeding pipelines
	- hot water (forward and backward) pipelines with armature
	- steam pipelines with armature
	- condensate return pipelines with armature
	- pipeline to GSPU (gas separator pump unit)
39a	Gas separator pump unit (GSPU) with armature
39b	Gas processing facility (GPF)
39c	System of purge and dump gas pipelines of CCGT and GSPU

73a	Compressor room for compressed air with receivers
81a	Electrolysis room with receivers, including nitrogen generating room on sludge disposal site of oily water at flow rate 8-10 m/h, pressure of 20-22 m
Technical water supply at the site	
41a	Circulation pump station - above-ground part - underground part
41b	Circulation water lines - 2Ø1420×10 - 2Ø1620×10
43b	Water lines of supplementary at the production site 2Ø377×8 L=300 lm
44a	Ventilator cooling stacks 18 × 18m
44b	Pumping installation for cooling stack scavenging
46a	Pumping installation for drainage of main building - above-ground part - underground part
46b	Circular drainage of main building
46c	Pressure water passage of drainage of main building - Ø219 × 6
99a	Piezometric network at the CCGT production site
	- in site roads
	- access road
	- transfer of HV-220 kV
	- excavation works
	- soil embankment
	- transformer rerolling ways
	- Security fencing of the territory with the check-point
	- towers
	- trenches
	- security lighting
	- security alarm

6.5 Construction program

6.5.1 Material/equipment procurement program

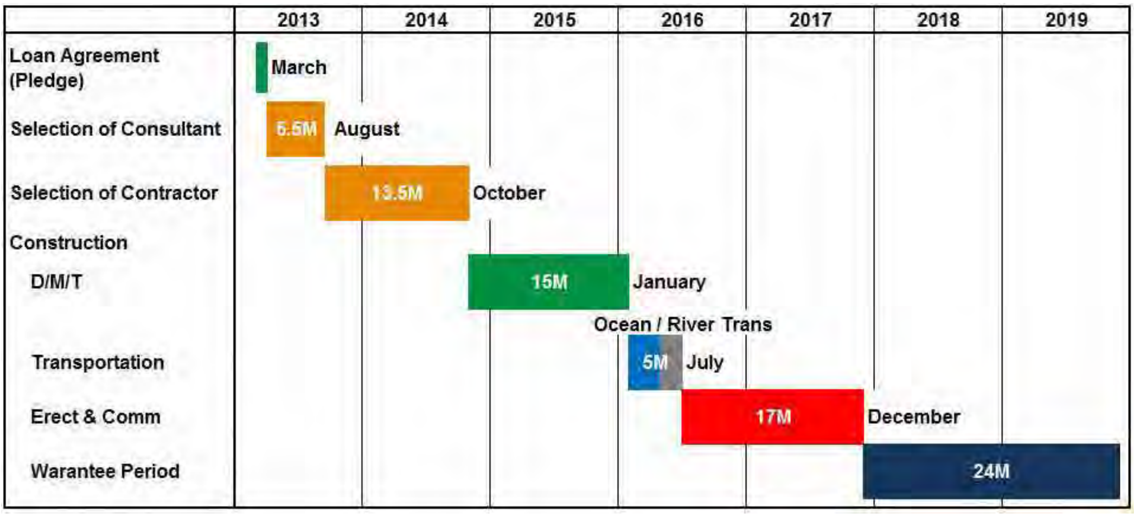
Equipments required for the construction of the Uzbekistan site are almost imported from overseas countries. Materials such as cement, aggregate, sand, rebar etc. can be procured in Uzbekistan.

6.5.2 Material/equipment transport program

Since Uzbekistan is an inland country without a coast line, difficulties are found in the transport of large-sized heavy products.
In the 450MW-class CCCGP No.2, the maximum weight of a product will exceed 300 tons even when the heavy product is divided in several parts for transportation.
Several months will be required for transportation when consideration is given to the canal transportation route by the Volga canal from the Black Sea (the Black Sea through the Caspian Sea) and the inland transportation route (through the Republic of Turkmenistan).
Again, when a construction program is to be worked out, a sufficient transportation period must be taken into account with consideration given to the frozen period of the Volga and the distance of transportation.

6.6 Project Implementation Schedule

If the project is implemented as a yen loan project, it will require 56 months to complete: 19 months from the agreement of the two governments through the selection of international consultants and the preparation of EPC (engineering, procurement, and construction) contracts plus 37 months for the construction of the circulating fluidized bed boiler power generation system. Figure 6-6-1 shows the project implementation schedule from the agreement of the two governments to the completion of the project in the form of a bar chart. This implementation schedule will be revised as necessary due to changes in related conditions.



Remarks: D/M/T - Design, Manufacturing and Test

Figure 6.6-1 Project Implementation Schedule

7. System Analysis and Grid Connection Plan

7.1 System analysis

7.1.1 Objective

A 450 MW combined cycle co-generation plant No.2 (hereafter called as CCCGP No.2), which is scheduled to begin its operation in 2015, is to be added to the Navoi Thermal Power Plant. The objective of the power system analysis is to evaluate the impact of installing this facility under normal condition and emergency condition against the nation's power grid, specifically to the 220-kV network surrounding the power plant. The task of this system analysis is mainly composed of three sub-tasks, namely power flow analysis, fault current analysis, and stability analysis.

7.1.2 Premise

(1) Examined Case
The analysis covers the 220-kV network surrounding Navoi Thermal Power Plant, bordered by three 500 kV substations, namely, Syrdaria Substation, Guzar Subsation, and Karakul Substation. Figure 7.1.2-1 shows the area to be analyzed in this study (220-kV power system network around Navoi Power Plant as of year 2010). The analysis simulates the winter peak of year 2015, as the commission of the generation facility is scheduled in the year. The system analysis is carried out using PSS/E software, while SJSC Uzbekenergo uses another software, "Mustang," which had been developed in former Soviet Union.

Source: SJSC Uzbekenergo

Figure 7.1.2-1 Analyzed network area (Left: Analyzed area, Right: part of the analyzed area)

(2) Input Data/ Data Source
The JICA Study Team cited its key input data such as generated power and load from the preliminary study conducted by SJSC Uzbekenergo, SAESP. For the line constants and parameters related to generators, the team referred to the figures provided by SJSC Uzbekenergo's National Dispatch Center (NDC). Data which are not available in the above two sources are supplemented from the other sources such as SJSC Uzbekenergo's answer sheet to the team's questionnaire and the past JICA Study.

7.1.3 Power Flow Analysis

(1) Calculation Results
a. Loading
The power flow has analyzed with and without the new CCCGP No.2 to the Navoi Thermal Power Plant. For all the transmission lines, the calculated flow was within the allowable current capacity. For N-1 criteria, the sections which are “From K-Mozof Substation (SS) to Navoi Thermal Power Plant (TPP)” and “From Himiya SS to Navoi TPP” were evaluated. These cases showed that the analyzed network also satisfies the N-1 standard.

b. Voltage
For the purposes of maintaining the proper voltage, the shunt capacitors with required capacity might be necessary to be installed into the several substations, because several buses at substations show the voltage below their operation range (-10 % of base voltage).

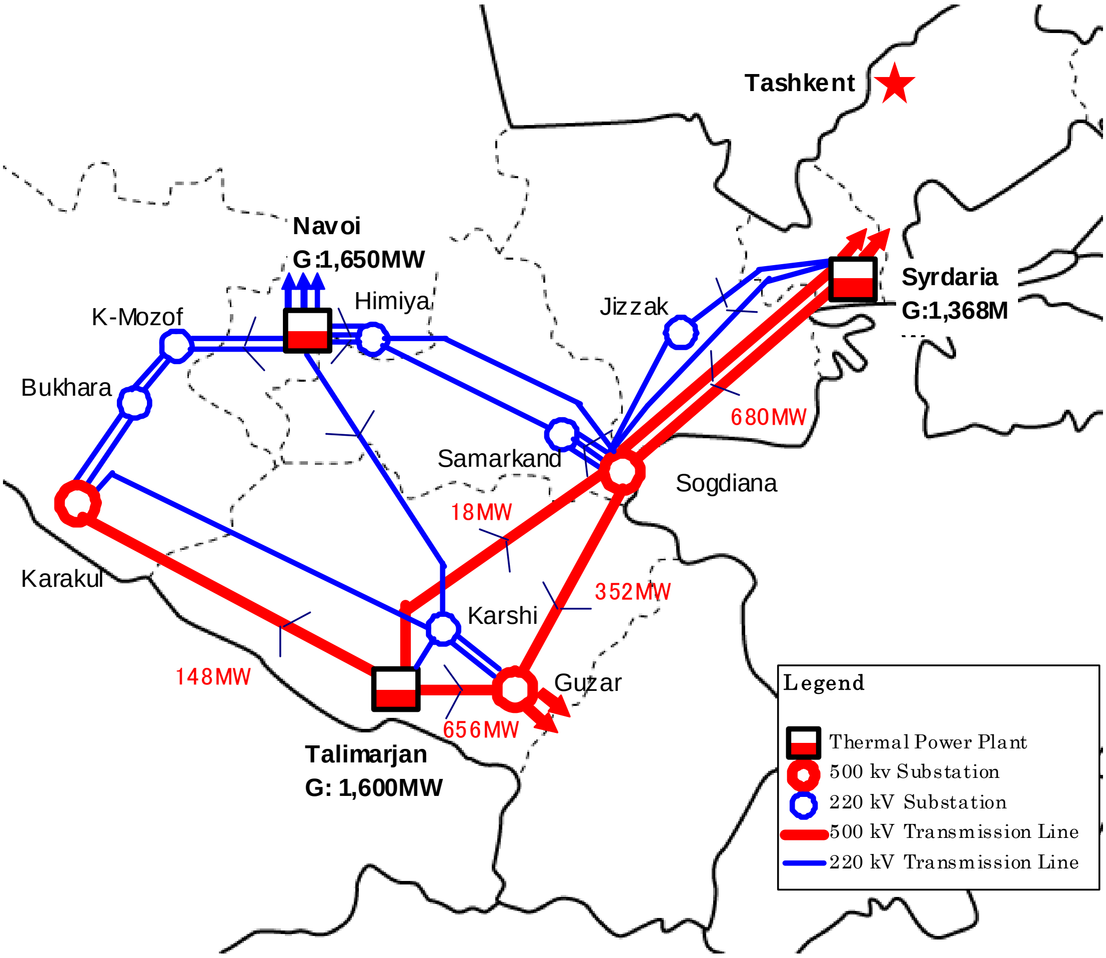
7.1.4 Fault Current Analysis

This analysis evaluates the impact of adding the new CCCGP No.2.
The 3-phase short-circuit current values for the 500 kV and 220 kV buses for major substations were examined (with and without 450-MW CCCGP No.2) as the most severe condition. The influence of introduction of 450 MW combined cycle power plant on the network system was +0.5 kA for a 500kV bus and +0.4 kA for a 220kV bus of Navoi Thermal power Plant in average. In summary, the current was within the rated current capacity, and therefore, the impact of adding CCCGP No.2 is confirmed to be small.

7.1.5 Dynamic Stability Analysis

System stability in the disturbance cases are examined under following conditions.
The fault sequence is described as follows:

0ms: Single circuit three-phase short-circuit fault at the selected section.
160ms: Fault clearance and the 1circuit open.
10s: End of calculation



Source: Developed by JICA Study Team

Figure 7.1.1-1 Power Flow Diagram for the Stability Analysis (During Winter Peak in 2015).

Table 7.1.1-1 shows the stability analysis results for three representative cases. The fault locations in the table were selected considering their heavy power flow.

Table 7.1.1-1 Stability Analysis Results

Case	Fault Section (1cct)	Result
Case 1	220 kV Navoi TPP – K-Mozof SS Transmission line	Stable
Case 2	220 kV Navoi TPP – Himiya SS Transmission line	Stable
Case 3	500kV Talimarjan TPP – Guzar SS	Stable

For the planned system in the year 2015, the oscillation waveforms of phase angle differences were found converged in the case of a single circuit fault of the primary heavy-loaded sections near Navoi TPP. Therefore, it was confirmed that the planned system was stably operated under such severe conditions.

7.1.6 Conclusion and Observations

The analysis revealed that there will be no significant problem of power flow, voltage, short-circuit current, and dynamic stability caused by connecting the new 450 MW CCCGP No.2 of the Navoi Thermal Power Plant to the currently-planned power system of year 2015. Therefore it is confirmed that the installation of CCCGP No.2 would not require to modify or strengthen the currently-planned power system.

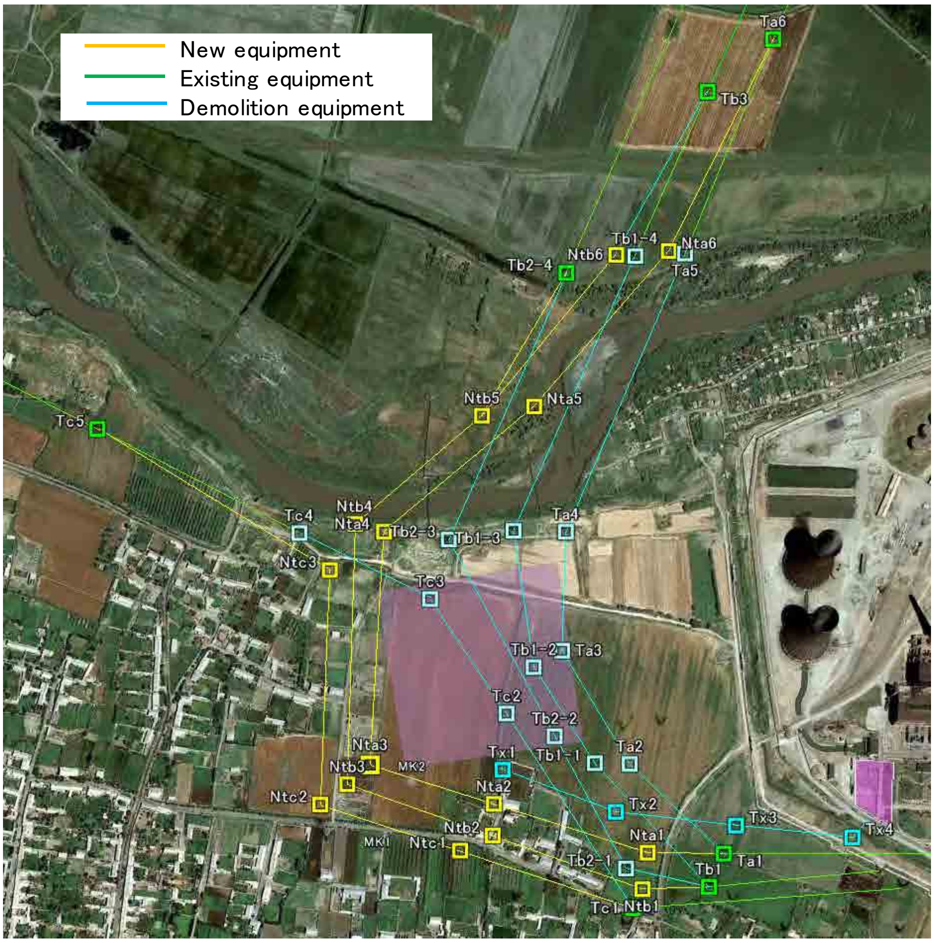
7.2 Grid Connection Plan

For the transmission line and substation design of this project, the materials and information provided by the counterpart and JICA Report" Republic of Uzbekistan Supplemental Study to enhance the collaboration with NEDO on Tashkent Heat Supply Power Plant Modernization Project" were referred to.

7.2.1 Layout of Transmission Line

Estimated layout of transmission line is shown in Figure 7.2.1-1
Concept of transmission line route selection

- The locations of towers are set to be good distance from west settlement and close to new thermal power stations as much as possible.
- The distance transmission lines is set to be secured as 40m in light of the length of tower arms, Right of Way (ROW: 25m)
- Although, some boundary towers between new towers and existing towers are considered as the reconstruction, it is possible to need to reconstruct more some towers and reinforce the members of towers, since there are unclear points which are the situation and the design conditions of existing towers.



Source: Study Team

Figure 7.2.1-1 Layout of Transmission Line

7.2.2 Basic design conditions of Transmission lines

For the basic design of this project, both the Regulations on Electrical Devices (PUE) and Uzbek-Standard (GOST) were referred.

7.2.3 Designs on a bay and bus bar into an existing substation

(1) Standard of Bay design

The study team has made assumptions in the basic design of such facilities based on international standards and our experiences of overseas design works.

(2) Design of Bus & bay in the existing substation

220kV cable system has been applied in this study due to safety and maintenance reasons. The route of bus bar is planning to be located under eight (8) transmission lines. The study team recommends that the underground cable system should be utilized in the bus bar from bay of the CCCGP No.2 due to secure an availability to prevent interruptions by maintenance and turbulence from other transmission lines.

7.2.4 Construction cost

Total construction cost including transmission line and substation is 9.3millon USD.

8. Environmental Social Consideration

8.1 Environmental status

8.1.1 Air quality

At residential, industrial and roadside area in Navoi City in 2010, the nitrogen dioxide (NO_2) concentration is 0.015~0.11 mg/m^3, higher than the maximum permissible concentration (MPC) at the maximum level with annual average of 0.04 mg/m^3.
This value satisfies the hourly and the annual average standard of IFC/WB EHS Guidelines.
The sulfur dioxide (SO_2) concentration is 0.001～0.009 mg/m^3, which is well below MPC at the maximum level. This value satisfies the standard value specified in IFC/WB EHS General Guidelines.

8.1.2 Water quality

It should be noted that water quality of Zerefshan River in Navoi, upstream of the power plant, exceeds the Uzbekistan standard in SS, oil content, sulfate, heavy metals, and other items.
The inlets of the power plant is located upstream of the outlets, thus intake water not getting any impacts by the discharge; however, water quality of SS, oil content and sulfate exceeds the MPC.
Salinity and water temperature are increasing every year, for which the existing power plant is said to be one of the pollution source.

8.1.3 Noise and vibration

Noise level in the residential area located 1km fro the site is 54dB, which satisfies the Uzbekistan environmental standard (55dB) and IFC/WB EHS General Guidelines.
The survey of vibration around the power plant site has not been conducted.

8.1.4 Natural environment

Navoi power plant site is situated in the western side of Zerafshan lowland which is a plain within the submontane district, surrounded by a flat district extending 10km.The layer of the project area consists of quaternary deposit of alluvial clayey loam and sandy loam, 5m to 10m thick.

The wind around the project site is mainly east wind, so the exhaust gas from Navoi power plant is blown westward. The average wind speed in the project area is 1.9~3.5m/s throughout the year exceeding of 8m/s is rare.

Zerafshan River is 750km long, flowing from east to west. River water is taken between Zaatdin Village and Navoi City to be used at 4 irrigation canals. Remaining river water flows beside Navoi power plant site.

The project site is adjacent to the residential area and the power plant already under influence of human activity.

Precious species of plant and animals designated by IUCN (International Union for Conservation of Nature and Natural Resources) and by the Uzbekistan Red Data Book are not observed.

30 species from 7 families of aquatic organisms are observed in Zerafshan River, Most of the aquatic organisms are local species, 4 species are categorized as Least Concern (LC) with IUCN List.

8.1.5 Social environment

The existing Navoi power plant site is located 6km northwest of Navoi City, the south side is the residential area of Uyrot Village, the east side is the residential area of Michurin Village, the west side is the mixture of residential area and farmland of Yangiobod Village.
The near residential area from the existing power plant site is located 650m west and 400m south west of the site.

8.2 Environmental Impact Assessment and other legal system

8.2.1 The gap with JICA Environmental Guidelines (April 2010)

The comparison was made between the content of the EIA for CCCGP No.2 with the requirement of JICA Guideline on Environmental and Social Consideration.
In the result of this review, most of the information related to following plans were not described in the EIA Report for CCCGP No.2 and were not explained to resident peoples and affected peoples.

- Environmental management Plan in the construction and operation phase
- Monitoring Plan in the construction and operation phase
- Land Acquisition and Resettlement Action Plan (LARAP)

8.3 Scoping and TOR of the survey

8.3.1 Result of the review of the EIA

The EIA describes that emission of NO2 before the project implementation was 3,543 t/ y, and will both decrease to 3,454t/y after the project is in operation.

The estimated NO2 concentration from Unit 3 and 8 which are to be decommissioned in this project is 67.15μg/m^3（0.79MPC), whereas the estimated concentration from CCCGP No.2 is 14.455μg/m^3（0.17MPC). Consequently, this project will largely contribute to the decrease of NO2 concentration.

In this project, adoption of forced-draft cooling tower system was planned in the EIA, but forced draft air cooling system will also be considered. The amount of thermal water discharge into Zerafshan River will decrease after decommission of Unit 3 and 8.

According to the regulation in Uzbekistan, water temperature rise at 500m downstream of the water outlet shall be 3 ºC or less. The estimated maximum water temperature rise by blow-down from a forced-draft system at 100m downstream of the outlet is 0.5 ºC.

Washing wastewater is generated from the water treatment system for CCCGP No.2 at the rate of 92.5m3/h and is discharged into Zerafshan River after treatment.

The estimated noise level in the residential area near other project site, taking into consideration of the attenuation effect of the buildings and the green zone, will be below the environmental standard value. The estimated vibration level from the power plant is less than 50dB.

According to the EIA, 30 households (11 households in Uyrot village and 19 households in Yangiobod Village) will be resettled as a result of land acquisition for transmission line etc.

8.4 The result of survey

8.4.1 Reassessment of the prediction

(1) Air pollution

Emission amount of NO_2 from CCCGP No.2 increases from 18.3g/s to 32.5g/s; therefore, prediction on the impact caused by NO_2 emission was conducted using emission gas data.
The maximum ground concentration becomes similar to the one of the initial plan, if stack height is set to 90m; thus complying with the regulatory standard of Uzbekistan.

However, in consequence of consultation with Uzbekistan, there was a requirement to keep height of the stacks as low as possible. As a result of the consideration by Uzbekenergo through a method used in Uzbekistan, the stack height was set to 90m, on the ground that the maximum ground concentration standard from CCCGP No.2 in Uzbekistan is satisfied by the stack height of 90m.

Assessing impact of the pollutants at the whole power plant, it is necessary to consider the operation condition and gas emission amount of the existing power plant along with the operation of CCCGP No.2.

In case of shutting-down of Unit 3 and 8, NO_2 emission is increased to 4,687ton/year compared to 4,636ton/year before CCCGP No.2 in operation. However in case of shutting-down of Unit 3, 6, 8 and 10, NO_2 emission is decreased to 4,146ton/ year.

The maximum ground concentration of NO_2 generated by the operation of CCCGP No.2 and Unit3, 6, 8, 10 are shut down, 2～9μg/m3 will be decreased in all wind speed. In this case, assuming that NO_2 concentration around the power plant will become about the same as the standard of Uzbekistan, 85μg/m^3, or even lower.

(2) Water pollution

In this project, forced-draft cooling tower system was finally adopted. This system does not generate large amount of thermal effluent as is the case of one-through system, and only the 240m3/h of blow-down from cooling tower will be generated.

The reduction of thermal effluent due to the shutdown of Unit 3 and 8 is 28,000m^3/h. The total amount of effluent after this project will be about 60% with the reduction of about 27,760m^3/h.

Since used water in CCCGP No.2 is tap water, waste water is enough to comply with the regulatory standard of Uzbekistan as well as EHS Guideline of IFC/WB.
However, water quality at the outlet of the waste treatment facility shall be monitored to confirm the compliance to the effluent standard of Uzbekistan and IFC/WB.

(3) Noise

During construction phase, the noise level resulting from the operation of the construction machinery is slightly over 55dB at 300m from the boundary of the site, and below 55 dB at 400m from the boundary, which meets daytime environmental standard of the Uzbekistan and IFC/WB guidelines, but exceeds the nighttime standard of 45dB. The mitigation measure will be made to minimize the noise impact.

During operation phase, noise levels from CCCGP No1 and CCCGP No.2 is below 55dB at 300m from the boundary of the site, which meets daytime environmental standard of the Uzbekistan and IFC/WB guidelines, but not satisfied the nighttime standard. The mitigation measure will be made to minimize the noise impact.

(4) Vibration

During construction phase, the vibration level of the construction machinery at the residential area 300m from the plant site is below 40dB which is very low.
During operation phase, the vibration level at the residential area 300m from the project site is 30dB, a sufficiently low level.

8.4.2 Environmental assessment

The environmental impact assessment according to the result of the survey was conducted.
Environmental management plan and monitoring plan were prepared in according to the environmental impact assessment.

8.5 Comparison of alternatives including zero-option

8.5.1 Consideration of the zero option

In the case where CCCGP No.2 is not constructed and the existing old-type power plants (Unit 3 and Unit 8) continue operation, the air quality around the plant area and will remain in a bad condition, the reliability of the facility will decrease, and the risk of accident will increase.

8.5.2 Consideration of the alternative project site

In the EIA, the north end of the existing power plant site is considered as an alternative site for constructing CCCGP No.2.
However, further consideration of this plan was called off as technical, topology and many resettlement of household.

8.5.3 Consideration of cooling system for the condenser

While the condensers in the existing power plants, except Unit 11 and 12, adopt one-through system, either forced draft cooling tower system or forced draft air cooling system will be adopted in the CCCGPNo.2 power plant.

The use of air-cooling system has no actual achievement in the past in Uzbekistan, and in conclusion the forced-draft cooling-tower cited in the EIA was adopted.

8.6 Environmental management plan (mitigation measures)

8.6.1 Environmental management plan during construction phase

At the construction phase, the PIU of the SJSC Uzbekenergo and Navoi Power Plant shall carefully consider the construction activity with supervision consultant and encourage the EPC contractor to well understand the necessary mitigation measures and to implement them.

8.6.2 Environmental management plan during operation phase

Navoi power plant is responsible for organizing an environmental management unit to develop and implement the environmental management plan as a mitigation measures.

Basic policy of the environmental management plan is to coordinate with the local community, and sufficient explanation of the positive mitigation measures for the local people is very important.

8.7 Environmental monitoring plan

The environmental monitoring plan during construction and operation phase is made to monitor air, water, noise etc to keep the values specified in Uzbekistan environmental laws.

8.8 LARAP

Four (4) times of public consultation for giving explanation about the project and the EIA has been held as follows.

- EIA explanation meeting
- Supplementary Interview with Affected People
- Additional Stakeholder meeting on Environmental and Social Consideration
- Stakeholder meetings related to resettlement

In the above meetings, Project Owner held several meetings in order to obtain consent from the residents. Finally, all resettlement households agreed with the relocation to new places.

8.9 Brief resettlement Action plan

8.9.1 Analysis of the legal framework concerning land acquisition and resettlement

There are no laws or legislation in Uzbekistan that specifically address matters related to involuntary resettlement. However, land acquisition is governed by the several laws and regulations. These regulations provide a sound basis for acquiring land for public purposes and for compensating land users according to the registered use of the land.

Where there are gaps between the Uzbekistan legal framework for resettlement and JICA’s Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA’s Policy.

The JICA’s principle of avoidance or minimization of resettlement is reflected in Uzbekistan Legislation. Uzbekistan has ensured that all land and structures will be registered prior to resettlement, at no cost to the displaced persons, and then transferred or compensated under the relevant entitlement.

The appropriate actions will be implemented in order to address the gap between Uzbek laws and regulations and JICA's policy.

8.9.2 Necessity of land acquisition and resettlement

A resolution was issued by Karmana District Hokim № 605-К of 11th July, 2012 on forming a special commission to estimate the size of compensation to citizens whose households includes in the resettlement zone.

The Project will affect to 33 households located at two makhallas "Uyrot" and "Yangiobod". Thus, there are 139 displaced persons at this zone. All of the displaced persons will be needed of the compensations and assistances. Of 33 households, there are 10 households located at makhalla "Yangiobod" that were refused by local authorities to register as the legal owners of assets on the using land plots.

8.9.3 Implementation of socioeconomic survey concerning land acquisition

1) Population census survey

Navoi Province is located in the central part of Uzbekistan. The area of the province constitutes 110.8 thousand square kilometers or 24.8% of total area of the country. Population is 886 thousand.

2) Property/estate survey

Total loss of affected area (housing and household outbuildings) for 12 households in Uyrot makhalla is 4,745.9m^2 and for 11 households in Yangiobod makhalla is 1,012.2m^2. For 10 Illegal households, 1,228.0m^2 basis will be acquired.

3) Household finance/life survey

The average monthly income per households is USD$277; that is USD$2.28 per household member a day. This amount is somewhat higher than USD$2.15 – the poverty level established by the World Bank and other international organizations in Uzbekistan as a required minimum per person a day for purchasing basic food items.

8.9.4 Requirement of compensation for lost assets and livelihood restoration

1) Compensation of lost assets

All registered assets were valued by independent evaluation agency through calculating the real replacement cost based on cost of materials, type of construction, labor, transport and other construction costs. Total buildings replacement cost for 23 legal displaced persons is USD$ 641,501.

Monetary support for 10 illegal displaced persons by the SJSC Uzbekenergo is USD$ 20,488.

2) Livelihood restoration

Legal owners will be assisted by the SJSC Uzbekenergo to organize legal documents in support of their ownership.

Regarding the 10 uninhabited illegal houses, the expense for the houses will be paid by the Navoi TPP as a support activity.

8.9.5 Grievance system

JICA's Guideline requires that a grievance redress mechanism is established and maintained.

Grievance Focal Point is an organization handling all the complaints from the local inhabitants, and is established within Makhalla which is an organization of the inhabitants, and within districts which is an administrative organization.

8.9.6 Implementation system

The main institutions that will be involved in Land Acquisition and Resettlement activities are the SJSC Uzbekenergo as executing agency, PIU, Design Institute Project Consultants, Provincial and District and municipal town authorities, State Unitary Enterprise Land and Immovable Cadastre Service at district level..

8.9.7 Implementation schedule

The resettlement plan has to include the full details of all land and resettlement arrangements, including verification of asset viability by the displaced persons. It is expected that this can take place prior to loan approval by JICA.

The project loan is expected to be approved in February or March 2013. Construction is set to start at the end of October 2014.

8.9.8 Cost and funding

The budget for land preparation costs is USD$10,361, for housing and structures is USD$641,501, for trees is USD$4,072 and for structures for illegal people is USD$20,488. The total budget is USD$744,064 including contingency (10%).

The SJSC Uzbekenergo will allocate 100% of the cost of compensation at replacement cost.

8.9.9 Monitoring system/monitoring form

The Land Acquisition and Resettlement activities will be monitored internally and externally. Internal monitoring will be carried out by the PIU and in conjunction with District Hokimiyat. External monitoring agency will be selected by PIU and approved by JICA.

The monitoring and reporting will continue for two years since the all affected households finish relocating to the new place.

9. Project Cost and Financial Analysis

9.1 Project Cost

The total cost of this project is comprised of the cost of construction of the plant and the interest during the construction (IDC). The cost of construction of the plant is comprised of the cost of equipment (facility design and production, equipment procurement, transport, installation, civil engineering and the construction work, commissioning, spare parts), and such cost for preparation of operation as consulting services and contingency.

The total project cost has not been calculated individually based on a detailed design, but rather been estimated from the costs of similar electric power generation plants constructed in the past.

9.1.1 Assumptions for Calculation of Initial Investment

(1) Project formation

Equipment costs for this project are on the basis of a full turnkey contract with a single contractor.

(2) Financing plan

It is assumed that 85% of the project costs are covered by the loan and remaining 15% of plant construction costs and Interest During Construction will be self financed.

(3) Items to be excluded from project cost

Following items are excluded on the estimation of the project cost.

- Costs for purchasing the land for new plant and compensations for residents of resettlement
- Costs for demolition and relocation of the existing transmission lines.
- Costs for obtaining necessary approvals and licenses for construction of new plant.
- Cost of development of on-site access roads into the construction yard
- Power and water required during construction of new plant
- Fuel and Power during commissioning

(4) Initial investment

The initial investment is comprised of the total of the cost of equipment construction, cost of preparation for the commencement of operation and interest during construction and is as shown in Table 9-1-1-1.

Table 9-1-1-1 Initial investment

Unit: Thousand US $

Item	Cost
Cost of equipment construction	472,727
Cost of preparation for the commencement of operation	43,324
Interest during construction	6,881
Total	522,982

9.2 Financial Evaluation

The analysis of the financial viability is based mainly on FIRR. While financial costs are project cost, fuel cost and other O&M costs, financial benefits are revenues from electricity sales and heat sales. As FIRR is 5.73% and higher than WACC (2.82 %), it can be concluded that this project is financially viable in the base case. The result of the sensitivity analysis shows that the most critical variable is electricity tariff. FIRR does not reach WACC if electricity tariff is lower than the projection by 20%.

The financial model for FIRR is also utilized for conducting cash flow analysis and financial ratio analysis. For the project life after commissioning, total cash flow is expected to stay positive. In Year 11, Debt Service Coverage Ratio is expected to be barely above 1.0. Although cash flow from operating activities covers debt service with a thin margin in the most critical year, Current Ratio and Quick Ratio, both of which will reach 4 times, suggests that liquidity on hand can absorb unforeseeable adverse changes in cash flow.

9.3 Economic Evaluation

The economic evaluation measures the effects of the project by the EIRR. While economic costs are project cost, fuel cost and other O&M costs, economic benefits are these from electricity production, heat production, energy saving and CO2 reduction. In the base case, EIRR is 15.88% and higher than social discount rate (conventionally 10-12%). This project can be considered beneficial from the view point of the national economy. In the case that economic benefit of power production decreased by 20%, EIRR also declines to 11.31% and touches social discount rate.

9.4 Key Performance Indicators

The operational and effect indicators are following:

(1) Operational Indicators
a. Rated Gross Power Output
b. Rated Heat Output
c. Plant Capacity Factor
d. Availability Factor
e. Gross Energy Efficiency

(2) Effect Indicators
a. Rated Gross Power Output
b. Rated Heat Output
c. Rated Annual Net Power Generation
d. Rated Annual Heat Generation

10. Scope of Yen Loan Project

This project is proposed to implement on the “Full Turn-key” basis to precede each works smoothly and communicate closely.
The scope of Yen Loan project is based on “Full Turn-key”.

10.1 Scope of Yen Loan Project

The main equipment and facilities such as gas turbine, steam turbine, HRSG, generator and transformer, etc, are proposed to be scope of yen loan portion of Navoi CCCGP No.2 project.

10.2 Scope of SJSC Uzbekenergo

The buildings, civil structure, etc, are mainly proposed to be scope of SJSC Uzbekenergo of Navoi CCCGP No.2 project.

10.3 Works and Services to be provided by SJSC Uzbekenergo

Drinking water, hot water, natural gas, electric power for use during construction, etc. shall be provided by SJSC Uzbekenergo and/or the Consultant employed by the SJSC Uzbekenergo.

11. Proposal for implementation scheme and operation, maintenance and management system

11.1 Financial Stability

SJSC Uzbekenergo is financially sound. At the end of 2011, both Current Ratio and Quick Ratio are more than 1.0 time with sizable margins upon 0.7 times, which is conventionally considered a cut-off point. Liquidity is unlikely to be a problem in the foreseeable future. In 2011, Uzbekenergo’s debt accounted for only 30% of its equity. Net Interest Payment/EBIT shows that Uzbekenergo’s profitability covered interest payment. These suggest that both size of debt and interest payment were at manageable level. The result of the financial evaluation suggests that this project does not affect the financial health of SJSC Uzbekenergo.

11.2 Proposal for the operation maintenance management system and scheme for this Project

The Study Team would like to propose the following for the operation maintenance management for this Project.

(1) Operation maintenance management system for this Project
The Study Team proposes that the operation and maintenance management division should consist of the operation and maintenance groups, similarly to the case of the existing units. This will ensure a clearer definition of the job responsibilities and smoother job execution.

(2) Improvement of operation skill
For the “CCPP Navoi - 478MW Shop”, the facilities operation technique has been acquired at the time of commissioning. The Study Team propose introduction of simulator facilities for the purpose of further improvement of the operation skill in future.

(3) Performance management
One of the biggest causes for deterioration of the gas turbine performance is found in the contamination of the compressor passageway.
The Study Team would like to propose that the optimum compressor blade washing frequency should be determined by subsequently accumulating the operation data and compressor blade washing efficiency data.

(4) Maintenance of gas turbine
The maintenance level of the gas turbine has a serious impact on the availability factor of the overall power generation facilities.
The Study Team would like to propose that the hot parts should be inspected and replaced under supervision of the technical advisor of the OEM.

12. CDM Related Surveys

12.1 CDM Methodology

In CDM, the emission reduction volume under the project is defined as follows:
・Emission reduction volume = Baseline emission volume - Project emission volume

A project emission volume refers to the volume of emission from an actual project, whereas the emission volume in the baseline scenario means an emission volume in a "scenario unrealized if the project does not fall under a CDM project."

The EIA of this project calculates the emission reduction volume according to the stipulations in the above-mentioned report. The specific calculation method and calculation results are as follows.

・Estimation of Effect of GHG Reduction Based on the CDM Methodology

a. Baseline emission volume
- Annual power supply: 450,000 kW × 8,000 hr = 3.60 GWh
- Emission coefficient: 593 g CO_2 / kWh
- Annual baseline emission volume: 2,134,800 t CO_2

b. Project emission volume

- Annual fuel consumption: 763.5 × 10^6 Nm^3 (natural gas)
- Emission coefficient: 1.9 t CO_2 / 1,000 Nm^3
- Annual project emission volume: 1,450,650 t CO_2

c. Emission reduction volume when the project is implemented

- Annual emission reduction volume = 2,134,800 t CO_2 - 1,450,650 t CO_2 = 684,150 t CO_2

12.2 CDM Related Procedure

The DNA (Designated National Authority) of Uzbekistan, the Technology Transfer Agency under the Ministry of Economy of the nation, is responsible for CDM.
Uzbekistan worked on the introduction of global warming gas emission control measures. As a result, the nation has introduced as many as 100 laws and regulations, including the "Law of Republic of Uzbekistan on the Rational Energy Use" enacted in 1997, to protect the environment directly and indirectly and control use of natural resources and energy.

12.3 CDM Application

Uzbekistan has established the DNA in the country and been working on CDM projects ever since to meet the Kyoto Protocol.
To this end, the Government of Uzbekistan picked up 33 projects in 2009 to work on whether CDM is applicable to these projects.

CDM application in the power generation sector has been studied mostly by SJSC Uzubekenergo. This body has been working currently to file application documents of this project and preceding CCCGP No.2 Project in 2013 to the Ministry of Economy.

13. Workshop in Japan

This workshop was intended to obtain findings and experiences that could be effectively employed in the phase of implementing a yen loan project in the future. The counterparts of Uzbekistan were invited to Japan to make a field trip to the factories of major equipment manufacturers and combined cycle power plants and to listen to the lectures on the combined cycle power generation, in such a way that the related people would get required information.

Chapter 1 Preface

1.1 Background of Survey

In the Republic of Uzbekistan (hereinafter referred to as Uzbekistan), as a result of satisfactory economical development since 2002, demand for electricity is increasing at the average yearly rate of approximately 2%. According to the power demand estimation by Uzbekistan in 2004, it is expected that demand for electricity will increase at the equivalent rate and the maximum demand will reach approximately 11,200 MW at least in 2014.

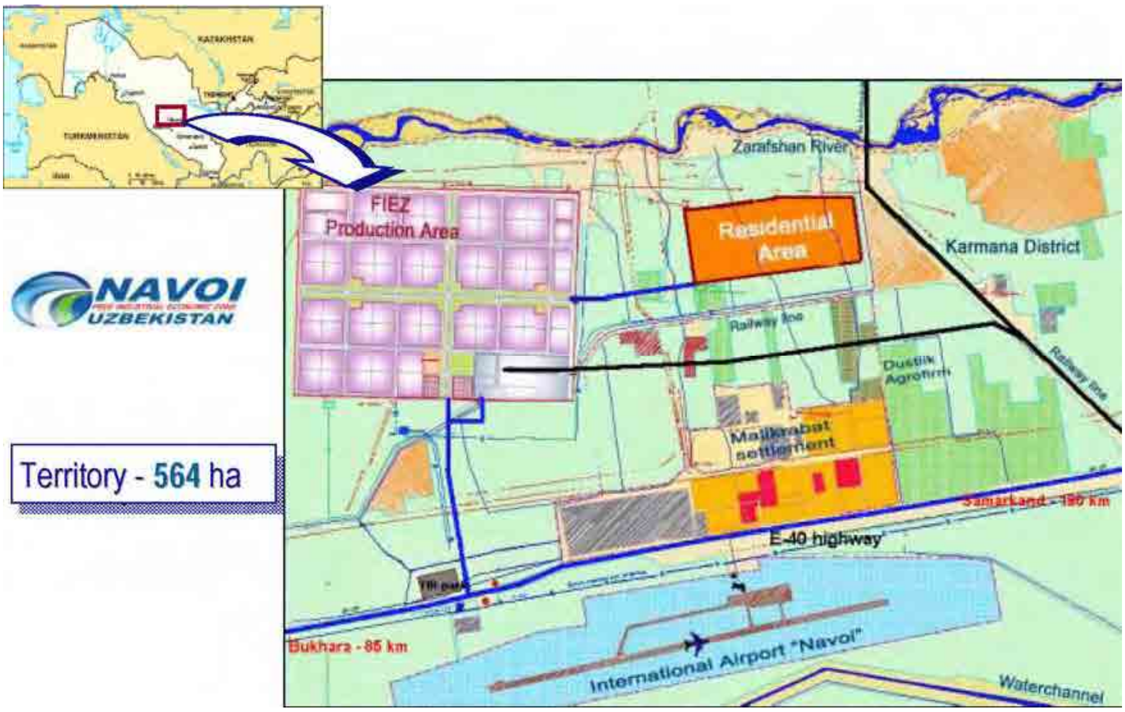
On the other hand, though the rated capacity of the total power generation in Uzbekistan is approximately 12,400 MW in 2009, the actual power generation capacity stays less than approximately 10,000 MW, since many power plants have been used for 40 to 50 years since they were constructed. Aging facilities have low power generation efficiency and cause such problems as more emission of greenhouse gas, NOx, etc. per generated electric energy.

On these backgrounds, the SJSC Uzbekenergo of Uzbekistan, since it is urged not only to introduce high-efficiency power generation facilities out of regard for the environment by utilizing fuel efficiently but to increase the power generation capacity in preparation for future electricity shortage, is working to modernize the aging thermal power plants.

This project intends to modernize the existing Navoi Thermal Power Plant (1,250 MW) near the Navoi City, Uzbekistan, as a part of these activities. Near the Navoi City, there is the largest-scale national metal mining complex in Uzbekistan, which is an important basis of economical development of Uzbekistan. A special industrial and economic free zone with an area of 564 ha was established near the Navoi Airport, which was constructed newly with President’s Decree in 2008, in order to call in overseas countries’ investments actively. The Navoi Power Plant is expected to be modernized to meet the demands for electric power and heat energy necessary for those investments. Figure 1.1-1 shows the outline of the Navoi special industrial and economic free zone introduced by the Shaxkat Tsuryagan of Vice Minister of the Ministry of Foreign Economy, Investments and Trade in the Japan–Uzbekistan Economical Cooperation Conference held in April 2010.

Table 1.1-1 shows the facility capacity and the current effective capacity of the twelve units of the Navoi Power Plant. Eight of the twelve units are of heat and power supply type, three are of power supply type, and one is of heat supply unit. Among them, the oldest unit has been used for as long as 50 years and others have been used for 30 years or more. They are superannuated. For example, it is found from this table that the effective capacity of the heat supply units lowered by a remarkable 50%, while the effective capacity of the power generating facilities lowered by approximately 10%. On such a background, the Combined Cycle Cogeneration Plant (hereinafter to be collectively called as CCCGP) No.2 featuring high energy conversion is to be introduced in time for disusing the existing power plants Nos. 3 and 8 by 2015. Having borrowed money from the Reconstruction and Development Fund of Uzbekistan, the SJSC Uzbekenergo is now constructing CCCGP No.1 adjacent to the Navoi Power Plant. At present, the construction makes good progress as scheduled and is scheduled to be completed in October this year.

In March 2012, the Uzbekistan Government requested yen loan for this project to the Japanese Government. Thus, this survey is conducted to make preparations for appraisal of the yen loan for introduction of CCCGP No.2.



Source: Material of Japan–Uzbekistan Economical Cooperation Conference in 2010

Figure 1.1-1 Navoi Special Industrial and Economic Free Zone

Table 1.1-1 Capacity of Navoi Thermal Power Plant

Unit No.	Facility type	Capacity of power generating facilities (MW)	Capacity of heat supplying facilities (Gcal/hr.)		Operation started in	Effective capacity of power generating facilities (MW)	Effective capacity of heat supplying facilities (Gcal/hr.)	
			For supplying heat to region	For industry			For supplying heat to region	For industry
1	Cogeneration plant	25	34	50	1963	15	0	0
2	Cogeneration plant	25	34	50	1963	20	34	50
3	Power generation	150	-	-	1964	145	-	-
4	Cogeneration plant	150	33	-	1965	145	33	-
5	Cogeneration plant	50	-	200	1966	45	-	150
6	Cogeneration plant	60	66	26	1967	55	0	0
7	Cogeneration plant	50	-	199	1971	45	-	113
8	Cogeneration plant	160	33	-	1968	150	33	-
9	Cogeneration plant	160	33	-	1969	145	33	-
10	Heat supplying	-	100	-	1972	-	0	-
11	Power generation	210	-	-	1980	155	-	-
12	Power generation	210	-	-	1981	180	-	-
Total		1,250	333	525		1,100	133	313

Source: Pre-F/S Report

1.2 Purpose of Survey and Scope of Survey

1.2.1 Purpose of Survey

The purpose of survey consists in to carry out studies necessary for judging whether the introduction of “Navoi Thermal Power Plant Modernization Project (CCCGP No.2)”, for which the Government of Uzbekistan requests as an object of the yen loan is viable as an ODA project. The studies include the necessity of introduction, conceptual design, construction cost, implementation schedule, implementation (procurement and construction) methods, implementation structure, management and operation and maintenance systems and environmental and social considerations of the project.

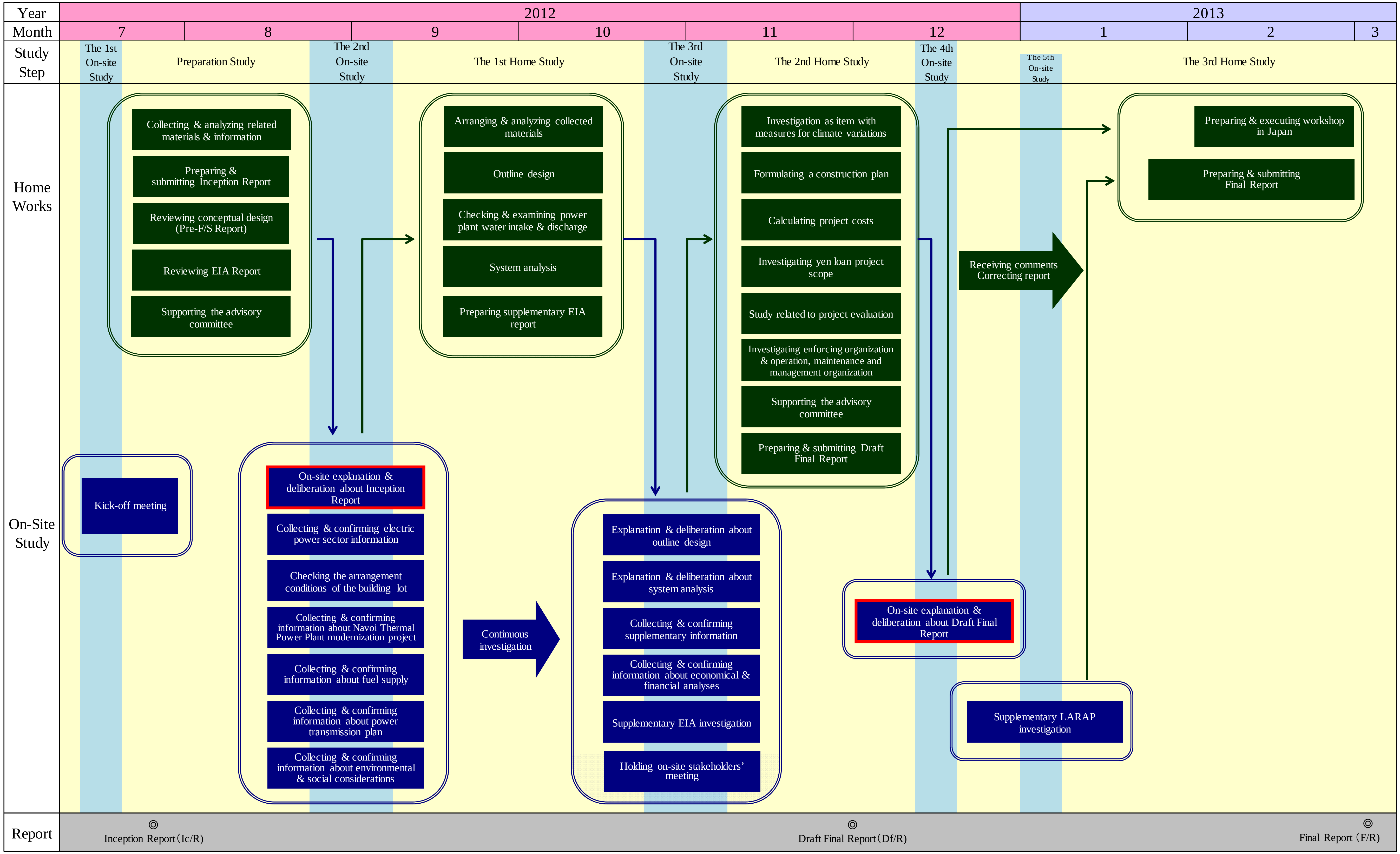
1.2.2 Scope of Survey

The scope of this survey is as follows:

(1) Confirmation of the plan studied by upper level structure of Uzbekistan
(2) Collection and confirmation of information about the electric power sector
(3) Collection and confirmation of information related to modernization of the Navoi Thermal Power Plant
(4) Check and review of the conceptual plan (Pre-F/S Report)
(5) Check and review of the EIA Report
(6) Check of the current situation and future prospect of fuel supply
(7) Check and examination about taking in and draining of power plant water
(8) Check of the present conditions of the project candidate sites
(9) Support of holding of the meeting with stake holders on the site
(10) Support of the advisory committee in JICA related to environmental issues
(11) Survey on electrical network systems
(12) Supplementary survey of EIA report
(13) Conceptual design including the heat supply system
(14) Inland transportation and construction plan
(15) Estimation of project cost
(16) Proposal about the project scope for the yen loan
(17) Proposal about the implementation organization, management and operation and maintenance systems
(18) Survey related to project evaluation
(19) Survey on countermeasures against climate change
(20) Support of implementation of technical training in Japan

1.2.3 Duration of the Study

Schedule of the Study is shown in the next page.



Source: Study Team

Figure 1.2.3-1 Schedule of the Study

1.3 Organization of the Team

Table 1.3-1 shows the names and duties of the study team (hereinafter referred to as the Team) members.

Table 1.3-1 Organization of the Team

Name	Duty
Hideyuki OKANO	Team Leader / Power Plant System Planning Expert
Kenji MIKATA	CCCGP System Expert
Toru KAMO	Fuel Supply Planning Expert
Hideki ASAYAMA	Mechanical Expert
Masamichi SHOJI	Electrical and I&C Expert
Mistake SHIMADA	Civil Engineering & Construction Planning Expert
Yasuhiro YOKOSAWA	Transmission Expert
Atsumasa SAKAI	Power System Analysis Expert
Norihiko FUKAZAWA	Environmental Consideration Expert
Yoko HAMADA	Social Consideration Expert
Nobuyuki KOBAYASHI	Economical & Financial Analyst

Source: Study Team

Chapter 2 Socio-economic Situation in Uzbekistan

2.1 Overview

Uzbekistan is a landlocked country with approximately 28 million residents in 2011. The country has the largest population among the five counties in Central Asia (Kazakhstan, Kyrgyz, Tajikistan, Turkmenistan, and Uzbekistan). In terms of Gross Domestic Product, Uzbekistan has the second largest economy in Central Asia only after that of Kazakhstan. Although its economy is growing at a rapid pace in recent years, Uzbekistan is still classified as a Lower-middle-income economy by the World Bank. External trade is commodity-driven. Major Merchandize export items are oil/gas and energy products, cotton, and foodstuff while major merchandize import items are machinery, chemical products, and foodstuff. Major trade partners are Russian Federation, Kazakhstan, and China for export and Russian Federation, Korea, and China for import.

Table 2.1-1 Basic Indicators

Country Name	Republic of Uzbekistan
Surface Area	447,400 square km
Population	27. 8 million (2011)
GDP (Nominal, Sums million)	77,750,600 (2011)
GDP (Nominal, USD million)	43,494 (2011)
GDP per Capita (USD)	1,572 (2011)
GDP Growth (Real, %)	8.3% (2011)
Merchandize export (USD million)	10,529 (2010)
Merchandize import (USD million)	8,044 (2010)
Exchange rate (Year average)	1787.60 sums/USD (2011)
Exchange rate (Year-end)	1795.00 sums/USD (2011)

Source: Ministry of Foreign Affairs of Japan (http://www.mofa.go.jp/), JETRO (http://www.jetro.go.jp/indexj.html), ADB “Key Indicators for Asia and the Pacific 2012”

2.2 Socio-economic Conditions

2.2.1 Population

The mixture of mild population growth and urbanization characterizes the demography of Uzbekistan. The total population has experienced a steady growth as the annual growth rate had been slowed down from the mid-1990s to the early-2000s and has stayed at approximately 1% for the last decade. The country has the highest population density among the five counties in Central Asia (Kazakhstan, Kyrgyz, Tajikistan, Turkmenistan, and Uzbekistan). The State Committee of the Republic of Uzbekistan on Statistics estimates that urban dwellers accounted for more than a half of total population (51.4%) in 2011.

Table 2.2.1-1 Population Trends (1995-2010)

	1995	2000	2005	2010
Total population (million)	22.9	24.8	25.9	27.4
Population growth (annual change, %)	2.0	1.3	0.9	1.2
Density (persons per square km)	53	58	62	63

Source: ADB "Key Indicators for Asia and the Pacific 2012"

2.2.2 Labor Force

The labor force has been growing consistently as steady growth of population resulted in an increase in working-age population. In 2010, employment of the agricultural sector accounted for 26.8 % of the employed labor force and that of the industry sector for 13.2%. The number of unemployed workers remained stable for the last several years.

Table 2.2.2-1 Labor Force in Uzbekistan

	2006	2007	2008	2009	2010
Total labor force (thousands)	11,493	11,299	11,603	11,930	12,287
Employed	10,467	10,735	11,035	11,328	11,628
Unemployed (registered)	26	23	17	20	16
Annual growth of labor force (%)	3	2	3	3	3

Source: ADB "Key Indicators for Asia and the Pacific 2012"

2.3 Macroeconomic Conditions

2.3.1 Gross Domestic Product

Higher prices of global commodities such as cotton and gold are one of the major factors affecting the overall economy in recent years. Partially due to the favorable external conditions, Uzbekistan has enjoyed a rapid expansion of its economy since the mid-2000s. The agricultural sector in which cotton is a major crop, remained approximately 20% of GDP, though its share in the economy has been gradually declined. The Industry sector grew at a relatively high rate but a slowdown of the global economy has affected this sector since 2008 when the Lehman Brothers bankruptcy caused economic downturn worldwide. However, the Uzbekistan government has supported investment in infrastructure in recent years and this effort alleviates negative effects of the external shock. On the demand side, private consumption remained robust and contributed to an expansion of the service sector.

Table 2.3.1-1 GDP by Industry Origin

	2006	2007	2008	2009	2010
GDP (% change, constant price)	7.4	7.7	9.0	8.1	8.5
Agriculture (% change, constant price)	6.2	6.5	4.7	5.8	6.6
Industry (% change, constant price)	7.5	6.6	6.8	4.1	4.2
Service (% change, constant price)	8.6	13.4	15.3	9.3	11.6
GDP by sector origin					
Agriculture (% of GDP at current price)	27.9	25.9	21.9	20.6	19.8
Industry (% of GDP at current price)	29.9	29.9	32.3	33.6	33.4
Service (% of GDP at current price)	42.2	44.2	45.9	45.8	46.8

Source: ADB "Key Indicators for Asia and the Pacific 2012"

2.3.2 Production Index

Agricultural and fishery production had been growing at consistent pace in the period from 2007 to 2010. Industrial production had grown at a faster pace than agricultural and fishery production, though the economic downturn worldwide slowed its growth in 2009 and 2010. Machinery production, in particular automobile, prevented a sharp decrease in industrial production.

Table 2.3.2-1 Annual Growth of Production Indexes

	2007	2008	2009	2010
Agricultural and Fishery Production Index (Annual growth, %)	6.1	4.5	5.7	6.8
Industrial Production Index (Annual growth, %)	12.1	12.7	9.0	8.3

Source: JETRO (http://www.jetro.go.jp/indexj.html)

2.3.3 Inflation and Money Supply

According to official figures, inflation was more stable in the period from 2006 to 2010 than in the early-2000s when inflation surpassed 20% per annum. The inflation of the food price index is even milder than that of the consumer price index. Change of the producer price index has been much more volatile than that of the consumer price index. Money supply, both nominal and percentage of GDP, was expansive from 2006 to 2008.

Table 2.3.3-1 Inflation and Money Supply

	2006	2007	2008	2009	2010
Consumer price index (annual change, %)	8.7	6.1	7.2	7.8	7.6
Food price index (annual change, %)	7.4	2.0	3.3	4.4	4.8
Producer price index (annual change, %)	30.2	14.1	9.1	24.7	15.6
Money Supply (M2, billion Sums)	3,146	4,598	6,088	N/A	N/A
M2 (% of GDP at current market price)	15.2	16.3	18.0	N/A	N/A

Source: ADB “Key Indicators for Asia and the Pacific 2012”

2.3.4 Balance of Payment

A rapid increase of the merchandize export for the last decade is mainly due to robust commodity prices, in particular natural gas. As major export items in Uzbekistan are commodities such as natural gas, cotton, and gold, the commodity boom in the 2000s provided favorable terms of trade for export. An increase of the merchandize import is slower than that of the merchandize export but stronger private sector consumption stimulated import of machinery such as automobile parts. Remittance from immigrant workers outside of Uzbekistan is a sizable portion in the balance of payment. Because of the above factors, both the current account balance and the overall balance had been positive in the period from 2006 to 2010. Nevertheless, Uzbekistan Sums was steadily depreciating over US Dollars in the same period. In consideration of a relatively high inflation and export competitiveness, the Central Bank of the Republic of Uzbekistan allowed nominal depreciation of the currency under an adjustable peg system.

Table 2.3.4-1 Balance of Payment

(Unit: million USD)

	2006	2007	2008	2009	2010
Trade balance	1,744	2,296	2,204	1,613	2,484
Merchandise exports	5,615	8,026	9,817	10,890	10,529
Merchandise imports	3,841	5,730	7,612	9,277	8,044
Current balance	2,933	4,267	4,472	4,136	5,663
Other goods, services, and income	-12	20	229	179	1,021
Unrequired transfer	1,171	1,951	2,038	2,344	1,150
Overall balance	1,564	2,155	2,731	2,200	5,663
Direct Investment	195	739	918	987	N/A
Current account balance (% of GDP)	17.2	19.1	17.4	12.6	6.6
Overall balance (% of GDP)	9.2	9.6	10.6	6.7	14.3
Exchange rate (Sums/USD, average)	1,215.6	1,260.8	1,314.2	1,458.8	1,576.8

Source: ADB “Key Indicators for Asia and the Pacific 2012”

2.4 Government Finance and External Debt

2.4.1 Government Finance

The total revenue accounted for approximately 20% of GDP in the period from 2006 to 2010. Since the revenue comes mainly from taxes, strong economic growth, a boom in global commodity markets and tax reform improves the performance of government revenue in recent years. The countries in Central Asia have a narrower tax bases as a legacy of the Soviet era. In order to tackle this weakness, the Uzbekistan government made efforts to expand a tax base by reducing tax burden on small business. Based on the official figures, the Uzbekistan government effectively controlled government expenditure within its revenue and maintained state budget surplus in the period from 2006 to 2010.

Table 2.4.1-1 Government Finance

(Unit: billion Sums)

	2006	2007	2008	2009	2010
Total revenue	4,485.4	6,145.0	8,760.8	10,840.2	13,596.7
Current revenue	4,485.4	6,145.0	8,760.8	10,840.2	13,596.7
Taxes	4,184.9	5,666.5	8,132.8	10,224.5	12,740.5
Total expenditure	4,388.4	5,823.8	8,197.1	10,763.9	13,386.9
Overall budgetary balance	97.0	321.2	563.7	76.3	209.8
Total revenue (% of GDP)	21.2	21.8	22.5	22.0	21.8
Total expenditure (% of GDP)	20.8	20.7	21.0	21.8	21.5
Overall budgetary balance (% of GDP)	0.5	1.1	1.4	0.2	0.3

Source: ADB “Key Indicators for Asia and the Pacific 2012”

2.4.2 External Debt

The total debt outstanding and disbursed almost doubled from 2006 to 2010. Nevertheless, because of an economic growth, the external debt over GNI decreased in the same period. Uzbekistan has the second lowest external debt over GNI in Central Asia (Kazakhstan, Kyrgyz, Tajikistan, Turkmenistan, and Uzbekistan) after Turkmenistan. According to a media report in January 2012, the President of Uzbekistan Islam Karimov stated that the total size of external debt did not exceed 17.4% to GDP and 53.7% to the exports volume. ADB’s data suggested that debt service (USD 594.5 million) accounted for 5.6% of the merchandize export and 23.9% of the trade surplus in 2010. This suggests that debt service has remained at a manageable level.

Table 2.4.2-1 External Debt

(Unit: million USD)

	2006	2007	2008	2009	2010
Total debt outstanding and disbursed	4,073.9	4,211.1	4,686.1	6,549.7	7,404.3
Long-term debt	3,915.9	4,012.7	4,465.3	6,386.3	7,166.7
Public and publicly guaranteed	3,289.0	3,133.9	3,144.4	3,245.6	3,245.7
External Debt (% of GNI)	24.0	18.8	17.0	20.1	19.0
Total long-term debt (% of total debt)	96.1	95.3	95.3	97.5	96.8
Principal repayment on long-term debt	677.4	649.0	710.5	717.0	470.6
Interest on long-term debt	170.2	167.7	141.0	120.3	118.1
Interest on short-term debt	3.3	7.3	8.0	2.3	5.8

Source: ADB “Key Indicators for Asia and the Pacific 2012”

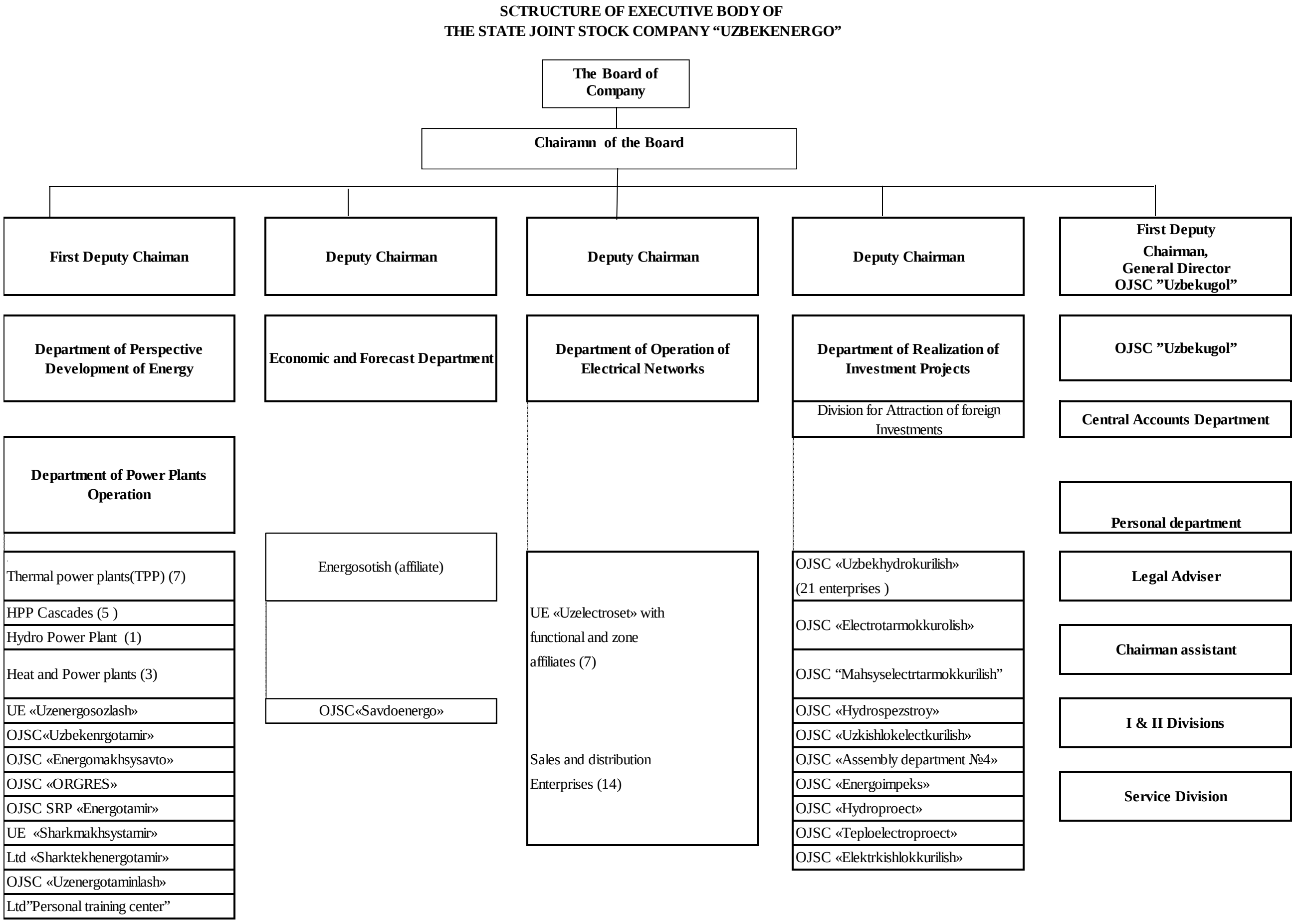
Chapter 3 Overview of the Power Sector in the Republic of Uzbekistan

3.1 Overview of power sector in the Republic of Uzbekistan

3.1.1 Organization

In the Republic of Uzbekistan, there was reorganization in August 2001, and the Ministry of Electric Power and Electrification was changed into the State Joint Stock Company Uzbekenergo (hereinafter referred to as "SJSC Uzbekenergo"). The organization structure of the SJSC Uzbekenergo is shown in Figure 3.1.1-1. SJSC Uzbekenergo includes a power generation company, power transmission company, power distribution company, affiliated company (EnergoSotish, etc), and coal company (Ugol). SJSC Uzbekenergo is run by the board of directors and the council as a higher-level organization. The board of directors consists of the chairman of the board and four deputy chairman of SJSC Uzbekenergo approved by the ministerial conference of the Republic of Uzbekistan. SJSC Uzbekenergo has a payroll of about 40,000. Amid the movement for improved business administration efficiency, the number of the department managers and specialists at the head office of SJSC Uzbekenergo is restricted to 55 according to the decision of the ministerial conference.

The council has jurisdiction over reorganization of the companies including the affiliated company, revision of the articles of association, increase or decrease of capital, and liquidation, and is staffed by eleven members of the council (Vice-president, Vice-chairperson of the national asset committee, Undersecretary of the ministry of finance, Undersecretary of the ministry of macro-economy statistics, and President of SJSC Uzbekenergo).



Source: SJSC Uzbekenergo Booklet, 2008 Version

Figure 3.1.1-1 SJSC Uzbekenergo organization chart

3.1.2 Overview of existing power generation facilities

In 2010, SJSC Uzbekenergo produced 50.158 GWh of electric power, of which 799.2 GWh was exported. In the same year, the SJSC Uzbekenergo imported 898.5 GWh of electric power.

The generation capacity of all the power generation facilities in the Republic of Uzbekistan exceeds 12,400 MW. The thermal power plants accounting for 85.1% and the hydraulic power plant accounting for 11.4% are run by the SJSC Uzbekenergo, and the remaining power generation facilities accounting for 3.5% are run by other organizations.

The SJSC Uzbekenergo anticipates a substantial increase (around 1 to 2%) in electricity demand. To meet this growing demand, the company is planning to maintain the capacity of self support through introduction of new facilities, to improve the reliability and quality of power supply, to save power, and to enhance operation efficiency of fuel and power. Furthermore, to protect the local ecosystem and to enhance global environment, the company is making efforts to develop an on-site power generation technology and renewable energy source. Table 3.1.2-1 and Table 3.1.2-2 show the overview of the existing thermal power plants and hydraulic power plants. Power generation facilities in Uzbekistan consist of ten thermal power plants (of which three are cogeneration power plants) and twenty-eight hydraulic power plants. The overall installed capacity is 12,033MW (10,619MW by thermal power plants plus 1,414MW by hydraulic power plants). Of these, the following four power plants each have an installed capacity of over 1,000MW: These power plants are the Syrdarya thermal power plant (with an installed capacity of 3,000MW), the Navo-Angren thermal power plant (with an installed capacity of 2,100MW), the Tashkent thermal power plant (with an installed capacity of 1,860MW), and the Navoi thermal power plant (with an installed capacity of 1,250MW). Furthermore, three cogeneration power plants as well as thermal power plants supply heat to thirteen regions.

Many of these power plants have been operating for 40 to 50 years after commencement of commercial operation, and require renewal or replacement due to degradation. However, no plants have been renewed or replaced since commencement of commercial operation of the Talimarjan thermal power plant, unit-1 (having a generation capacity of 800 MW) in 2004, and reinforcement of 300 MW facilities by rehabilitation of the Syrdaria thermal power plant units-7 and -8 in 2005.

Hydroelectric power plants of the company with the installed capacity of 1.4 million kW, are mainly united into cascades of hydroelectric power plants and operate under watercourse.

Table 3.1.2-1 Overview of the facilities in the existing thermal power plants

No.	Name of Plant	Type of Plant	No. of Turbine - Generator Units	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	Steam Turbine & Boiler	10	3,000	Gas, Oil	1972-1981	2,573.7	185,463 – 238,418
2	Novo-Angren TPP	Steam Turbine & Boiler	7	2,100	Coal, Gas, Oil	1985-1995	1,449.2	56,731 - 110,245
3	Tashkent TPP	Steam Turbine & Boiler	12	1,860	Gas, Oil	1963-1971	1,723	231,542 - 295,138
4	Navoi TPP	Steam Turbine & Boiler	12	1,250	Gas, Oil	1963-1981	980.1	207,387 - 349,429
5	Talimarjan TPP	Steam Turbine & Boiler	1	800	Gas, Oil	2004	-	36,605
6	Takhiatash TPP	Steam Turbine & Boiler	5	730	Gas, Oil	1962-1990	599.7	139,474 - 263,641
7	Angren TPP	Steam Turbine & Boiler	8	484	Coal, Oil, Coal gas	1957-1963	197	158,937 - 288,787
8	Fergana CHP	Steam Turbine & Boiler	7	305	Gas	1954-1979	200	101,051 - 299,183
9	Mubarek CHP	Steam Turbine & Boiler	2	60	Gas	1985-1986	57	71,602 - 128,515
10	Tashkent CHP	Steam Turbine & Boiler	1	30	Gas	1939-1964	-	351,318 - 414,962
	Total			10,619			7,779.7	

Source: SJSC Uzbekenergo

Table 3.1.2-2 Overview of the facilities in the existing hydraulic power plants

No	Name of plant	Type of plant	Place	Number of Unit	Total installed Capacity	Beginning year of operation	Total valid plant capacity (MW)
1	Charvak HPP	Hydraulic Power	Tashkent region	4	600	1970-1972	620.5
2	Khodjikent HPP	Hydraulic Power	Tashkent region	3	165	1976	165
3	Gazalkent HPP	Hydraulic Power	Tashkent region	3	120	1980	120
4	Chirchik GES	Hydraulic Power	Tashkent region	10	190.7	1941-1956	190.7
5	Kadyrya GES	Hydraulic Power	Tashkent region	8	44.6	1933-1946	44.6
6	Nizne-Bozsu GES	Hydraulic Power	Tashkent region	10	50.8	1943-1960	50.8
7	Tashkent GES	Hydraulic Power	Tashkent	10	29	1926-1954	29
8	Farkhad GES	Hydraulic Power	Syrdarya region	4	126	1948-1960	126
9	Sharikhan GES	Hydraulic Power	Andijan region	6	27.8	1943	27.8
10	Samarkand GES	Hydraulic Power	Samarkand region	9	40	1945	40
	Total				1,393.9		1,414.4

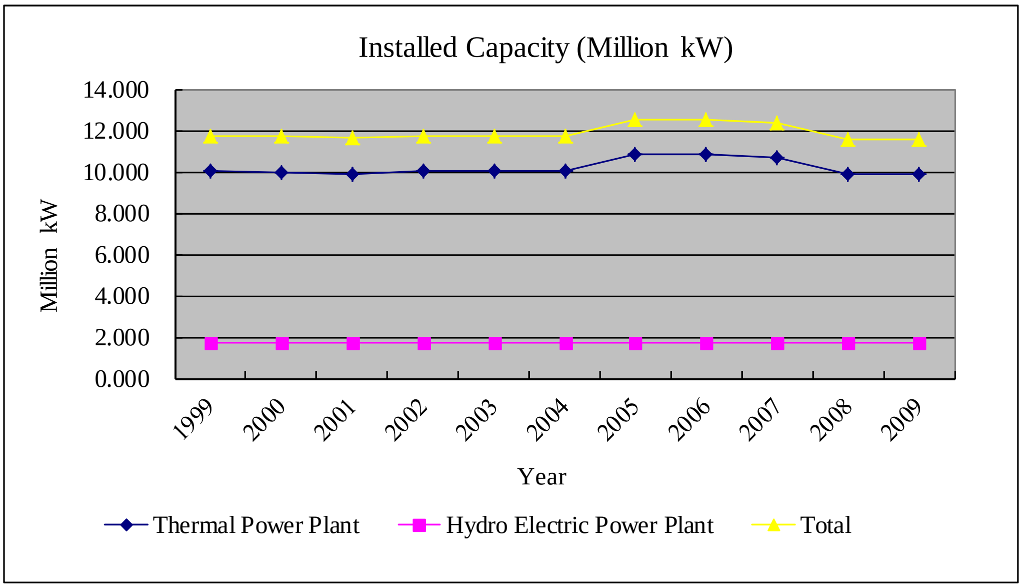
Source: SJSC Uzbekenergo

In the meantime, Table 3.1.2-3 and Figure 3.1.2-1 show transition of installed capacity of thermal and hydroelectric power plants. Installed capacity of both power plants remained almost unchanged in the past 10 years.

Table 3.1.2-3 Transition of installed capacity of thermal and hydroelectric power plants

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Thermal Power Plant	10.014	10.000	9.921	10.041	10.041	10.041	10.841	10.841	10.649	9.870	9.870
Hydro Electric Power Plant	1.690	1.690	1.710	1.710	1.710	1.710	1.710	1.710	1.710	1.710	1.710
Total	**11.704**	**11.690**	**11.631**	**11.751**	**11.751**	**11.751**	**12.551**	**12.551**	**12.359**	**11.580**	**11.580**

Source: SJSC Uzbekenergo



Source: SJSC Uzbekenergo

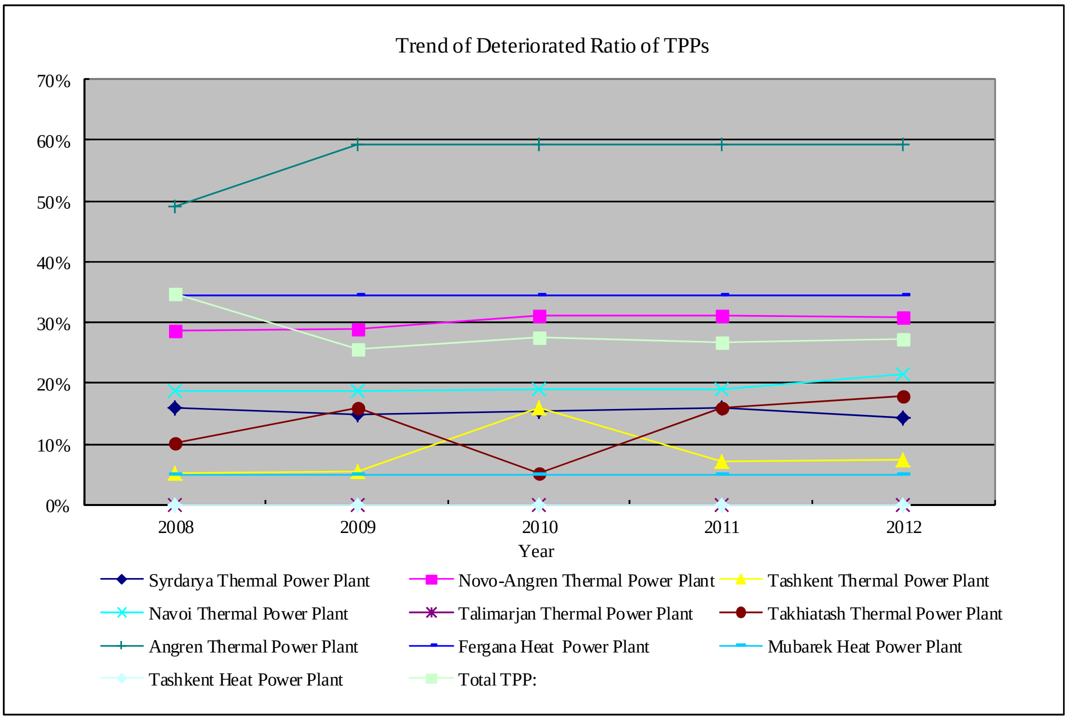
Figure 3.1.2-1 Transition of installed capacity of thermal and hydroelectric power plants

Table 3.1.2-4 shows available capacity of each thermal power plant. As shown in Table 3.1.2-4 and Figure 3.1.2-2, average deteriorated ratio (= (Installed capacity – Available capacity)/Installed capacity x 100) shows around 30%, that is, one third of installed capacity was lost. Largest deteriorated thermal power plant is Angren thermal power plant which shows around 60% of deteriorated ratio, that is, more than half of installed capacity was lost. Recovery of this lost capacity is an urgent issue for power sector in Uzbekistan.

Table 3.1.2-4 Transition of Available Capacity of the existing TPPs

Name of Thermal Power Plant	Available capacities, MW				
	2008	2009	2010	2011	2012
Syrdarya Thermal Power Plant	2,518.1	2,556.5	2,536.0	2,519.3	2,573.7
Novo-Angren Thermal Power Plant	1,497.5	1,491.0	1,448.0	1,448.2	1,449.2
Tashkent Thermal Power Plant	1,763.7	1,755.7	1,562.0	1,724.6	1,723.0
Navoi Thermal Power Plant	1,015.8	1,015.8	1,014.0	1,013.8	980.1
Talimarjan Thermal Power Plant	-	-	-	-	-
Takhiatash Thermal Power Plant	654.8	612.4	692.8	613.4	599.7
Angren Thermal Power Plant	247	197	197	197	197
Fergana Heat Power Plant	200	200	200	200	200
Mubarek Heat Power Plant	57	57	57	57	57
Tashkent Heat Power Plant	-	-	-	-	-
Total TPP:	7,953.9	7,885.4	7,706.8	7,773.3	7,779.7

Source: SJSC Uzbekenergo



Source: SJSC Uzbekenergo

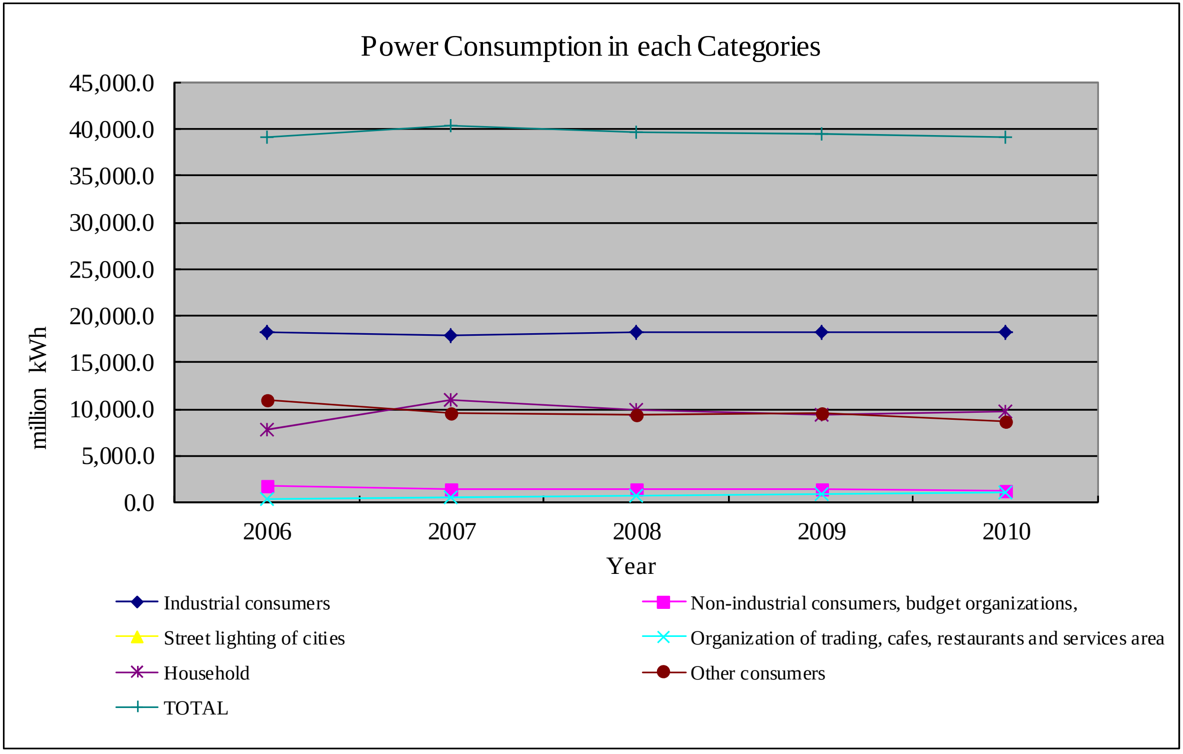
Figure 3.1.2-2 Transition of Deteriorated Ratio of the Existing TPPs

Table 3.1.2-5 shows power consumption in each category in the past 5 years. In the past 5 years, power consumption for each category is almost unchanged.

Table 3.1.2-5 Power Consumption in each Category

Year / Category	2006	2007	2008	2009	2010
Industrial consumers	18,240.3	17,859.2	18,285.1	18,176.9	18,307.1
Non-industrial consumers, budget organizations, Street lighting of cities	1,787.3	1,399.7	1,381.0	1,389.8	1,278.6
Organization of trading, cafes, restaurants and services area	410.8	528.4	765.5	919.3	1,000.0
Household	7,767.8	11,071.3	9,891.4	9,411.8	9,836.2
Other consumers	11,014.8	9,559.2	9,375.3	9,562.9	8,760.6
TOTAL	39,220.9	40,417.9	39,698.3	39,460.7	39,182.5

Source: SJSC Uzbekenergo



Source: SJSC Uzbekenergo

Figure 3.1.2-3 Power Consumption in each Category in the past 5 Years

Table 3.1.2-6 shows fuel consumption records at thermal power plants including heat and power plants. Figure 3.1.2-4 shows the fuel ratio in thermal power plants in 2008. Natural gas is 93.9 %, heavy oil is 1.8 %, and coal is 4.1 %. Natural gas as the environmental friendly fuel accounts for the major percentage.

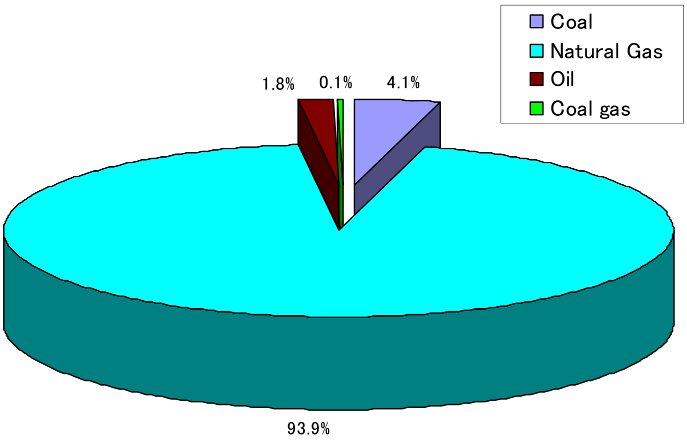
In 2008 the total power generation amount is 45,474 GWh = 163,706 TJ, and therefore overall average thermal efficiency of all thermal power plants is as follows.

163,706 / 531,370 x 100 = 30.8%

Table 3.1.2-6 Fuel Consumption at Thermal Power Plants

Type of Fuel	Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Coal	M tons/yr	2.22	2.04	2.5	2.15	2.35	1.8	2.61	2.05	2.77	2.66	2.18
	TJ/yr	21,125	19,407	23,764	20,408	22,357	17,118	24,839	20,582	27,811	26,706	21,887
Natural Gas	Gm^3/yr	12.69	12.55	13.54	13.67	12.46	12.42	12.99	12.69	12.95	12.97	14.61
	TJ/yr	428,841	424,205	457,750	462,064	421,065	419,812	439,196	433,490	442,372	443,055	499,078
Mazut	M tons/yr	1.41	1.53	1.56	1.12	1.37	1.26	1.09	0.63	0.78	0.57	0.24
	TJ/yr	54,947	59,919	61,105	43,851	53,387	49,160	42,667	25,244	31,255	22,840	9,617
Coal Gas	Gm^3/yr	0.29	0.28	0.25	0.05	0.21	0.35	0.37	0.36	0.30	0.30	0.22
	TJ/yr	1.106	1.061	0.937	0.186	0.788	1.343	1.387	1.289	1.074	1.074	788
Total	TJ/yr	504,914	503,532	542,620	526,323	496,810	486,091	506,703	479,317	501,439	492,602	531,370

Source: SJSC Uzbekenergo



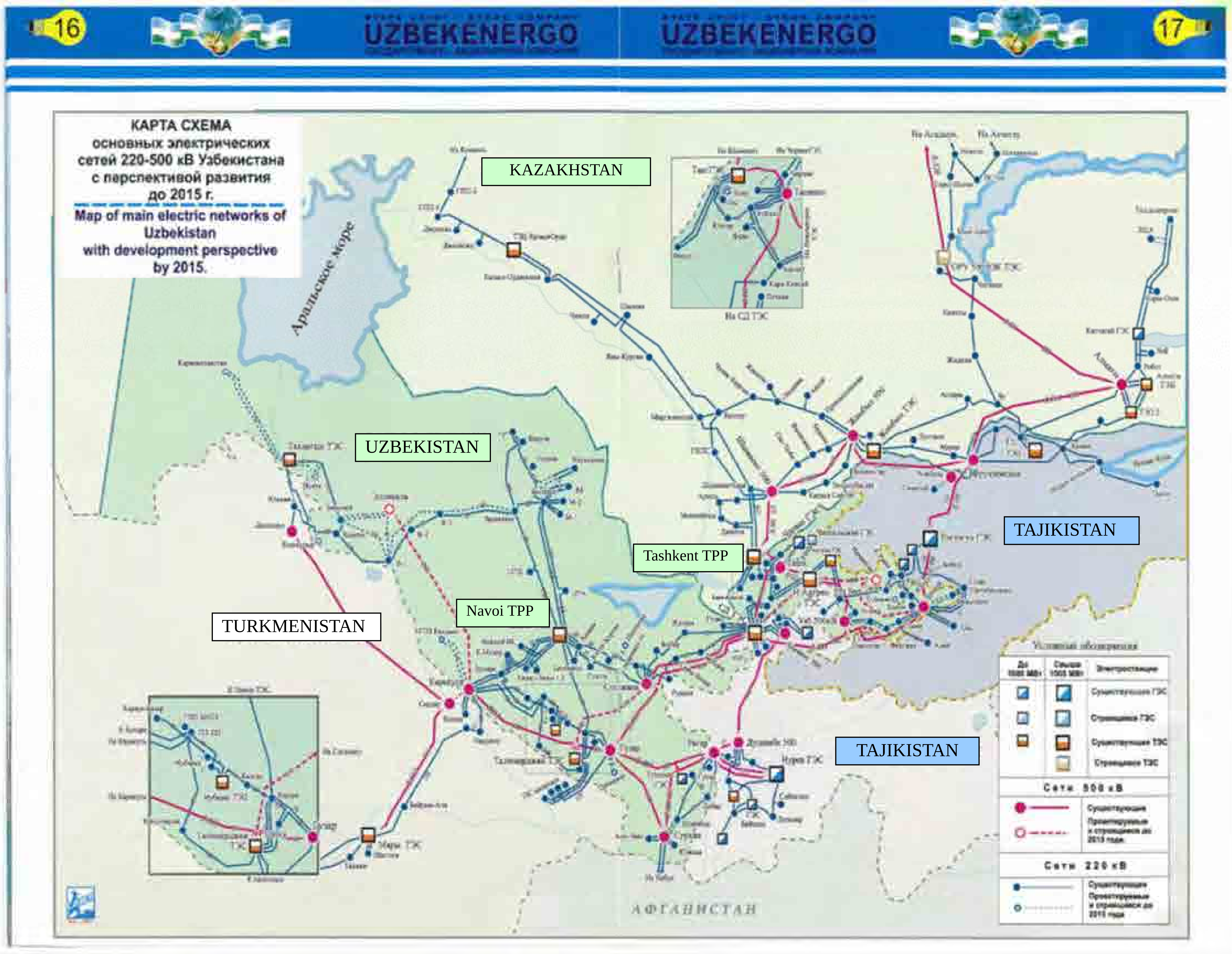
Source: SJSC Uzbekenergo

Figure 3.1.2-4 Fuel ratio in thermal power plants (2008)

3.1.3 Overview of power transmission facilities

(1) Power grid system

The power grid system in the Republic of Uzbekistan was constructed at the time of the former Soviet Union, where five countries including Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan were assumed as constituting one integral area. Thus, after independence of each country, the power grid system constitutes an international linkage system. The 500 kV transmission line is also linked to Russia via Kyrgyzstan and Kazakhstan. Thus, the power grid system is characterized by a large scale system and operation of stable frequency. The 500 kV and 220 kV lines are used in the trunk network, and the 110 kV lines serve for local supply systems. The vast majority of the trunk network consists of one-circuit transmission lines. The outage at the time of transmission line trouble is minimized by parallel operation of the 500 kV and 220 kV circuits.



Source: 2010 Annual Report of SJSC Uzbekenergo

Figure 3.1.3-1 Power grid system for the Republic of Uzbekistan

As will be discussed in Subsection 3.1.4, there has not been much fluctuation in demands for the past ten years. Reinforcement work was not applied to the 500 kV transmission line of the trunk network for some time since 1991, as shown in Table 3.1.3-1 reflecting such demand. However, to meet the requirements for further reduction of transmission loss and subsequent increase in demand, expansion work was performed in 2007 and 2008. As of 2012, the 500 kV transmission line measures 2,331 km, the 220 kV transmission line measures 6,121 km, and the 110 kV transmission line measures 707 km.

Table 3.1.3-1 Overall extension of transmission lines

Year	Length of Transmission Lines / km		
	500kV	220kV	110kV
2003	1,662	5,620	234,847
2004	1,662	6,134	689
2005	1,659	6,158	692
2006	1,659	6,152	692
2007	1,730	6,182	692
2008	1,847	6,173	692
2009	2,043	6,152	692
2010	2,043	6,079	692
2011	2,310	6,121	707

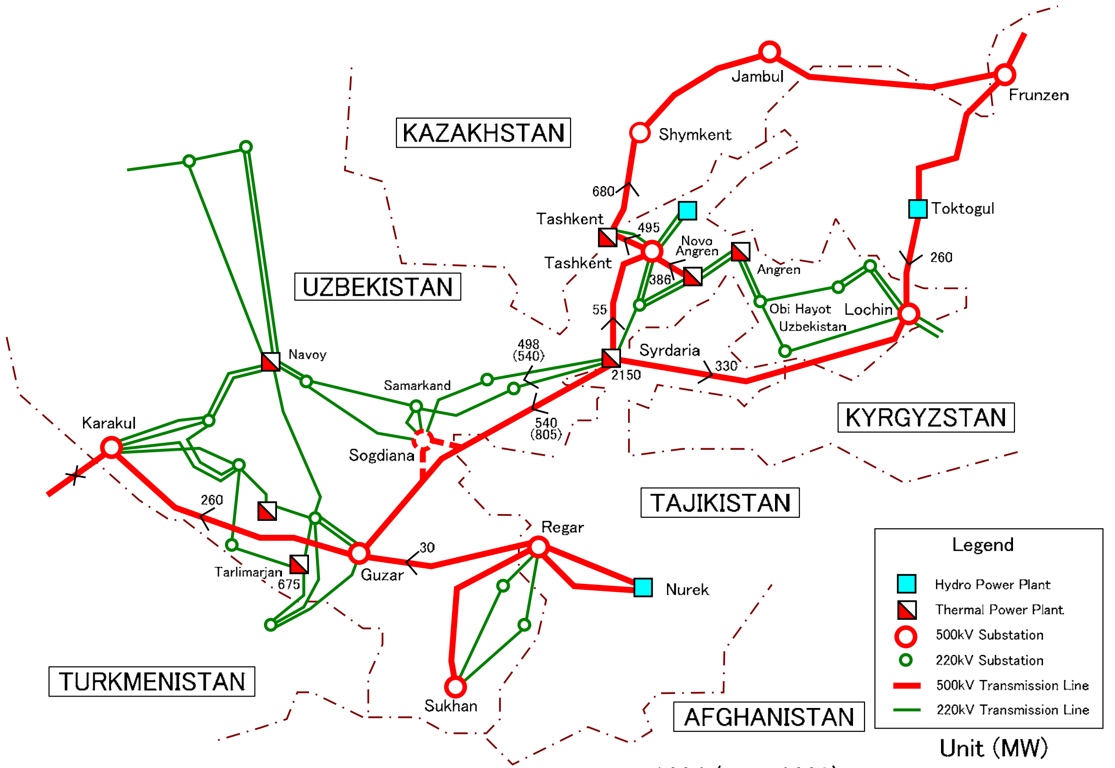
Source: SJSC Uzbekenergo

(2) Power flow

Seventy percent of the power sources including the Tashkent thermal power plant (with a generation capacity of 1,860 MW) located at the center of demand, the Novo Angren thermal power plant (with a generation capacity of 2,100 MW), and Syrdarya thermal power plant (with a generation capacity of 3,000 MW) are located in the northern district. The major power flow goes from north to southwest. The overall power transmitted from the Syrdarya thermal power plant at the time of maximum demand in December 2003 was 1,345 MW -- 805 MW via the 500 kV transmission line, and 540 MW via the 220 kV transmission line (Figure 3.1.3-2).

However, in the south of the Republic of Uzbekistan, the Talimarjan thermal power plant (having a generation capacity of 800 MW) commenced commercial operation in 2004. This reduced the power flow to the southwest. The result was a total of 1,038 MW power transmission capability - 540 MW via the 500 kV transmission line and 498 MW via the 220 kV transmission line.

Furthermore, the excessive load on the 220 kV transmission line in the center of the Republic of Uzbekistan with the major center located in Samarkand was reduced by the new construction of the 500 kV Sogdiana substation in July 2005. The power grid system characteristics have been greatly enhanced by the implementation of these measures.



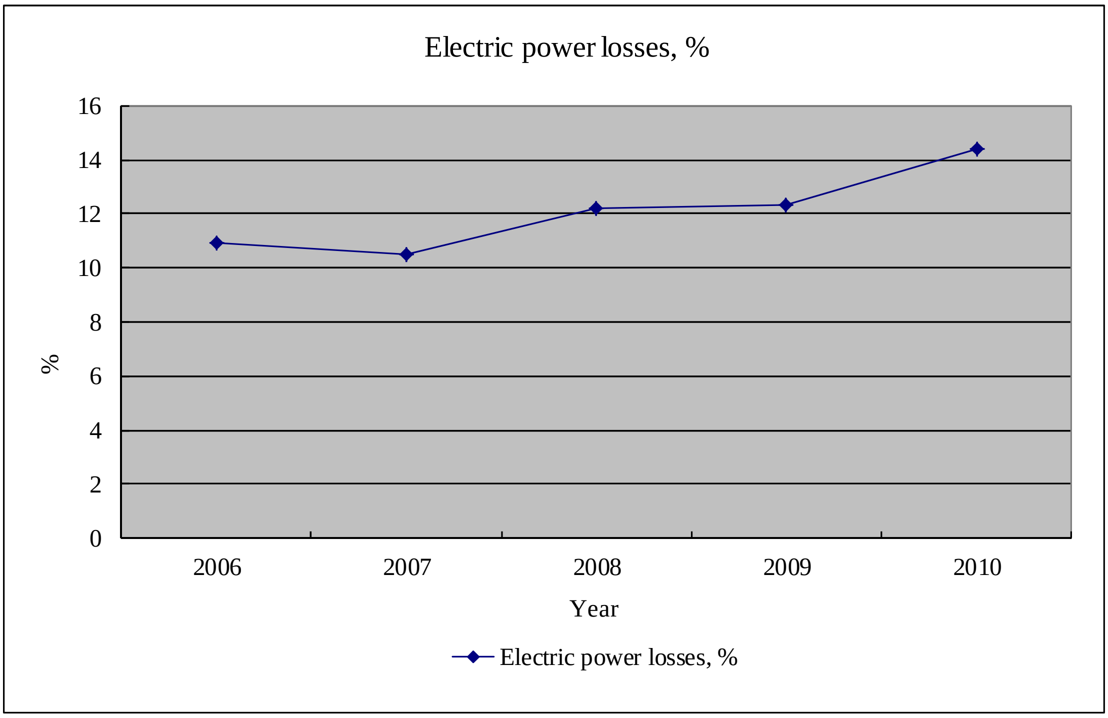
Power Flow at Peak Demand Time on Dec. 2004 (Dec. 2003)

Source: Sector Study for Power Sector in Uzbekistan (2004, JBIC)

Figure 3.1.3-2 Power flow in the Uzbekistan power system

(3) Loss in power transmission and distribution

The loss in power transmission and distribution can be divided into technical loss and non-technical loss. The technical loss rate of Figure 3.1.3-2 shows a transition of about 10 % up to the year 2010 from 2006. After that, a rapid increase can be observed. This may have been caused by the degradation of power transmission and distribution facilities. However, the reason for a rapid increase amid the stagnation of the overall demand is not yet clear. The reduction in the loss rate is effective in reducing the amount of primary energy used, hence in protecting the global environment. It is necessary to examine the reasons in greater detail and to take required measures.



Source: SJSC Uzbekenergo

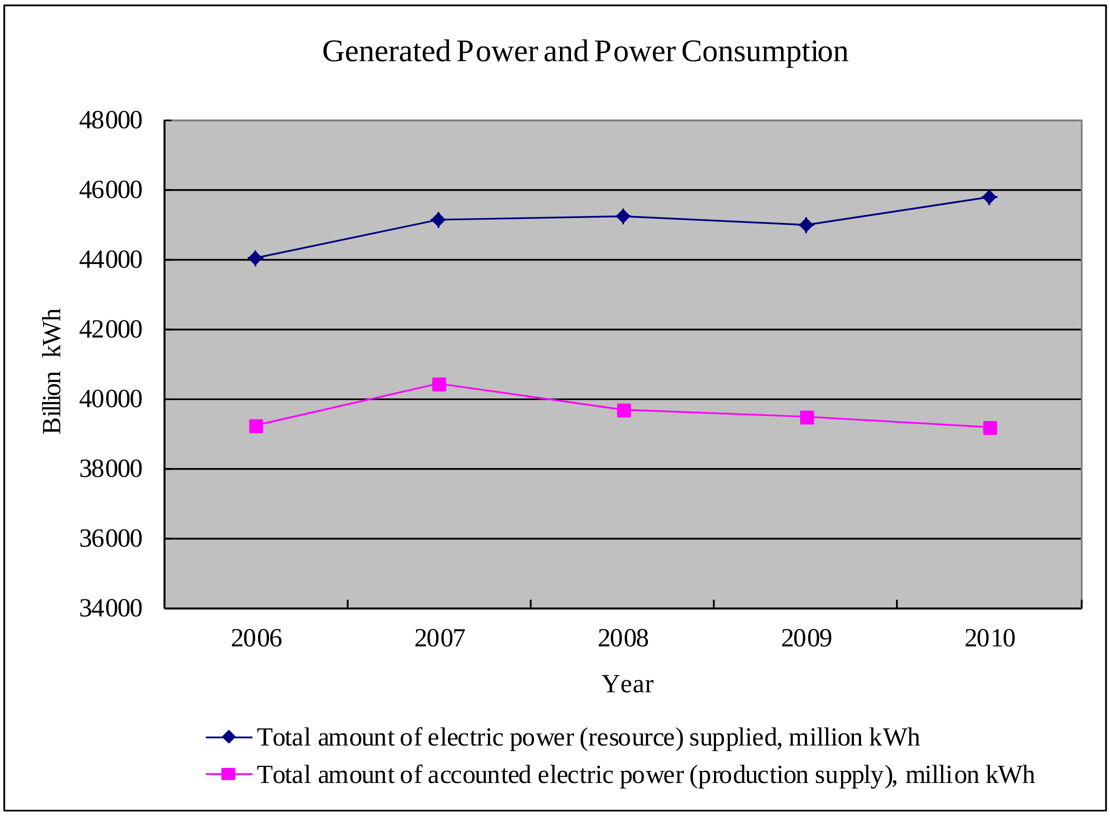
Figure 3.1.3-2 Transition of power transmission and distribution loss rate

3.1.4 Power demand

Figure 3.1.4-1 shows the transition of the generation and consumption of power in the last 5 years. The overall demand for electric power in the Republic of Uzbekistan had exhibited annual reduction for ten years after independence in 1991 due to economic confusion and stagnation of industrial activities. However, economy has been on an upward trend after that, and the overall demand for electric power is also on an upward trend, even though this trend is very slow.

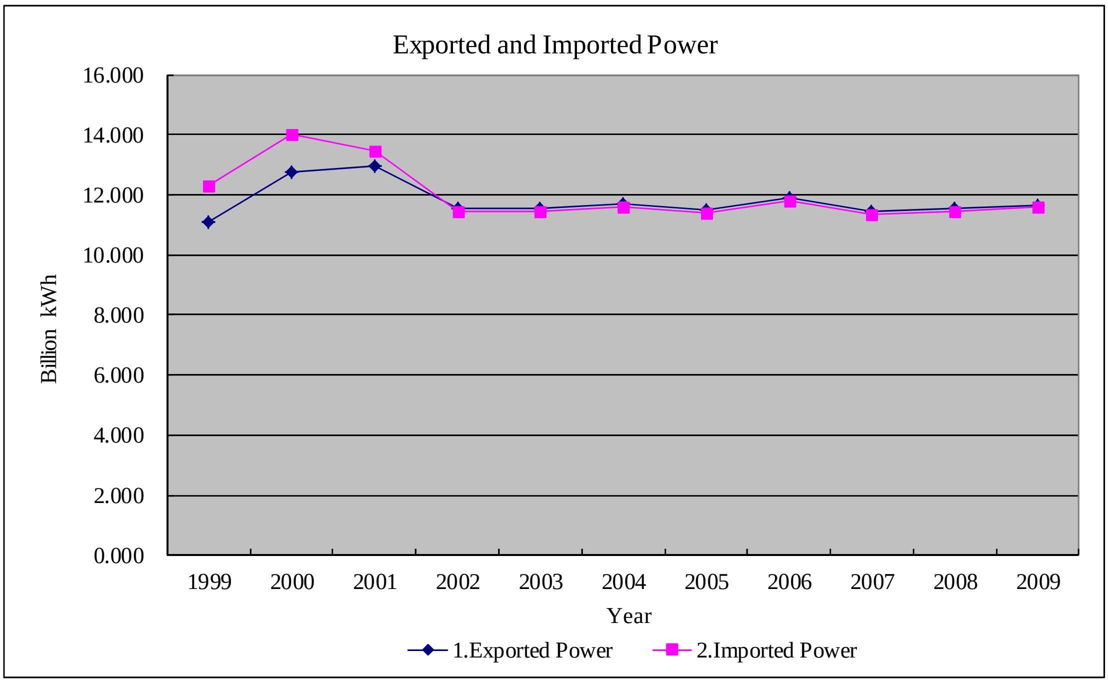
Figure 3.1.4-2 shows the transition of the imported and exported electric power. As described above, electric power is exchanged among Uzbekistan and the surrounding countries. The export and import power exhibits a slight fluctuation from 1999 to 2002, while both are generally stabilized from 2003 to 2009. The possible cause is that the electricity rate is not yet determined for exchange of electric power among the surrounding countries, and transaction of water, electricity and natural gas is performed on a barter basis.

Figure 3.1.4-3 shows the transition of the maximum demand for electric power and generation capacities in the last ten years. The demand for electric power in Uzbekistan registered a level of 8,608 MW in 1991 during the age of the Soviet Union. The demand had been on a downward trend since independence in the same year to reach a level as low as 7,379 MW in 1995. After that, reflecting the economic recovery, there was a slight increase in the demand, but the record for 2008 is 7,727 MW, without the maximum record of the past being surpassed. Furthermore, in comparison with the generation capacity, the reserve margin in the generation capacity at the time of maximum demand (calculated from the percentage between maximum demand and effective capacity, although the value corresponding to the shutdown due to maintenance and other work is subtracted, where this value was omitted for the sake of simplification) was 21 % in 2005. By contrast, this percentage was increased to 28 % in 2008, exhibiting a satisfactory transition level.



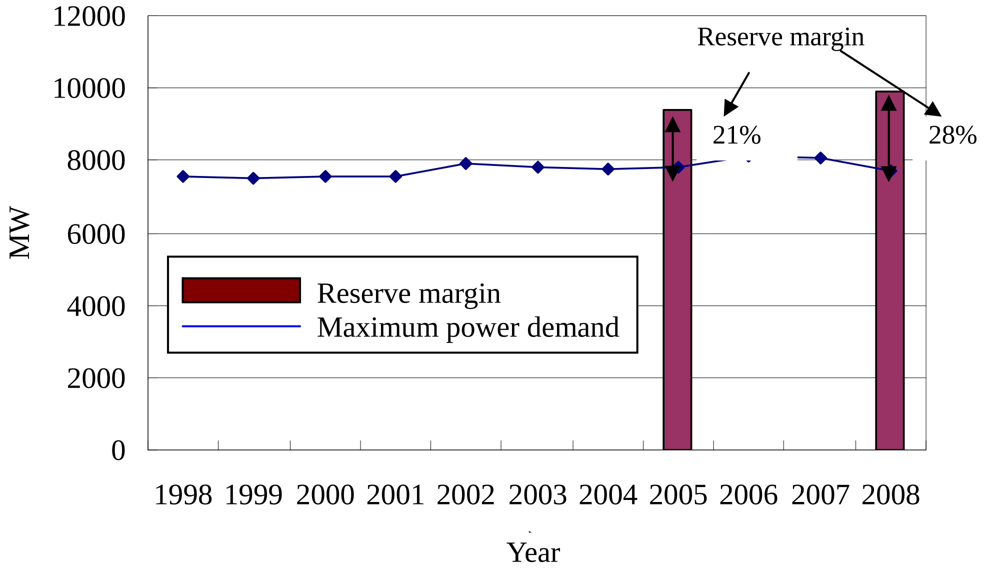
Source: SJSC Uzbekenergo

Figure 3.1.4-1 Transition of electricity generation and electricity consumption in the last 5 years



Source: SJSC Uzbekenergo

Figure 3.1.4-2 Transition of the imported and exported electric power in the last ten years



Source: SJSC Uzbekenergo

Figure 3.1.4-3 Transition of the maximum power demand and reserve margin

3.1.5 Power generation development plan

In the Republic of Uzbekistan, the position of the most important national investment items for gas development, electric power development and others has been clearly defined by the Executive Order of the President in an effort to ensure a sustainable development of economy. According to Power Generation Development Plan up to 2015 made by SJSC Uzbekenergo; expansion of the Talimarjan thermal power plant, expansion of the Navoi thermal power plant, expansion of the Novo-Angren thermal power plant and modernization of the Tashkent heat supply power plant are approved as the important projects for electric power development in that time period. For the funds of these projects, the SJSC Uzbekenergo depends mainly on the loans from JICA and other international cooperation agencies.

In this context, the Navoi CHP Plant is located at the south-east of the Navoi Province, and is evaluated as the major power source as well as the important heat supply source. Accordingly, if the modernization project of this power plant is financed as a Japanese ODA Loan project and is implemented as planned, a significant contribution is anticipated to be made to a stable supply of heat and electricity in Uzbekistan as well as Navoi.

Table 3.1.5-1 Power generation development plan up to 2015

No.	Name of plants	Type of plants	Installed capacity, MW	Type of fuel	Year of launching
1	Construction of CCGT at Navoi TPP	Combined cycle gas turbine	478	Natural gas	2012
2	Construction of gas turbine plant at Tashkent Heat Power Plant	Gas turbine plant	3x27	Natural gas	2013-2015
3	Construction of two CCGT at	Combined	2x450	Natural	2014

No.	Name of plants	Type of plants	Installed capacity, MW	Type of fuel	Year of launching
	Talimarjan TPP	cycle gas turbine		gas	
4	Construction of power generating unit at Angren TPP	Thermal power plant	150	Coal	2014
5	Construction of CCGT at Tashkent TPP	Combined cycle gas turbine	370	Natural gas	2014
6	Expansion of Mubarek Heat Power Plant with installation of GTP	Gas turbine plant	140	Natural gas	2014
7	Expansion of Navoi TPP with installation of second CCGT unit	Combined cycle gas turbine	450	Natural gas	2015

(Note) TPP: Thermal Power Plant, CHP: Combined Heat and Power
Source: SJSC Uzbekenergo

3.1.6 Power demand forecast

SJSC Uzbekenergo planned power generation by their Thermal Power Plant from 2012 to 2020 is shown in Table 3.1.6-1. During the term its growth rate will be around 1.0% per year.
As described in item 3.1.2, the available capacity of the existing thermal power plants is reduced to 70% of their installed capacity in 2012. Therefore, new installation or modernization of power plant is necessary to cover such gap between maximum power demand and available capacity. On the other hand, 2,569MW generation capacity is planned to be developed, as shown in Table 3.1.5-1. This figure includes the capacity by replacement of the existing power plants. Therefore, to keep the stability of power supply to correspond to increasing power demand, it is necessary to implement said power generation development plan steadily.

Table 3.1.6-1 Power Demand Forecast up to 2020

Unit: Billion kWh

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Electric Power Demand	50.5	50.7	51.2	51.7	52.2	52.7	53.3	53.8	54.4
Growth Ratio (vs. previous year)	-	0.40%	0.99%	0.98%	0.97%	0.96%	1.14%	0.94%	1.12%

Source: SJSC Uzbekenergo

3.1.7 Activity for Developing Renewable Energy by SJSC Uzbekenergo

In Uzbekistan the complex of works on the environment protection and an establishment of corresponding normative requirements is carried out in full conformity with laws of the Republic of Uzbekistan.
“About Protection of Nature”, “About Air Protection”, “About Rational Using of Energy”, “About Ecological Expertise”, in line with the documents accepted at the international level concerning ecological and nature protection problems.

SJSC Uzbekenergo having observed requirements of the nature protection legislation of the

Republic of Uzbekistan provides realization of necessary measures in the area, directed to

- Reduction of pollutant emission to atmosphere and discharges in water basins ;
- Rational utilization of water resources ;
- Waste utilization ;
- Disturbed soils re-cultivation ;
- Dimensioning emissions and discharges up to the technically reasonable values.

3.1.8 Renewable Energy in Uzbekistan

SJSC Uzbekenergo is promoting Renewable Energy in Uzbekistan to diversify fuel and energy balance, SJSC Uzbekenergo plans to implement the following projects.

(1) Solar power plant
- Capacity : 50MW
- Period of construction ; 2016 to 2018
- Power generation: 110mil. kWh per year
- Saving natural gas volume: 36mil. m^3 per year
- Project cost: 250mil. USD
- Source of finance: Own finance and foreign investment

(2) Pilot wind power plant
- Capacity : 0.75MW
- Period of construction ; 2011
- Power generation: 1.28mil. kWh per year
- Saving natural gas volume: 0.4mil. m^3 per year
- Project cost: 2.87mil. USD
- Source of finance: Own finance

(3) Wind power units
- Capacity : 100MW
- Period of construction; 2016 to 2018
- Power generation: 210mil. kWh per year
- Saving natural gas volume: 68mil. m^3 per year
- Project cost: 250mil. USD
- Source of finance: Own finance and foreign investment

3.2 Electricity and Heat Tariff

3.2.1 Electricity Tariff

In Central Asia, Uzbekistan is one of the countries where cross-subsidy is relatively small. In the period of 2002-2004, tariff reform was initiated. This effort brought a significant reduction of cross-subsidy to the power sector by the mid-2000s[1]. Retail tariff of electricity has increased at 8-10% higher than annual rate of inflation for the period of 2004-2011[2]. As a result, a direct subsidy to cover production cost is not provided to electricity. In the current tariff table, there are ten types of customer category. Cheaper tariff for large industrial customers shows that tariff setting remains economically rational.

On retail prices of electricity, SJSC Uzbekenergo submits a tariff petition to the Ministry of Finance which is in charge of review and approval of electricity tariff. The retail prices of electricity have been revised twice or three times per year for the period of 2010-2012. The data obtained from SJSC Uzbekenergo show that average price of electricity tariffs has margin over production cost, which includes fuel cost, maintenance cost, depreciation and interest payment. The weighted average price of electricity sales was 83.53sum/kWh in 2011 and surpassed the production cost for the same year. For the period of 2010-2011, the supply cost has been lower than tariff rates in most customer categories except large industrial users, a customer category which is offered the most inexpensive tariff rate but charged an additional fee. With the current level of electricity tariff, it is plausible that SJSC Uzbekenergo obtains revenue sufficient for recovery of both investment and operation costs for power generation.

The Final Report for Central Asia Economic Cooperation Power Sector Master Plan, which is funded by ADB, estimates cost recovering tariff level at USD 0.07/kWh or 137.2sum/kWh. However, the estimated cost is based on efficiency of existing gas-fired power plants and export price of natural gas which is higher than the price of natural gas in the domestic market. The estimated cost fairly shows a hypothetical production cost in the case that fuel price would reach international level but it is somewhat immoderate as actual production cost. According to the aforementioned master plan, the Uzbekistan government is likely to support capital costs for investment in electricity. The Ministry of Finance in Uzbekistan currently supports SJSC Uzbekenergo in recovery of investment cost by maintaining electricity tariff at appropriate level and deducting taxes and duties. In the view point of beneficiary payment principle, continuing tariff revision above inflation is appropriate to ensure sufficient investment in the power sector in the long run.

Table 3.2.1-1 Electricity Tariff by Customer Category

（Unit: Uzbekistan Sum）

Cat.	Customer	Apr-10	Oct-10	Dec-10	Apr-11	Oct-11	Apr-12	Oct-12
1	Industrial (connected load >750 kW)*	55.50	60.45	60.45	65.80	71.70	76.50	81.90
2	Industrial (connected load <750 kW)	70.50	76.80	76.80	83.60	91.10	97.50	104.40
3	Industrial Agriculture	70.50	76.80	76.80	83.60	91.10	97.50	104.40

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[1] ADB (2005), “Electricity Sectors in CAREC Countries”

[2] WB (2011), “Project Appraisal Document for Talimarjan Transmission Project”

Cat.	Customer	Apr-10	Oct-10	Dec-10	Apr-11	Oct-11	Apr-12	Oct-12
4	Electrified Railway	70.50	76.80	76.80	83.60	91.10	97.50	104.40
5	Non-industrial consumers	70.50	76.80	76.80	83.60	91.10	97.50	104.40
6	Commerce	72.00	78.40	78.40	85.40	93.00	99.50	106.50
7	Residential**	70.50	76.80	76.80	83.60	91.10	97.50	104.40
8	Air conditioning and Hot water	70.50	76.80	76.80	83.60	91.10	97.50	104.40
9	Advertisement and Illumination	110.00	110.00	110.00	110.00	110.00	110.00	110.00
10	Usage of power system	70.50	76.80	76.80	83.60	91.10	97.50	104.40
	Average	65.84	68.14	73.10	78.65	78.65	84.64	91.24

Source: SJSC Uzbekenergo
* Based on maximum load, additional fee is charged.
**Houses with electric stoves have preferential tariff.

Table 3.2.1-2 Production Cost of Electricity

	2007	2008	2009	2010	2011
Power Generation (GWh)	40,417.9	39,698.3	39,460.7	39,179.5	40,512.2
Total Production Cost (million sum)	1,483,508.1	1,882,782.0	2,130,853.6	2,428,727.4	2,493,510.0
Production Cost (Sum/kWh)	36.70	47.43	54.00	61.99	61.55

Source: SJSC Uzbekenergo

3.2.2 Heat Tariff

Heat, both steam and hot water, is a major byproduct of electricity generation and used for both household and industrial purposes. Based on the data obtained from SJSC Uzbekenergo, heat revenue surpassed production cost including fuel cost, maintenance cost, depreciation and interest payment. While the weighted average price of heat sales was 20,733.46sum/Gcal in 2011, the supply cost was 18,778.1sum/Gcal in the same year. It is concluded that heat tariff is at or above cost recovery level.

Table 3.1.8-1 Production Cost of Heat

	2007	2008	2009	2010	2011
Usable Heat (Gcal)	9,638,062.2	9,043,909.4	8,174,272.1	7,677,624.1	7,937,008.7
Total Cost (million sum)	91,120.8	102,105.7	106,644.3	118,324.5	149,041.9
Unit Cost (Sum/Gcal)	9,454.27	11,290.00	13,046.34	15,441.61	18,778.10

In the Navoi area, SJSC Uzbekenergo provides heat to its customers including chemical plants and residents via Navoi TPP. Billing of both steam and hot water is calorie-based under the same tariff table. Consumed amounts of steam and hot water are converted to calories. Heat tariff is revised every year as Navoi TPP submits a tariff petition to the Ministry of Finance with production cost data once a year. The Ministry of Finance is in charge of review and approval of heat tariff as well. A direct subsidy is not provided to heat. In the tariff table of Navoi TPP, there are four types of customer category. Profitability of heat production can provide indirect evidences on cost recovery. The profit of heat production in Navoi TPP had been positive for the period of 2007-2010. This may imply that heat production covered production costs required directly for its operation.

Table 3.2.2-2 Tariff Table of Heat for Navoi TPP in October 2012

Cat.	Customer	Price (Sum/Gcal)
1	Consumers except whole sellers and greenhouses	30,838
2	Whole sellers and greenhouses	26,349
3	Usage under SJSC Uzbekenergo system	23,248
4	Residential	16,961

Source: Navoi TPP

Table 3.2.2-3 Gross profit of heat production in Navoi TPP

	2007	2008	2009	2010
Heat power Production (000 Gcal)	2,862.0	2,759.0	2,235.0	2,329.5
Heat power sales (000 Gcal)	2,749.9	2,650.2	2,149.0	2,234.8
Profit from heat sales (million sum)	33,773.3	35,643.5	32 281.3	34,384.2

Source: Preliminary F/S for “The construction of the second CCGT Unit of 450MW at the Navoi thermal power station” (2012)

Chapter 4 Survey of Navoi Power Plant Facilities

4.1 Site situation

4.1.1 General

Uzbekistan is characterized by typical continental climate consisting of a very hot summer, comparatively cold winter, a great temperature difference between daytime and night time, and dry weather with little precipitation.

The planned project site is adjacent to the existing Navoi thermal power plant located in the suburbs of Navoi of Uzbekistan approximately 360 km west-southwestern (WSW) of Tashkent, capital of Uzbekistan.

The Navoi thermal power plant and the candidate construction site are located on the left bank of the Zarafashan River.

The CCCGP No.2 (450MW) power plant is considered to require a site area of approximately 9.0 Ha.

4.1.2 Site selection

The planned candidate construction site for the CCCGP No.2 (450MW) power plant is adjacent to the Navoi thermal power plant approximately 7 km northwest of Navoi city (city hall).

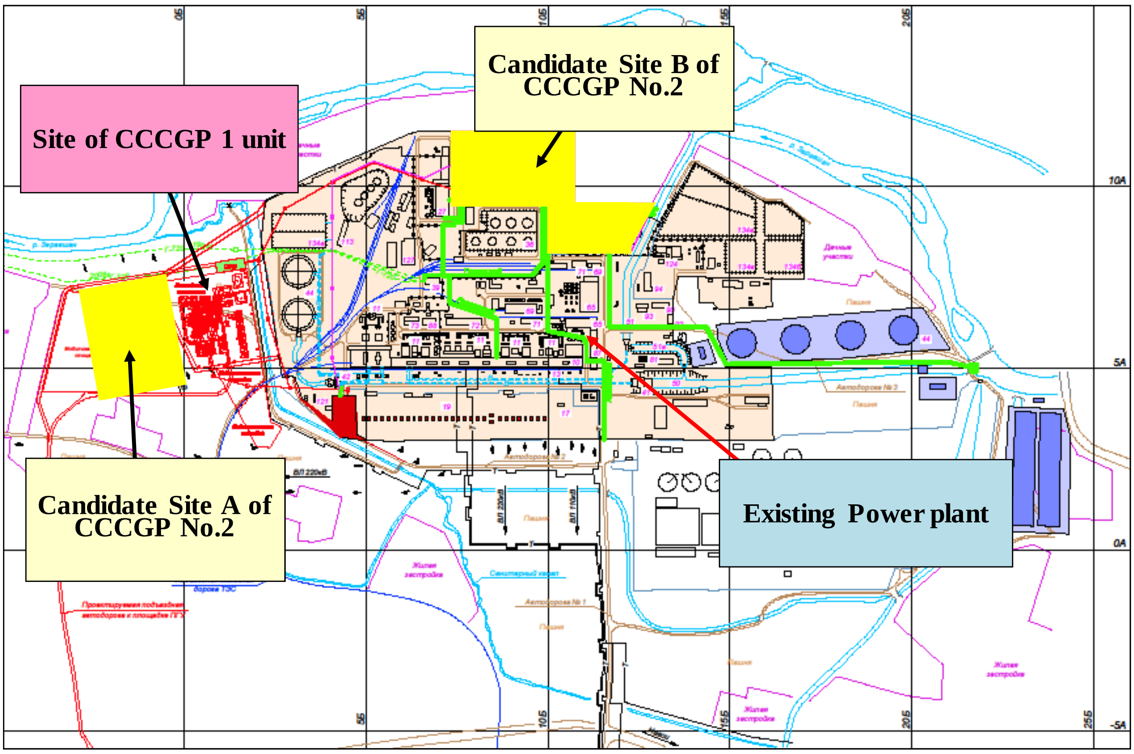
As illustrated in Figure 4.1.2-1, the candidate construction sites selected for a new power plant are two sites (candidate sites A and B) adjacent to the existing Navoi thermal power plant.

Candidate site A is situated in the area adjacent to the west side of the CCCGP No.1 currently under construction in the west of the existing Navoi thermal power plant.

Candidate site B is situated in the area adjacent to the north side of the existing Navoi.

The candidate construction sites, A and B, must be examined in order to establish which is more suited as a candidate site for the CCCGP No.2 (450MW) power plant.

Table 4.1.2-1 illustrates the comparison between candidate sites A and B.



Source: Pre-F/S Report

Figure 4.1.2-1 Plan view of CCCGP No.2 power plant construction sites

Table 4.1.2-1 Comparative table of construction sites

Item	Candidate site A	Candidate site B	Remarks
Installation position	West of CCCGP No.1 under construction	North of the existing Navoi thermal power plant	
Site acquisition	Possible to acquire the area for the CCCGP No.2 site measuring approximately 9.0 Ha	Difficult to acquire the area for the CCCGP No.2 site and the site required for construction	
Site conditions	The power transmission steel tower (currently being used) must be relocated. The existing structures (ground-based structures) other than the power transmission tower (currently being used) have already been removed.	The groups of garages and National Vacation Villages must be relocated.	
Access	A railway and access road are constructed up to the southern point of the planned site. However, the need for extending the access road width and others must be studied.	A new access road must be constructed. The existing power plant will be split by the access road.	

Item	Candidate site A	Candidate site B	Remarks
Workability	There seems to be no problem except for the problem of relocating the power transmission steel tower (currently being used).	The existing power plant structures must be removed to construct a new access road.	
Security	No security problem for the existing power plant as a result of constructing the CCCGP No.2.	Security problem will arise to the existing power plant because the existing plant will be split by the construction of a new access road.	
Others	Close to the existing power plant, fuel supply, water supply and heat supply. Smaller impact of the construction of the CCCGP No.2 upon the existing power plant.	Requires construction of a gas pipeline that splits the existing power plant.	
Evaluation	OK (accepted)	NG (rejected)	

Source: Study Team

The above Table suggests that candidate site A is superior to candidate site B as a candidate construction site for a new power plant.
Thus, candidate side A is recommended as a construction site for a new power plant.

4.1.3 Site condition

4.1.3.1 Site preparation

In the planned construction site for CCCGP No.2 (candidate site A), approximately 9 hectares of the site required for power plant construction has been prepared almost completely. However, the transmission lines of the four series and their foundations have not been removed. Thus, the transmission lines of the four series and their foundations must be removed or relocated.
The prepared ground level of candidate site A is BSL + 330.0m to +336.5m (BSL: Baltic Sea level).
It should be noted, however, that construction of the power plant requires a survey of the existing underground structures. If the existing underground structures are left unremoved, they must be relocated or removed.

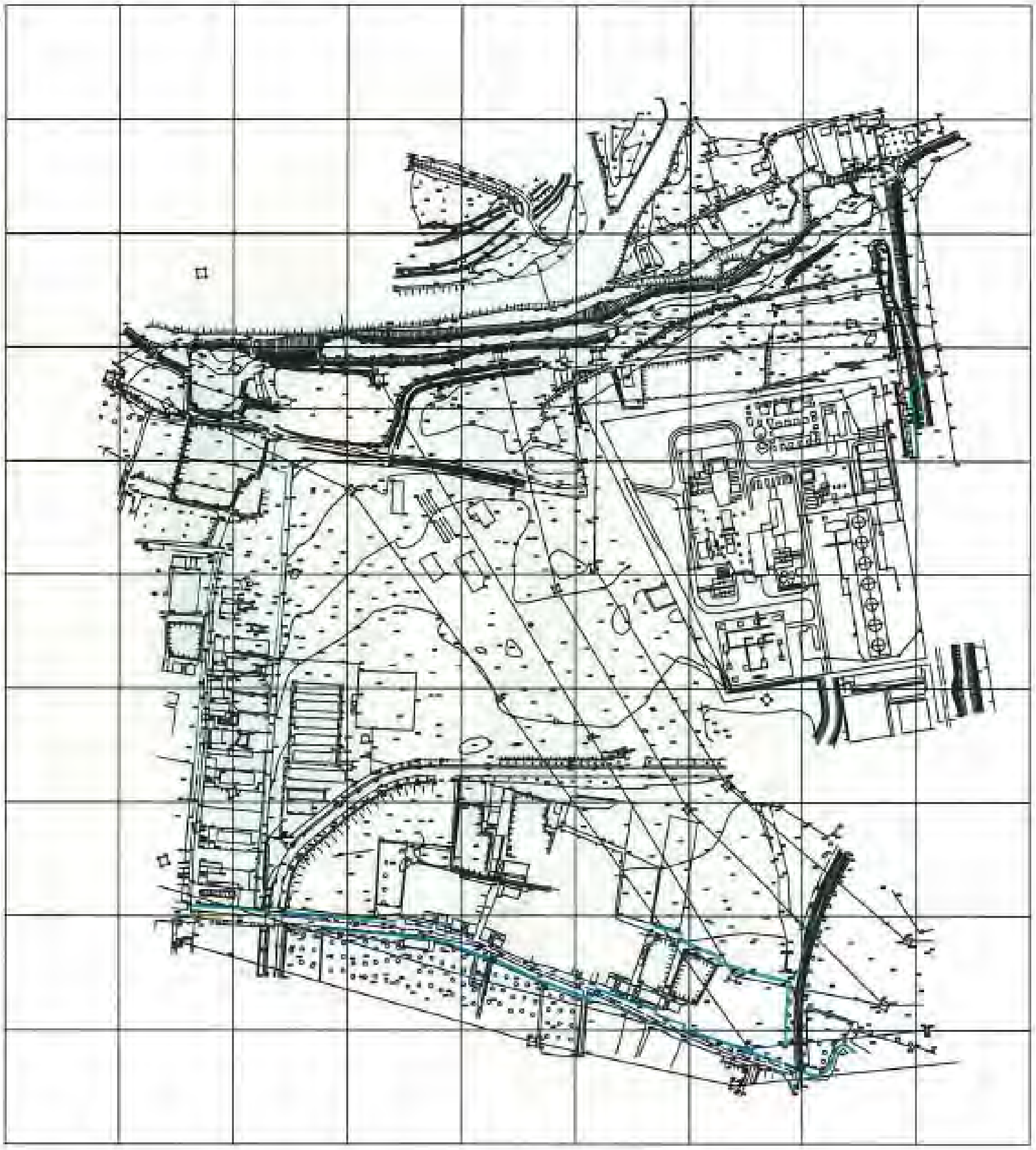
4.1.3.2 Physiographical and Geological condition

Physiographic location of the project site is on a left bank of the river Zeravshan in its middle course.
The Valley of Zeravshan River within the limits of the considered district extends in latitudinal direction. In the north the valley is confined by smooth hill slopes of Nuratin Mountains, in the south - by foothills of Zeravshan range (Zerabulak- Zihayetdin Mountains).
The width of the valley in the described valley achieves from 3-4 to 12-14 km.
The region is characterized by a long hot summer and comparatively warm winter.

Geologically in the valley of Zeravshan river the following river terraces are distinguished:

First terrace above flood-plain was mainly developed in the right bank part of the valley, where its width achieves 1-2 km, in the left bank part it stands out in a form of a narrow strip of 50-m width, being traced along the current riverbed.
Second terrace above flood-plain is also traced, mainly, on the right bank of the river.
Third terrace above flood-plain in the survey area is the most developed, it takes the greatest part of Zeravshan river valley.
On the surface of a third terrace above flood-plain, mainly, all the settlements, industrial enterprises are located, including Navoi thermal power plant (TPP).
Terrace cusp above water level in the river is 4-6 m.

Figure 4.1.3-1 shows the topographic map.



Source: SJSC Uzbekenergo

Figure 4.1.3-1 Topographic map.

4.1.3.3 Soil condition

The construction site for the CCCGP No.2 is composed of stratums of quaternary depositions of the barren complex represented by alluvial and proluvial loams and sandy loams of grayish-brown color. They are followed by wood-detrital soils and gravel.

The first from surface natural lithologic horizon consists of a loamy layer with the inclusion of a soil-vegetable layer and silt. The thickness of this layer may vary from 0.5 to 4.5 meters. Loams have the color from dark gray to yellowish-gray and gray-field. Loams are loess-like pulverescent and are of firm consistency.

Below this, the layer of a grussy soil occurs, which consists of fragments of clay slates with sandy-loam filler.

Under the layer of a grussy soil, the loamy sediments of alluvial origin of yellowish-gray to gray color occur.

Loamy soils of the first and second layers, along with their similarity, also have very close values of physical and mechanical properties.

Loamy soils of the first layer according to the extent of slumping from their own weight when soaked refer to the first type of collapsibility. Loamy soils of the second layer are not collapsible.

Soils are slightly saline.

Type of soil is salinity – hydrocarbonate-sulfate-calcium. Soils, as the environment, are strongly aggressive against Portland cement.

Clay soils are underlain by gravel-pebble depositions (layer 3) at a depth of 5.7-6.0 meters.

Pebbles are mostly of medium size, they are well-rounded, but there are also not well-rounded fragments.

The filtration properties of these depositions are characterized by the coefficient of filtration – 15.9 m/day.

4.1.3.4 Groundwater condition

The hydrogeological conditions are characterized by the development of ground water confined to quaternary depositions of the Zarafshan river valley, and within the study area they receive an additional feeding through infiltration of irrigation water and inflow of groundwater from the foothills.

The groundwater table is at the level of 5.5-6.0 meters. The long-term monitoring over the groundwater levels shows that the amplitude of their fluctuations is about 1.2 - 1.3 meters.

The groundwater mineralization reaches values from 1.2 to 2.05 g/l; they are characterized by sulfate aggressiveness in relation to concretes from standard cement grades.

4.1.3.5 Zero mark of the site

The zero mark of the project (0.000) corresponds to +332.910 above the sea level.

4.1.3.6 Construction area characteristics

The normative value of the snow cover weight for the 1st district is 0.50 (50) kPa (kgf/m2) (according to KMK 2.01.07-97 “Loads and effects”).

The normative wind dynamic pressure for the 1st district is 0.38 (38), kPa (kgf/m2) (according to KMK 2.01.07-97 “Loads and effects”).

The seismicity of the area according to KMK 2.01.03-96 is 8 points.

The maximum possible seismic accelerations are within 0.28 – 0.40 g.

4.1.3.7 Meteorological condition

Absolute maximum ambient temperature is +47 ^{o}C in July, absolute minimum ambient temperature is -28 ^{o}C in January and average annual ambient temperature is +14.3 ^{o}C.
Monthly mean ambient temperature in the hottest month is +28.2 ^{o}C in July.
Monthly mean ambient temperature in the coldest month is 0.2 ^{o}C in January.

The highest monthly mean humidity is 75% in January.
The lowest monthly mean humidity is 36% in July.

Average duration of frostless season is 221 days, the depth of freezing of soil is 40 cm, and maximum height of blanket of snow is 12 cm.

Prevailing wind direction is eastern, average wind speed is 1.8 to 2 m/sec.

Uzbekistan has two rainy seasons, from January to May and from October to December.
Annual average rainfall is 405 mm.

Annual snowfall is assumed 350 mm similarly in Tashkent.

4.1.3.8 Cooling water

The possible CCCGP No.2 cooling methods are:

- Once-through cooling method
- Mechanical draft cooling tower cooling method
- Mechanical draft air cooling method

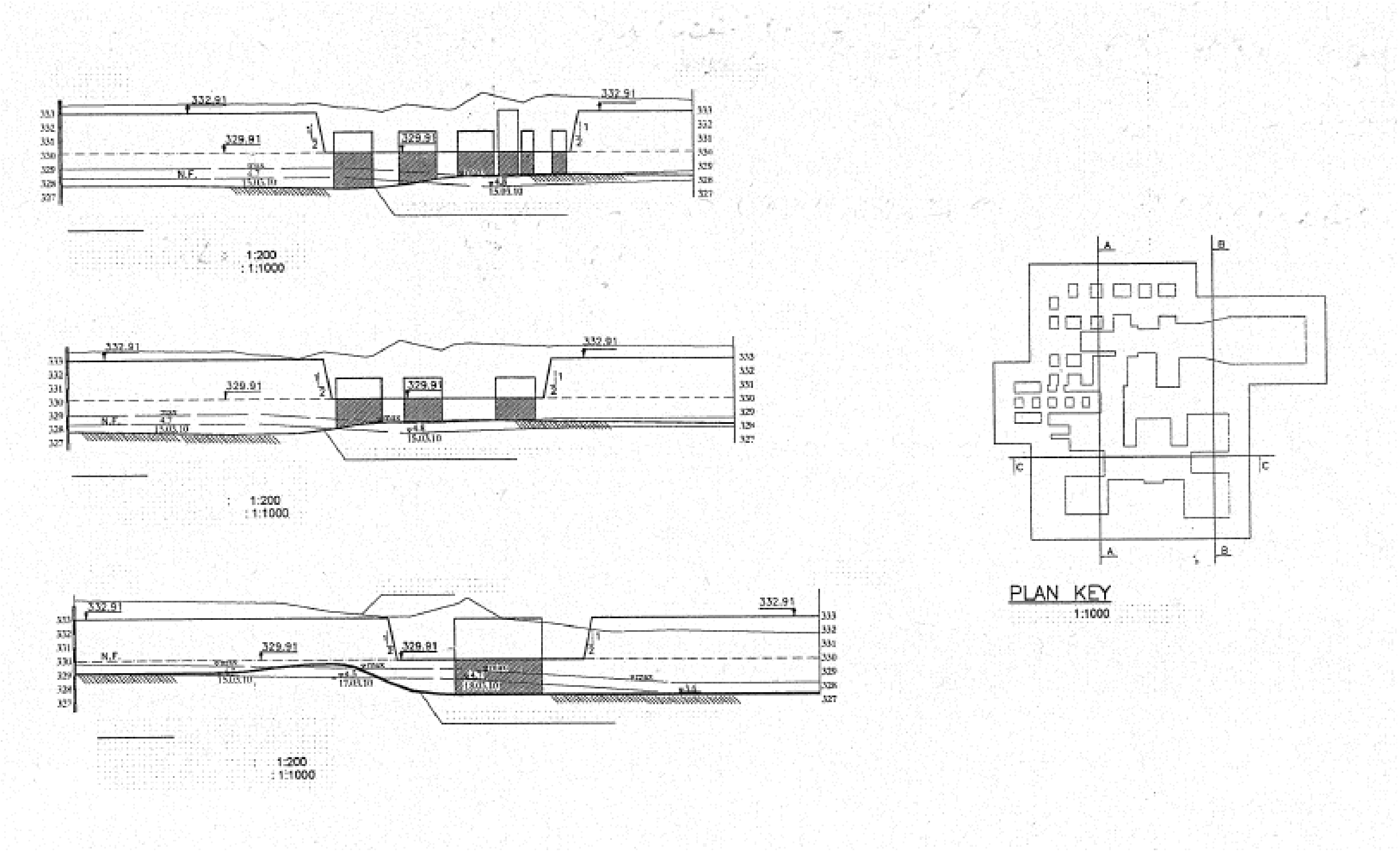
The existing Navoi thermal power plant depends on a mixtured of the once-through cooling method and the cooling tower cooling method using the cooling water supplied from the Zarafashan River. However, the water of the Zarafashan River is characterized by poor water quality. High maintenance costs and labor are required to repair the trouble caused by deposition of scales inside the condenser heat exchanger tube.
Further, the mechanical draft air cooling method has an advantage in that the use of cooling water is not required. However, the mechanical draft air cooling method has a disadvantage in that the plant performance deteriorates by the increase in the pressure of exhaust gas in the steam turbine.
Therefore, we would like to adopt the mechanical draft cooling tower cooling method as the CCCGP No.2 cooling method, where makeup water is supplied from the Zarafashan River after pre-treatment.

4.1.3.9 Foundation design

The soil quality at the planned CCCGP No.2 construction site is relatively good. For the major structures of the adjacent CCCGP No.1, the foundation structures are built directly without using any pile.
The foundation of the major structure of CCCGP No.2 in close proximity to CCCGP No.1 is considered to be based on the direct foundation structure, the same as that of the major structure of CCCGP No.1. When the type of CCCGP No.2 structure foundation is to be determined, a

detailed ground survey of the planned CCCGP No.2 construction site will be implemented. The foundation type will be determined after detailed designing has been performed based on the result of this survey.

Figure 4.1.3-2 illustrates the major structures of CCCGP No.1 and the cross section of soil.



Source: SJSC Uzbekenergo

Figure 4.1.3-2 Section of main structures and soil stratum

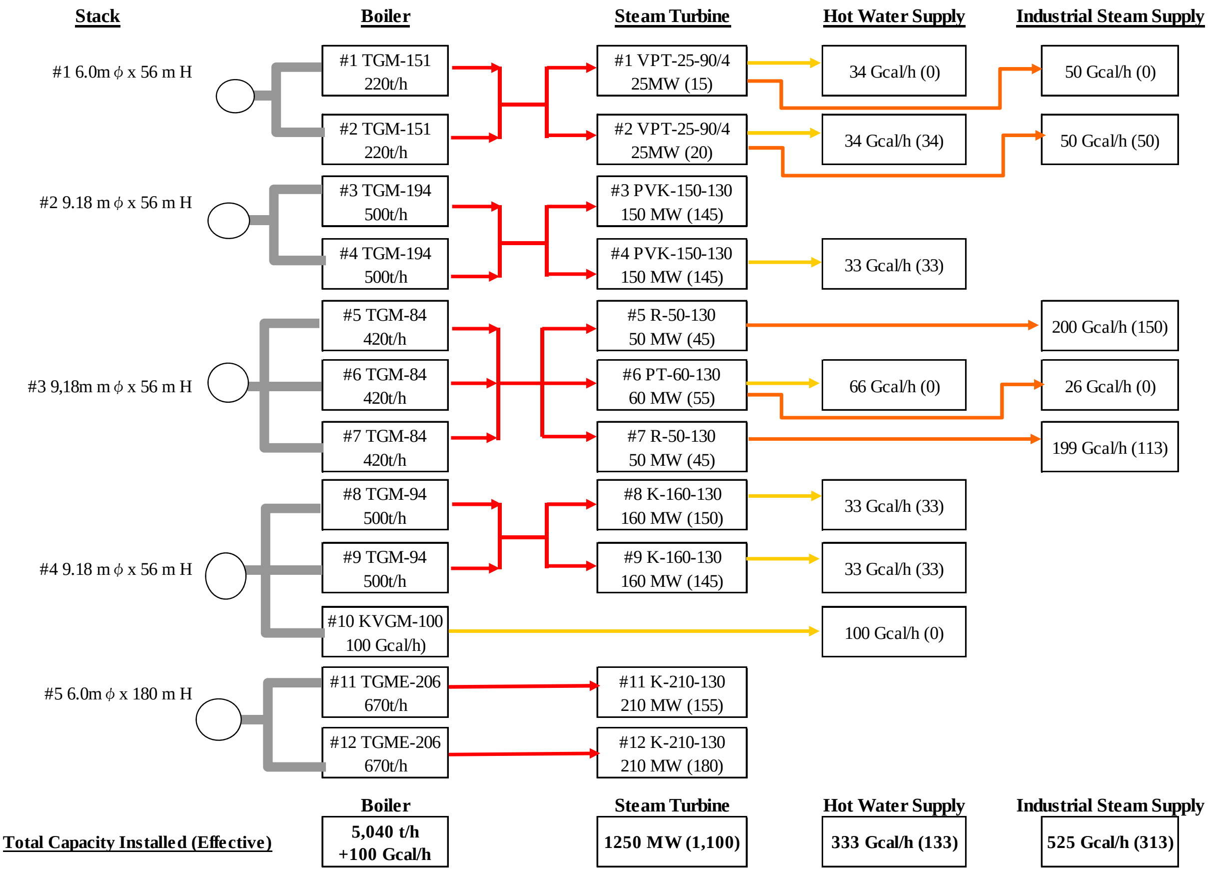
4.2 Existing facilities

4.2.1 Overview of the existing equipment in Navoi Thermal Power Station

(1) System configuration

The overview of the existing power and heat supply system of Navoi Thermal Power Station is as shown in Figure 4.2.1-1. The Power Station is consisted of 12 boilers and 11 steam turbines. No. 1 through No. 9 boilers and steam turbines, which are heat and electricity cogeneration type units, have their common main steam lines with adjacent unit(s) and the number of operating units is changed according to power and heat demand, resulting in high operational reliability. No. 10 boiler is installed for the purpose of hot water heating. On the other hand, No. 11 and 12 units are used exclusively for electricity generation. Five sets of stacks are installed for the 12 boilers. Flue gas ducts from two or three boilers are connected to each stack. The equipment in Navoi Thermal Power Station consists of electricity generation plants as well as steam supply system for neighboring industries and hot water supply system for district heating.

Figure 4.2-1 Heat and power supply system of Navoi Thermal Power Station



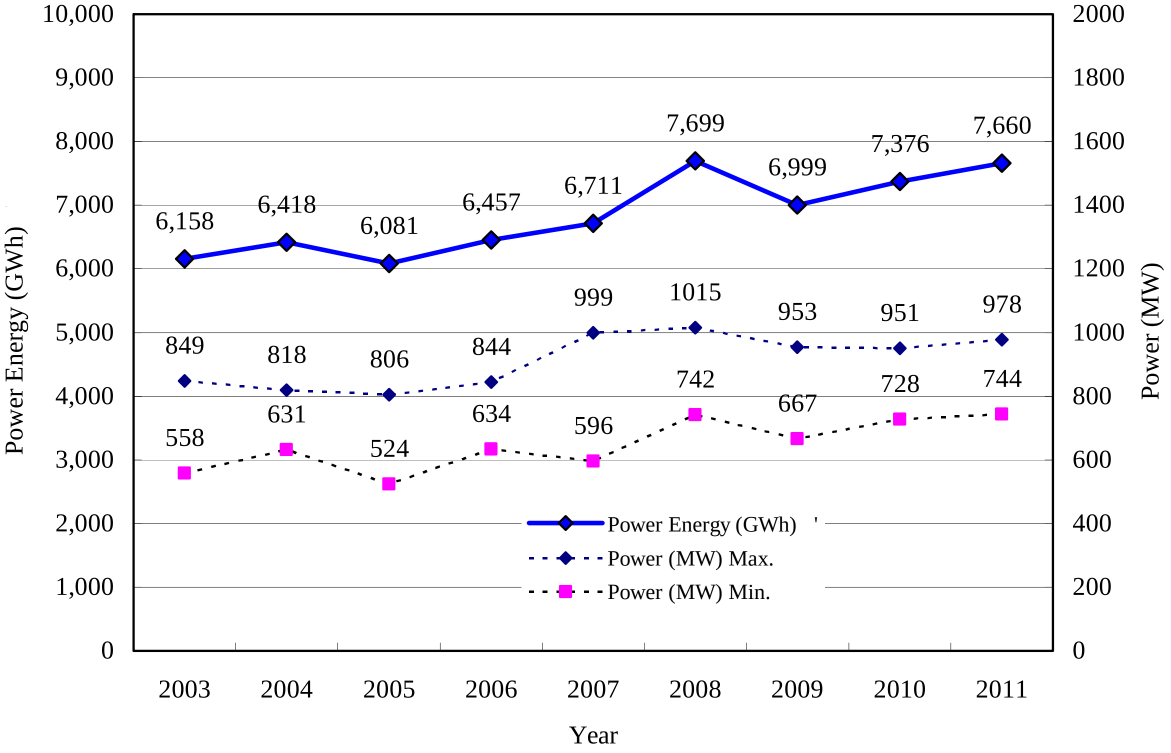
Source: SJSC Uzbekenergo

Figure 4.2.1-1 Heat and power supply system of Navoi Thermal Power Station

(2) Electric power supply

Navoi Thermal Power Station is the central plant in Navoi city, and is bearing the electric power supply to local residents and surrounding factories.

The transition of annual power generation (MWh) as well as the transitions of electric power (MW) of this plant for the past ten years is shown in Figure 4.2.1-2. The annual electric power generation was increasing by 2.5 to 3.3 % a year constantly from 2003 to 2011. Like the annual power generation, the maximum and minimum electric powers were also increased steadily.



Source: SJSC Uzbekenergo

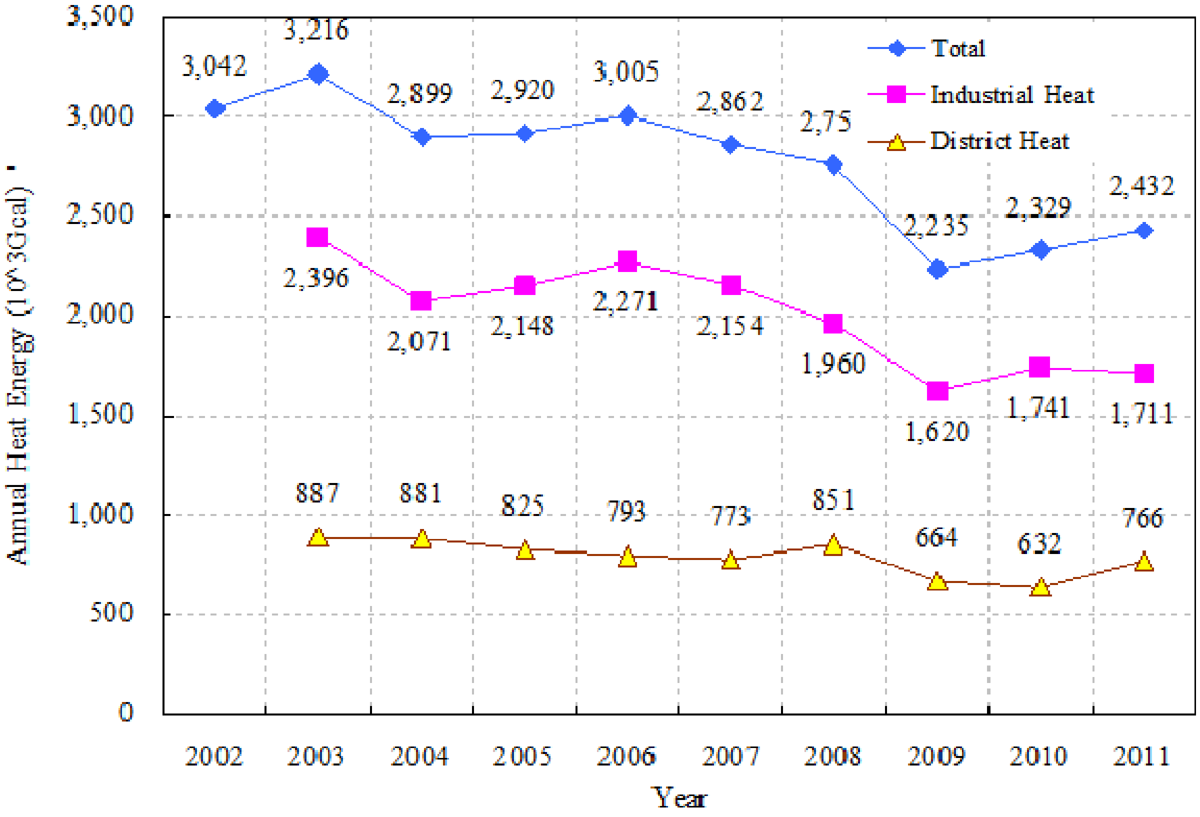
Figure 4.2.1-2 Annual power generation and max/min power for the past ten years

(3) Industrial steam and hot water supply

Navoi Thermal Power Station supplies not only electric power but also industrial steam for neighboring factories and hot water for district heating. Since it is the one and only supplier of these heat energies in the area, the Navoi Power Station has become indispensable for the important heat sources. The heat produced in the power station is in the form of steam and hot water. Steam is sent to neighboring factories, and hot water is sent to each home in Navoi city.

The heat currently supplied by steam from Navoi Thermal Power Station is sent to two chemical factories at a distance of four kilometers from the power station. Annual supply quantity of industrial steam in 2011 is 1711 Tcal/year. The heat supply from hot water in 2011 totals 766 Tcal.

The annual heat supplies for the past ten years are shown in Figure 4.2.1-3. Unlike the electric power generation, the industrial steam supply and hot water supply are descending from 2003 through 2009, and from 2009 to 2011, they are stable or slightly increasing.



Source: SJSC Uzbekenergo

Figure 4.2.1-3 Annual industrial steam and hot water supply for the past ten years

(4) Supply pattern of power and heat

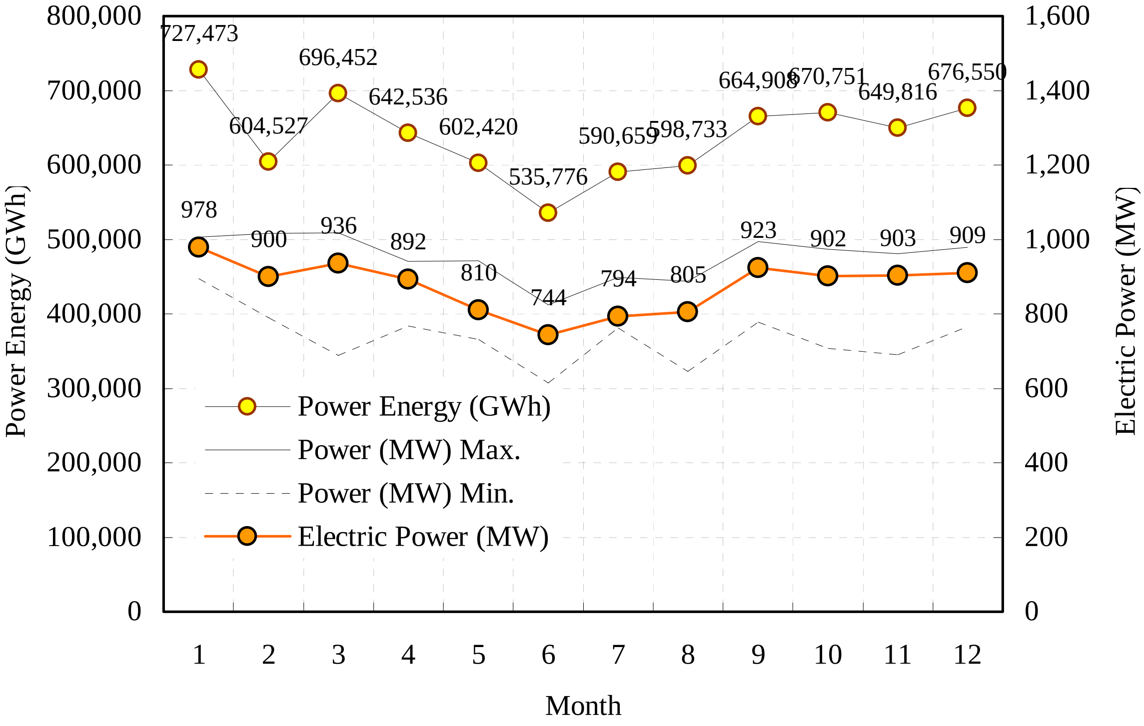
Table 4.2.1-1, Figures 4.2.1-4 and 4.2.1-5 show the record of monthly power and heat supply in Navoi Thermal Power Station in 2011. The amounts of electric power, industrial steam, and hot water supplied have a tendency of increasing in winter and decreasing in summer, but specifically the hot water supply shows the strongest tendency.

Total thermal efficiency of the existing facilities of Navoi Thermal Power Station is calculated as 63.7%. This data shows the ratio of the heat input (fuel consumption) and output (total supply of heat and power).

Table 4.2.1-1 Record of Monthly Power and Heat Supply in 2011

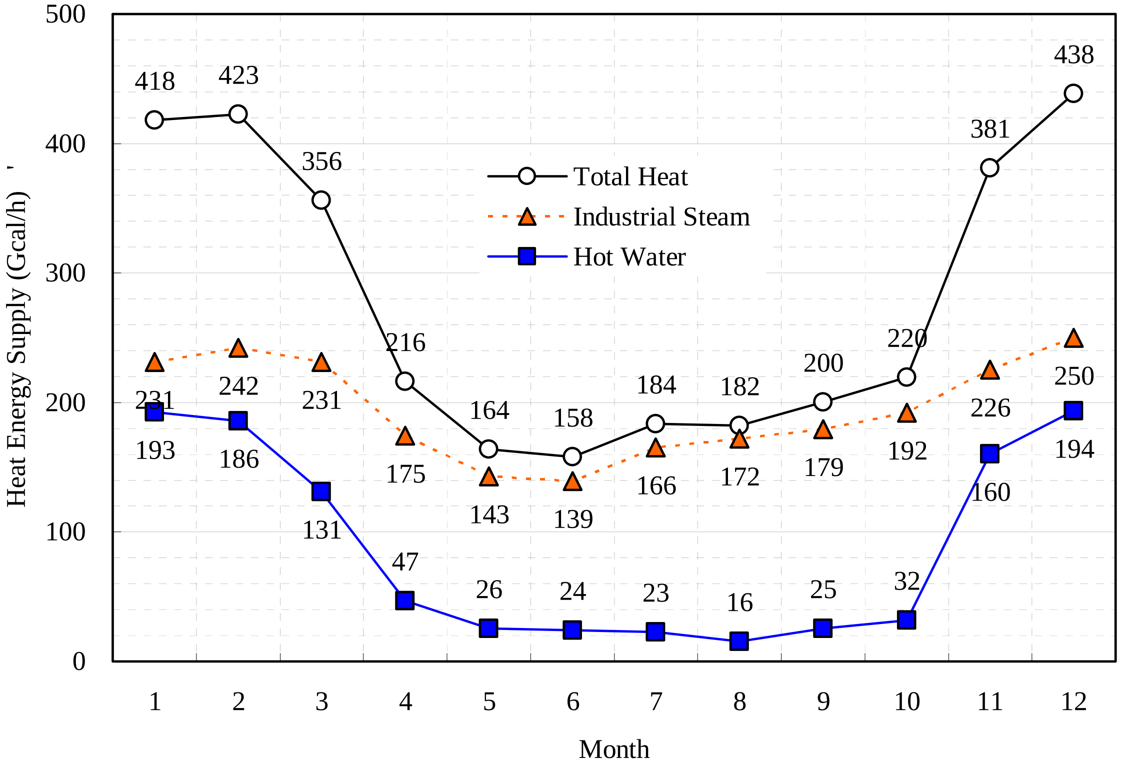
Month	Power (MW)		Power Energy (GWh)	Heat Energy (10^3Gcal)		
	Max.	Min.		District Heat	Industrial Heat	Total
1	1,006.0	894.4	727,473	143,426	172,226	310,897
2	1,016.2	789.4	604,527	124,827	162,945	283,939
3	1,018.6	688.2	696,452	97,464	171,979	264,992
4	940.2	768.0	642,536	33,896	125,709	155,724
5	943.2	731.5	602,420	19,125	106,366	122,087
6	824.8	615.2	535,776	17,244	100,327	113,807
7	897.2	761.8	590,659	17,085	123,149	136,533
8	887.8	645.3	598,733	11,551	128,049	135,548
9	993.7	778.5	664,908	18,332	129,075	144,341
10	973.5	707.9	670,751	23,763	143,056	163,373
11	961.7	690.4	649,816	115,407	162,402	274,509
12	979.0	765.0	676,550	144,062	186,103	326,209
Total	-	-	7,660,601	766,182	1,711,386	2,431,959

Source: SJSC Uzbekenergo



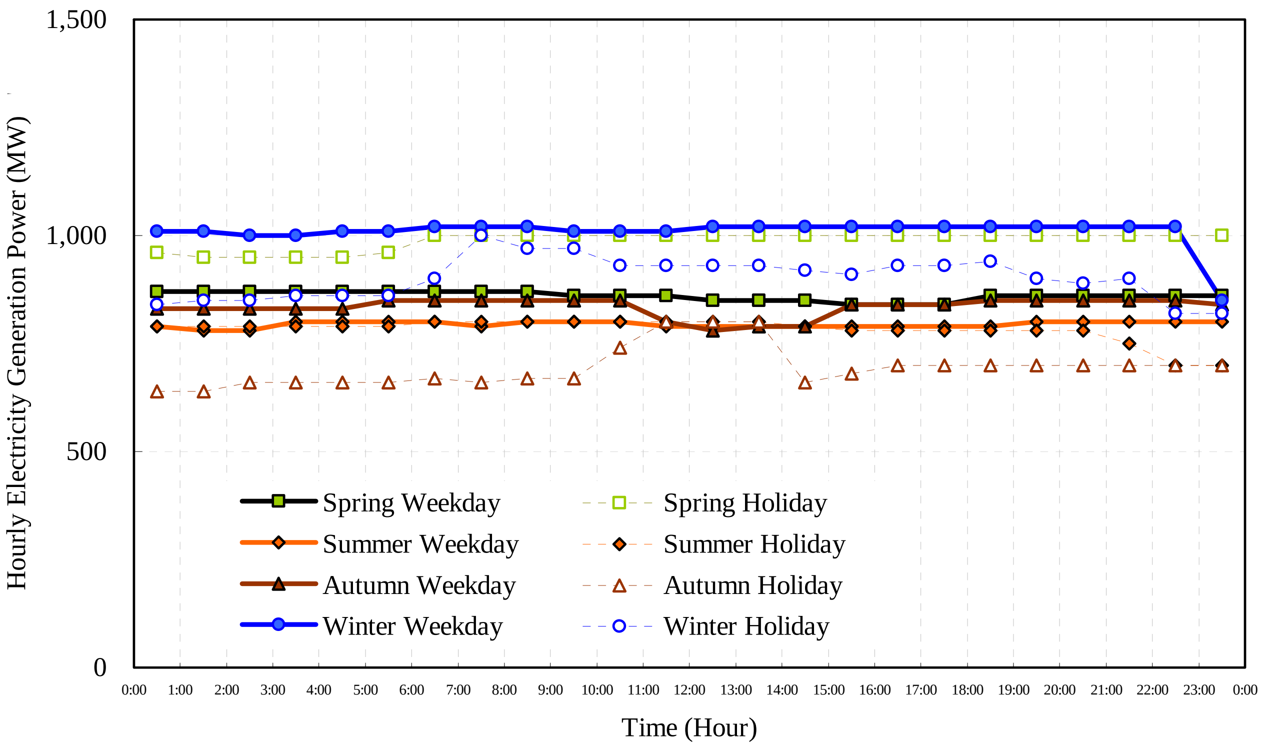
Source: SJSC Uzbekenergo

Figure 4.2.1-4 Monthly Electric Power Generation in 2011



Source: SJSC Uzbekenergo

Figure 4.2.1-5 Record of Monthly Heat Supply in 2011



Source: SJSC Uzbekenergo

Figure 4.2.1-6 Power supply pattern of Navoi Thermal Power Station in 2011

4.2.2 Situation of the existing equipment

Power generation units of Navoi Thermal Power Station consist of 12 boilers, 11 turbines, and 11 generators, and, the amount of rated generating steam is 5,040t/h and the rated power generation output is 1,250 MW. Operation of Unit No.1 was commenced in 1963 with 49 years having passed. Total operation hours of the units until now are about 220,000 to 360,000 hours, and degradation by operation is also progressing considerably in addition to aged deterioration.

Table 4.2.2-1 Operating Record of Navoi Thermal Power Plants

Unit №	Type of Plant	Installed (Effective) Capacity			Start-up Year	Operating Hours	Service Factor (%)(1)
		Power (MW)	Heat Supply (Gcal/hr)				
			Hot water	Industrial steam			
1	Heat and Power	25 (15)	34 (0)	50 (0)	1963	316,680	73.7
2	Heat and Power	25 (20)	34 (34)	50 (50)	1963	362,468	84.4
3	Power	150 (145)	-	-	1964	349,172	83.0
4	Heat and Power	150 (145)	33 (33)	-	1965	308,577	74.9
5	Heat and	50 (45)	-	200 (150)	1966	339,774	84.3

	Power						
6	Heat and Power	60 (55)	66 (0)	26 (0)	1967	311,919	79.1
7	Heat and Power	50 (45)	-	199 (113)	1971	314,936	87.6
8	Heat and Power	160 (150)	33 (33)	-	1968	326,414	84.6
9	Heat and Power	160 (145)	33 (33)	-	1969	317,604	84.3
10	Heat	-	100 (0)	-	1972	238,353	68.0
11	Power	210 (155)	-	-	1980	231,961	82.7
12	Power	210 (180)	-	-	1981	222,739	82.0
Total	-	1,250 (1,100)	333 (133)	525 (313)	-	-	-

Note (1): Averaged Service Factor (%) = The total operating hours/the total calendar hours from start-up to present time ×100.

Source: SJSC Uzbekenergo

Chapter 5 Fuel Supply Plan

5.1 Natural gas reserves in Uzbekistan

The proven natural gas reserves in Uzbekistan register an abundant figure of 1.603 trillion cubic meters (hereinafter referred to as "Tcm"), as of December 2011. This figure puts Uzbekistan in 5th place in the Eurasian region in terms of natural gas reserves, and in 25th place in the world. The gas fields are concentrated in the Amu Darya Basin in the southwest of the country and in the Central Ustyurt plateau west of the Aral Sea.
The following illustrates the transition of the proven natural gas reserves in Uzbekistan.

Table 5.1-1 Amount of proven natural gas reserves in Uzbekistan

Unit: Tcm

	At end 2001	At end 2010	At end 2011
Proved reserves	1.700	1.600	1.603

Source: BP Statistical Review of World Energy 2012

Table 5.1-2 shows the natural gas development projects in Uzbekistan. Projects are currently being implemented by the Russian companies and Asia companies based on the license of exploration for natural gas. The development of these gas fields are expected to increase the proven natural gas reserves in Uzbekistan.

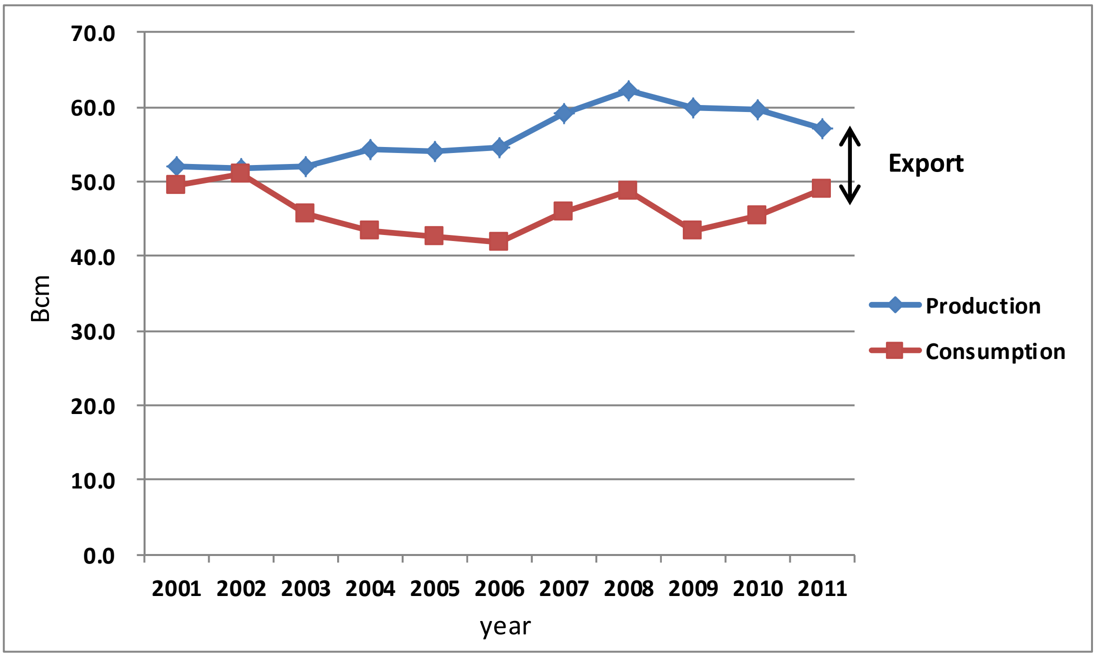
Table 5.1-2 Natural gas development projects in Uzbekistan

Field	Target production volume	Target reserves
Southwest Gissar and central Ustyurt region (7 fields)	3 Bcm/year	0.1Tcm
Western Ustyurt region (4 fields)	-	1Tcm
Khauzak and Kandym fields in Bukhara-Khiva and Gissar regions	4 Bcm/year	0.25Tcm
Aral Sea Surgli field	0.08 Bcm/year	-
Surkhandarya region Baisun field	2.2 Bcm/year	-
West Urga / Western Ustyurt region (3 fields)	0.7 Bcm/year	-

Source: Global Insight IEA and trade press

5.2 Production and consumption volumes of natural gas in Uzbekistan

The following describes the proven production and consumption volumes of natural gas in Uzbekistan during the period from 2001 to 2011. The natural gas production volume registers a gradual increase after 2001 to reach a peak value in 2008. This is followed by a slight decrease every year. The figure registered in 2011 was 57.0 Billion cubic meters (hereinafter referred to as "Bcm"). In the meantime, the consumption of natural gas in 2011 registers 49.1Bcm, the same value as that of 2001. Further, since Uzbekistan does not import natural gas, the difference between production and consumption volumes indicates the amount of export. The export volume in 2011 was 7.9 Bcm, accounting for approximately 14 percent of the total production.



Source: BP Statistical Review of World Energy 2012

Figure 5.2-1 Proven production and consumption volumes of natural gas (2001-2011)

Table 5.2-1 shows the R/P obtained by calculation based on the reserves of natural gas and its consumption. R/P ratios represent the length of time that those remaining reserves would last if production were to continue at the previous year's rate. It is calculated by dividing remaining reserves at the end of the year by the production in that year. The R/P is an index that shows how many years natural gas can be produced continuously in the future.

As a result, the R/P in Uzbekistan is 28.1 years as of present 2011, predicting a slight increase of over 26.8 years at the end of 2010. This is estimated to be due to an increase in the proven natural gas reverses achieved by the development of the gas field currently under way. When consideration is given to the continued development of gas fields in future, sufficient reserves can be estimated, even if the life time of this project is assumed to be 25 years.

Table 5.2-1 Reserves / Production Ratio of Natural Gas

	Unit	At end 2001	At end 2010	At end 2011
Proved reserves	Tcm	1.700	1.600	1.603
Production	Tcm	0.0520	0.0596	0.0570
R/P ratio	Year	32.7	26.8	28.1

Source: BP Statistical Review of World Energy 2012

5.3 Possibility of gas supply to CCCGP No.2

5.3.1 Verification of natural gas supply agreement

An agreement was signed with the JSC Uztransgaz for the supply of the natural gas of the Navoi Thermal Power Plant. This company is a subsidiary of the NHC Uzbekneftegaz in charge of overall management of the petroleum and gas sectors in Uzbekistan, and is mainly engaged in the transportation of natural gas. The agreement between the Navoi Thermal Power Plant and JSC Uztransgaz for the supply of natural gas is updated every year. The annual contracted volume for 2012 is 2,876.080million m^3N/year. This annual contracted natural gas volume is determined by the Navoi Thermal Power Plant estimating the amount of natural gas used in the following year and requesting the JSC Uztransgaz. This procedure allows the Navoi Thermal Power Plant to secure the natural gas on a priority basis.

At present, the Navoi Thermal Power Plant uses two types of natural gas; a natural gas containing sulfur content and a natural gas with minimal sulfur content. CCCGP No.2 is planning to use the natural gas with minimal sulfur content used in CCCGP No.1. The volume that can be supplied amounts to 419,300m^3N/h (450,000m^3/h at 20 degrees Celsius). The following describes the properties of the natural gas used in CCCGP No.1 and CCCGP No.2.

Table 5.3.1-1 Specifications of Natural Gas

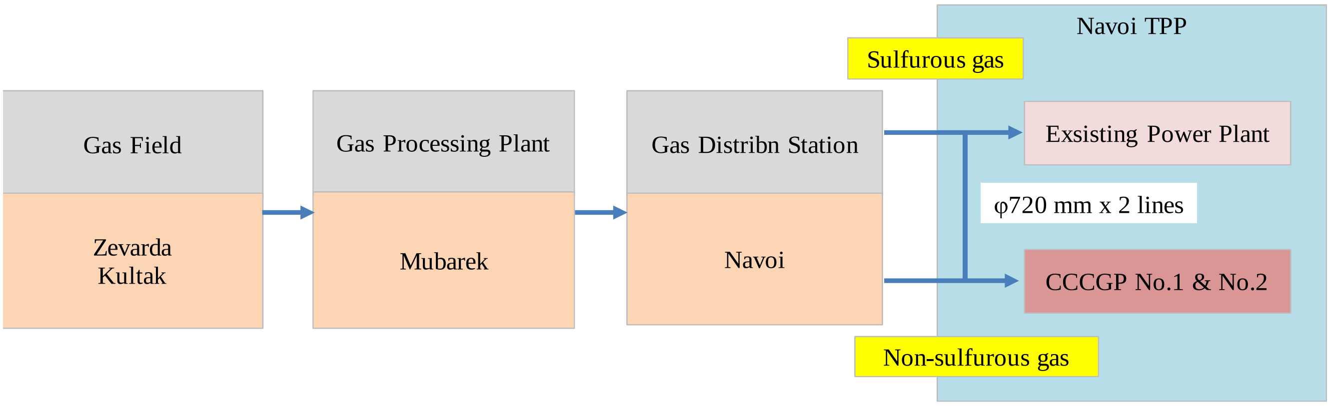
Components	Unit	Value
Methane	mol %	93.69
Ethane	mol %	3.07
Propane	mol %	0.64
i-Butane	mol %	0.09
n-Butane	mol %	0.14
i-Pentane	mol %	0.04
n-Pentane	mol %	0.04
Hexane	mol %	0.04
Oxygen	mol %	n/a
Nitrogen	mol %	0.42
Carbon dioxide	mol %	1.83
Total	mol %	100.00
Absolute water content	g/m^3	0.200
Lower Heating Value (20°C, 760mmHg)	kcal/m^3	8,150
Density (20°C, 760mmHg)	kg/m^3	0.722
Weight content of hydrogen sulfide	g/m^3	0.007
Weight content of mercaptan sulfur	g/m^3	0.016

Source: Navoi TPP

The natural gas supplied to the Navoi Thermal Power Plant is supplied from the Zevarda gas field and the Kultak gas field located in the Amu Darya Basin in the south of Uzbekistan. The following illustrates the locations of the Zevarda gas field and Kultak gas field, and the approximate transportation route from the gas fields to the Navoi Thermal Power Plant. The natural gas produced in the Zevarda gas field and Kultak gas field is refined in the Mubarek Gas Processing Plant (hereinafter referred to as "Mubarek GPP"), and is supplied to the Navoi Thermal Power Plant through the Navoi Gas Distribution Station (hereinafter referred to as "Navoi GDS").

Source: Study Team

Figure 5.3.1-1 Location of Natural Gas Field



Source: Navoi TPP

Figure 5.3.1-2 Approximate transportation route from the gas field to the Navoi Thermal Power Plant

5.3.2 Verification of the adequacy and feasibility of the project from the viewpoint of gas supply

Table 5.3.2-1 illustrates the consumption of the natural gas at the time of rated output in CCCGP No.1 and CCCGP No.2. The natural gas with minimal sulfur content used in CCCGP No.1 and CCCGP No.2 can be supplied in the volume of 419,300m^{3}N/h. By contrast, a total of natural gas consumption in CCCGP No.1 and CCCGP No.2 is 189,057m^{3}N/h. This shows that the natural gas can be supplied to the Navoi Thermal Power Plant.

Table 5.3.2-1 Hourly natural gas consumption of each unit at rated output

Unit : m^{3}N/h

Unit No	Fuel Consumption	Remark
CCCGP No.1	90,000	-
CCCGP No.2	99,057	-
Total	189,057	< 419,300 (450,000 m^3/h at 20 °C)

Source: Navoi TPP

Table 5.3.2-2 shows the annual consumption of natural gas in the Navoi Thermal Power Plant. The average annual consumption of natural gas in the last five years is 2,903.3 million m^{3}N. In the meantime, the annual natural gas consumption volumes at CCCGP No.1 and CCCGP No.2 are estimated at 720 million m^{3}N and 792.5 million m^{3}N, respectively, if the plants are operated for 8,000 hours every year. When the operation of CCCGP No.2 commences, existing power plants Nos. 3, 6, 8 and 10 in addition to existing power plants Nos. 1 and 2 will be shut down. When the natural gas with minimal sulfur content is used in all the units, the volume of natural gas that can be supplied every year will be 3,673 million m^{3}N (= 419,300 m^{3}N/year x 8,760h). By contrast, the annual consumption of natural gas in the Navoi Thermal Power Plant subsequent to commencement of commercial operation in CCCGP No.2 will be 3,361.5million m^{3}N/year. This indicates that the Navoi Thermal Power Plant can be supplied with natural gas.

Table 5.3.2-2 Annual natural gas consumption of each boiler unit for last 5 years

Unit : million m^3N/year

Unit No	2007	2008	2009	2010	2011	Average	Future
1	15.5	57.8	69.6	61.0	41.7	49.1	0
2	59.8	67.1	63.8	86.7	65.9	68.7	0
3	342.7	339.1	272.7	366.7	365.6	337.4	0
4	42.0	356.6	374.6	373.1	393.5	308.0	308.0
5	136.8	160.7	145.0	108.7	92.8	128.8	128.8
6	163.2	181.6	132.9	123.2	115.5	143.3	0
7	177.0	159.5	151.2	117.2	118.1	144.6	144.6
8	346.2	303.0	363.2	380.1	322.6	343.0	0
9	521.4	360.8	549.3	330.6	382.6	428.9	428.9
10	86.0	133.7	108.4	113.8	122.5	112.9	0
11	388.9	467.0	435.7	401.0	471.8	432.9	432.9
12	454.4	440.2	250.8	408.7	475.1	405.8	405.8
CCCGP No.1	-	-	-	-	-	-	720.0
CCCGP No.2	-	-	-	-	-	-	792.5
Total	2,733.9	3,027.1	2,917.2	2,870.8	2,967.7	2,903.3	3,361.5

Source: Navoi TPP

5.4 Order of priority for gas supply in the event of gas insufficiency at the Navoi Thermal Power Plant

There has been no public disclosure of the proven natural gas reserves and production volume in the Zevarda gas field and Kultak gas field that supply natural gas to the Navoi Thermal Power Plant. Since supply of electricity and hot water is essential to public life, the Government of Uzbekistan is required to ensure that natural gas is supplied to the Navoi Thermal Power Plant on a priority basis. Should there be any shortage of natural gas supply to the Navoi Thermal Power Plant, CCCGP No.2 will be operated on a priority basis as it is characterized by high power generation efficiency and capable of generating a greater volume of heat.

Chapter 6 Basic Design

6.1 Conceptual Design

6.1.1 Design Conditions

Design conditions shall be specified to complete the feasibility study for this project. However, all the detailed design conditions are still undecided because of less time schedule for discussion and study during the period of preparation of the feasibility study. Some design conditions may be tentatively specified or assumed at this feasibility study stage and will be revised or finalized at the further detailed design stage of this project. The following table 6.1.1-1 shows the design conditions necessary for completion of the feasibility study on Navoi Thermal Power Plant Modernization Project.

Table 6.1.1-1 Design Conditions and Specifications

Description	Conditions and/or Specifications	
(1) Basic Design Conditions	**Rated**	**Range**
a. Dry bulb temperature (°C)	15.0	- 28.0 to 47.0
b. Barometric pressure (kPa)	97.4	
c. Altitude (m)	332.91	
d. Relative humidity (%)	60.0	20.0 to 80.0
e. Wet bulb temperature (°C)	10.9	- 21.0 to 36.6
f. Temperature of cooling water	18.9	As per design of cooling tower
g. Type of fuel	Specified natural gas	
h. Supply pressure of natural gas at terminal point (MPa)	1.2	1.0 to 1.2
i. Supply temperature of natural gas at terminal point (°C)	15.0	-5.0 to 22.0
j. Export heat (Gcal/hr) 1.20 MPa steam	100	0.0 to Max.
0.25 MPa steam	100	0.0 to Max.
k. Maximum export heat capability	Dependable on model of GT, site ambient conditions, and design concept of manufacturer	
l. Conditions to define the maximum capability of bottoming and electrical systems	Ambient conditions: Dry bulb temperature 0.0 °C Relative humidity 20.0 % Wet bulb temperature -4.6 °C Duct firing temperature: 750 °C Export heat amount: 0 Gcal/hr	
m. Economically operable service life	25 years with reasonable repair and/or replacement of consumable and/or normal wear and tear parts	
n. Make-up water for process	Demineralized Zarafshan River water	
o. Make-up water for cooling tower	Treated Zarafshan River water	
p. Make-up water for hot water	Treated tap water	
(2) Specification of Main Equipment 1) Plant		
a. Type of shaft arrangement	Multi-shaft arrangement with a bypass	

Description	Conditions and/or Specifications
	stack
b. Type of control system	Micro-processor based DCS type
c. Type of steam turbine condenser cooling system	Mechanical draft wet type cooling tower
2) Gas turbine	
a. Supplier	Original equipment manufacturer
b. Application standards	ISO 3977 Part 3 or equivalent
c. Type of configuration	Open cycle, single shaft, heavy duty, Natural gas fired, cold end drive, axial exhaust type
d. Type of installation	Indoor installation with sound attenuation enclosure
e. Rating	Continuous base load rating with the load weighing factor of 1.0 for EOH calculation
f. Rotating speed	3,000 rpm
g. Type of coupling	Directly coupled with generator by integrated solid coupling
h. Shaft strength	To be designed to withstand the transient torque due to short circuit or out-of-phase synchronization, whichever is greater.
i. Temperature class	F-class with a wealth of commercial operating experience specified in Gas Turbine World Handbook 2010
j. Shaft lateral vibration	As per ISO 7919-Part 4 "Gas Turbine Sets"
k. Allowable speed variation range on continuous load operation	3,000 rpm ±3 %
l. Dry low NOx combustion system for natural gas	Yes
m. Inlet air cooling system	No
n. Type of starting device	- A synchronous generator/motor with a thyristor frequency converter or - A squirrel cage motor with a torque converter
o. Compressor on-line and off-line cleaning device	Yes
p. Wet type air compressor cleaning device	Yes
q. Pre-heater of natural gas fuel	As per manufacturer's option
r. Type of inlet air filter	Three stage or self-cleaning type with a dust removal efficiency of more than 99.5 % for ISO fine dust.
s. Bypass stack	Yes
3) HRSG	
a. Application standard	Relevant ASME Pressure Vessel Codes or equivalent
b. Type of configuration	Lateral or vertical gas flow type with evaporation drum and natural circulation
c. Type of cycle	Triple-pressure, reheat
d. Flue gas exit temperature	Higher than 100 °C in consideration of

Description	Conditions and/or Specifications
	impact on environment
e. Type of installation	Indoor installation
f. Supplementary duct firing temperature	Max. 750 °C
g. Flue gas stack	Stand alone type fabricated with steel plates supported by steel structures with a height of 90 m in consideration of impact on environment
h. Flue gas velocity at flue gas stack exit	not more than 25 m/s
4) Steam turbine	
a. Application standard	ISO 14661 or equivalent
b. Type of configuration	Two (2)-casing, three (3)-admission, two (2)-extraction, sliding pressure, full condensing, downward exhaust, low pressure turbine end drive type
c. Type of cycle	Triple-pressure, reheat
d. Type of pressure control of extraction steam	Internal pressure control type
e. Type of installation	Indoor installation with sound attenuation cover
f. Rotating speed	3,000 rpm
g. Minimum allowable speed variation range on continuous load operation	3,000 rpm ±3 %
h. Type of coupling	Directly coupled with generator by integrated solid coupling
i. Shaft strength	To be designed to withstand the transient torque due to short circuit or out-of-phase synchronization, whichever is greater.
j. Shaft lateral vibration	As per ISO 7919-Part 2 "Large Land-based Steam Turbine Generator Sets"
k. Steam bypass	Yes
l. Condenser	Shell and tube surface cooling type
5) Cooling tower	
a. Type	Mechanical draft wet type
b. Heat load	218 Gcal/hr
c. Circulating water flow rate	27,300 m^3/hr including water for auxiliary systems
d. Approach temperature	8 °C
e. Cooling range	8 °C
f. Temperature difference	5 °C
6) Hot water production system	
a. Type	Heat exchange type between water and Extracted steam
b. Capacity	100 Gcal/hr
c. Hot water supply temperature	110 °C
d. Return water temperature	55 °C
7) Generators	
a. Application standard	IEC 60034-3 or equivalent
b. Type	Horizontally mounted, cylindrical rotor, rotating field, air or hydrogen cooled

Description	Conditions and/or Specifications
	synchronous type
c. Rated voltage	22 kV
d. Type of exciter	Static or brushless type
e. Coil temperature rise	IEC B class
f. Insulator temperature limit	IEC H class
8) Main transformer	
a. Type of cooling	Oil natural and air forced type
b. Primary voltage	22 kV
c. Secondary voltage	220 kV
(3) Operational Requirements	
1) Type of operation	
a. Type of basic operation	Continuous base load operation
b. Anticipated range of plant controllable power load without steam bypass	30 to 100 %
c. Speed droop power load operation	Yes
d. Constant power load operation irrespective of heat export demand	Yes
e. Frequency control operation	Yes
f. Constant gas turbine inlet temperature operation	Yes
g. Gas turbine simple cycle operation	Yes
h. Operation manner	LCD operation in remote control room with keyboard and mouse
i. Blackout start	No
o. Isolated operation of gas turbine from network in an any emergency	Yes
2) Time required for start-up to full power after pushing start-up button (time for purge and synchronization is not included)	
a. Cold start	At longest __4__hours
b. Warm start	At longest __3__hours
c. Hot start	At longest __2__hours
d. Very hot start	At longest __1__hours
3) Voltage rating of auxiliary equipment power source	
a. AC power	
a) _200 kW≦P_	AC__6,300__V
b) __3__kW≦P<__200__ kW	AC__400__V
c) P<__3__kW	AC__200__V
b. DC power	DC__220__V
c. Lighting	AC__200__V
d. Instrumentation	AC__200__V
e. Control power	AC__100__V
f. Control signal	DC__24__V
(4) Basal Conditions for Arrangement of Main Equipment	
1) Gas and steam turbine generators	To be installed inside the gas and steam turbine separate buildings with a

Description	Conditions and/or Specifications
	ventilation system, an overhead travelling crane and laydown bay for carrying in and out of bulky components and maintenance spaces.
2) HRSG	To be installed inside building on the same center axis as the gas turbine generator.
3) Arrangement of axes of gas and steam turbine generators	To be arranged in parallel
4) Gas turbine air filter	To be located as high as possible above ground level
5) Control and monitoring and electrical equipment	To be located in the rooms integrated with the gas turbine building
(5) Emission	
1) Exhaust gas emissions (dry, 15 % O_2 basis) (75 - 100% load of gas turbine under duct firing operation over specified all ambient conditions)	
a. NOx	< 51 mg/Nm^3 as NO_2 (25 pomp)
b. SOx	Changeable depending on sulfur content
c. CO	< 10 ppmv
d. PM_{10}	< 5 mg/Nm^3
2) Airborne noise emission on steady state conditions without background noise	
a. Sound pressure level at a height of 1m on station boundary	< 55 dB(A) : Daytime < 45 dB(A) : Nighttime
b. Sound pressure level at a height of 1 m and a distance of 1m from equipment or enclosure	< 80 dB(A)
(6) Properties of Fuel Gas	
a. Temperature	Max. 22 °C, Min. -5 °C
b. Pressure	1.0 ~ 1.2 MPa
c. Composition	
	Performance point
CH_4	93.69 %
C_2H_6	3.07 %
C_3H_8	0.64 %
i-C_4H_{10}	0.09 %
n-C_4H_{10}	0.14 %
i-C_5H_{12}	0.04 %
n-C_5H_{12}	0.04 %
C_6H_{14}	0.04 %
O_2	n/a
N_2	0.42 %
CO_2	1.83 %
Total	100.00 %
d. Absolute water content	0.200 g/m^3
e. Lower Heating Value (20°C, 760mmHg)	8,150 kcal/m^3
f. Density (20°C, 760mmHg)	0.722 kg/m^3
g. Weight content of hydrogen sulfide	0.007 g/m^3
h. Weight content of mercaptan sulfur	0.016 g/m^3

Description	Conditions and/or Specifications
(7) Make-up Water for Bottoming System	
a. Type of water	Demineralized river water
b. Temperature	10 °C to 30 °C
e. Available flow rate	Max. 300 m^3/hr
(8) Make-up Water for Hot Water	
a. Type of water	Tap water
b. Temperature	10 °C to 30 °C
e. Available flow rate	Max. 180 m^3/hr
(9) Make-up Water for Mechanical Draft Cooling Tower	
a. Type of water	Treated river water
b. Temperature	10 °C to 30 °C
e. Available flow rate	Max. 560 m^3/hr
(10) Operation and Maintenance	
1) Gas turbine	Spare parts including consumed parts for two (2) years operation are to be included in scope of supply
2) Other equipment	ditto
3) Training of O & M staff at EPC contractor's works	Yes
4) Three(3) resident engineers (mechanical, electrical and control) of EPC contractor during defect liability period for operation and maintenance support	Yes
5) Inspection intervals of gas turbine on an EOH basis	
a. Combustion inspection	Min. 8,000 hours
b. Turbine inspection	Min. 16,000 hours
c. Major inspection	Min. 48,000 hours
6) Inspection intervals of other equipment	As per recommendation of manufacturer
7) Replacement intervals of filter elements	More than 8,000 hours for ISO fine dust
(11) Guarantee Items	
1) Plant net power output with specified heat export	Yes
2) Plant net thermal efficiency with specified heat export	Yes
3) Exhaust gas emissions at 75 - 100 % load of gas turbine at max. duct firing temperature over all specified ambient conditions	
a. NOx	Yes
b. CO	Yes
c. PM_{10}	Yes
4) Airborne noise emissions on steady state conditions under all specified operating conditions	
a. Sound pressure levels at a height of 1 m on the station boundary limit	Yes
b. Sound pressure level at a distance of 1m and a height of 1 m from equipment or	Yes

Description	Conditions and/or Specifications
noise attenuation cover	
5) Successful completion of two (2) weeks Reliability run	Yes
6) Shaft vibration of gas and steam turbine sets based on related ISO standards during the reliability run	Yes

6.1.2 Outline of Cogeneration System

This plant is a combined cycle cogeneration plant (CCCGP) which concurrently produces both heat and power energies. The plant is comprised of the following main components; a gas turbine, a gas turbine generator, an HRSG with a supplementary duct firing facility, a steam turbine, a steam turbine generator, a fuel gas compressor station, a water pre-treatment facility for exported steam, a water pre-treatment facility for export hot water and a hot water production system.

The plant shaft configuration is of multi-shaft type where the gas and steam turbine shafts are separated.

The gas turbine is of a large capacity F class type which is available in the world market with a wealth of commercial operating experience.

The HRSG is of triple-pressure and reheat cycle type. The F class gas turbine is commonly coupled with the triple-pressure and reheat cycle HRSG to elevate the plant thermal efficiency.

Without any supplementary firing in the duct between the gas turbine exhaust and the inlet to the HRSG, the heat and power requirements for this project could not be met by the bottoming system coupled with F class gas turbine. For the purpose, this plant is equipped with the supplementary duct firing system.

The steam turbine is of triple-admission, dual-extraction of medium and low pressure steams and condensing type. The medium pressure steam is extracted from the IP steam turbine section and exported to adjacent companies as industrial steam as it is. The low pressure steam from the LP steam turbine section is supplied to the production system of the district hot water. The pressure of the extracted steam is controlled with the PC valve integrated in the steam turbine.

The hot water production system consists of a water storage tank, water pre-treatment facilities, deaeration facility, steam to water heat exchangers and a hot water storage tank.

The Figure 6.1.2-1 is the simplified schematic diagram of the cogeneration system of this project.

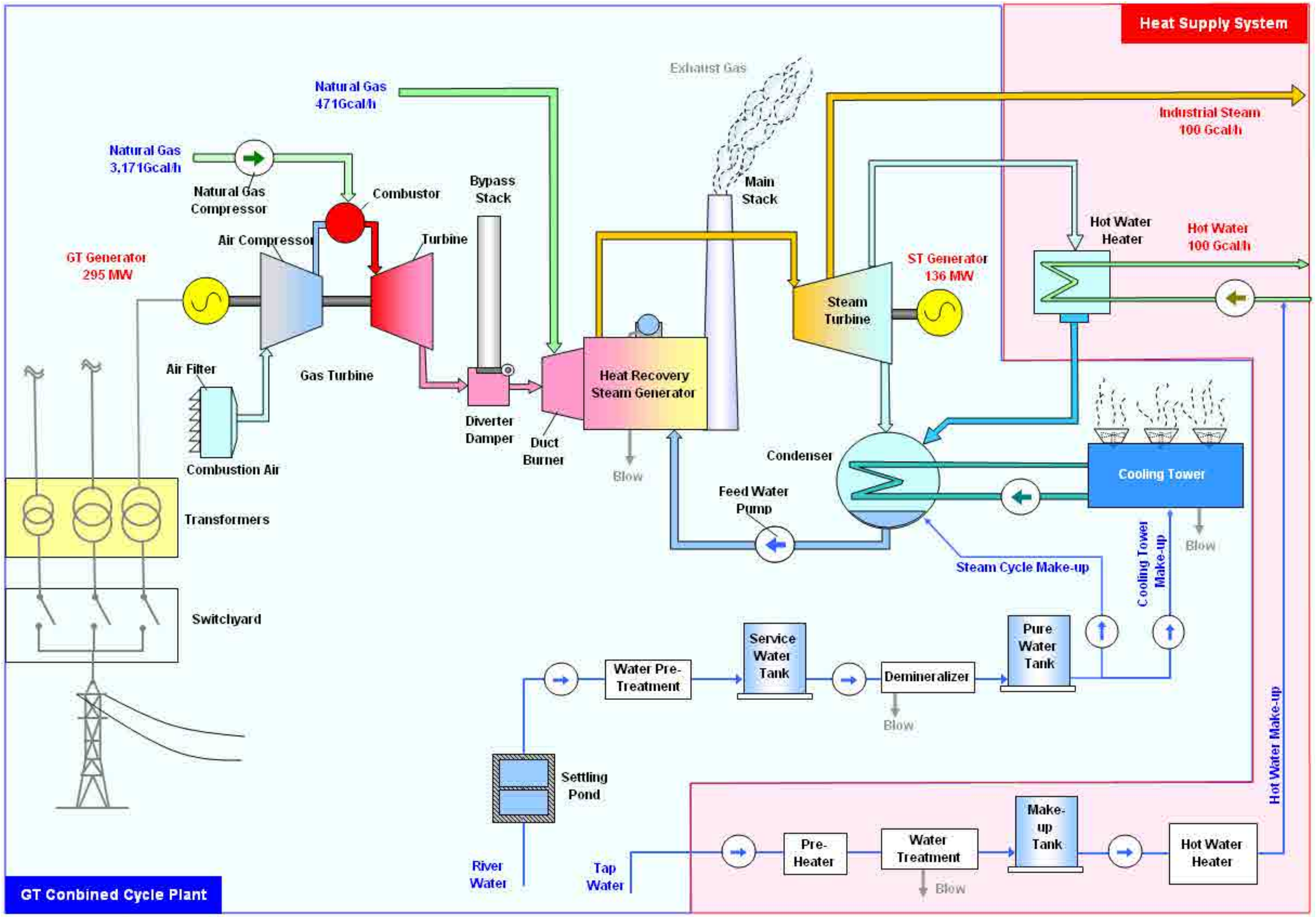


Figure 6.1.2-1 Simplified Schematic Diagram of Total Cogeneration System

6.1.3 Study on Shaft Configuration

(1) Type of Shaft Configuration

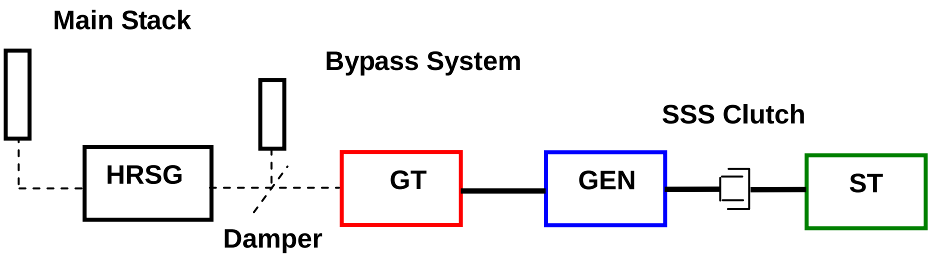
The following is a comparison study on the type of the shaft configuration of the combined cycle cogeneration plant (hereinafter to be collectively called as CCCGP) comprised of the one (1) gas turbine, one (1) heat recovery steam generator with a duct supplementary firing system (hereinafter to be collectively called as HRSG), one (1) steam turbine and generator(s).

Basically, there are two (2) types of shaft configurations. One is called single-shaft configuration where the gas turbine, a steam turbine and a generator are connected on the same shaft. The other is called multi-shaft configuration where the gas turbine/generator shaft and the steam turbine/generator are separate.

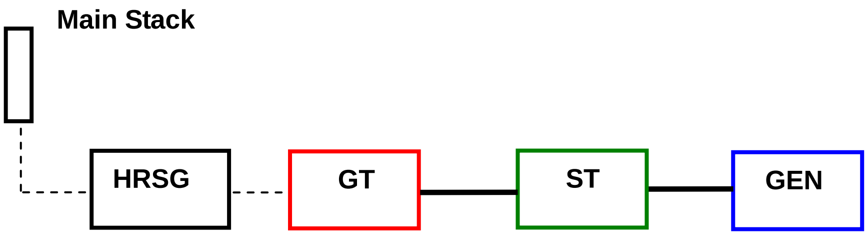
The single-shaft configuration is classified into two (2) types of configurations depending upon whether with or without a SSS clutch and a bypass system. In case of the former configuration, the power train is arranged in order of the gas turbine, the generator and the steam turbine. The SSS clutch is of auto-engagement and disengagement type and is located between the generator and the steam turbine. In case of the latter configuration, the power train is commonly arranged in order of the gas turbine, the steam turbine and generator.

In case of the multi-shaft type, two (2) types of CCCGP configurations with and without the bypass system could be considered. These four (4) types of CCCGP shaft configurations are as depicted on the Figure 6.1.3-1.

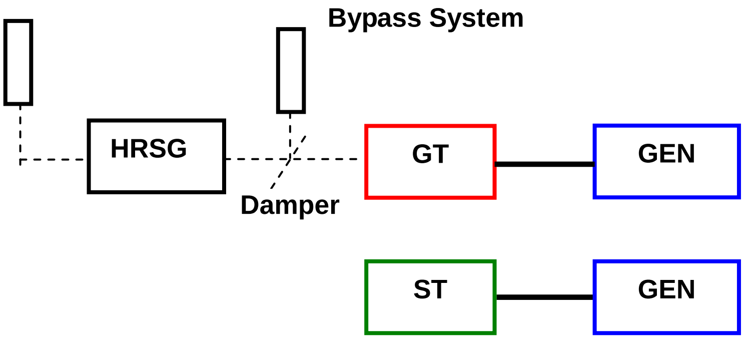
Single-Shaft CCCGP with SSS Clutch and Bypass System



Single-Shaft CCCGP without SSS Clutch



Multi-shaft CCCGP with Bypass System



Multi-shaft CCCGP with Bypass System

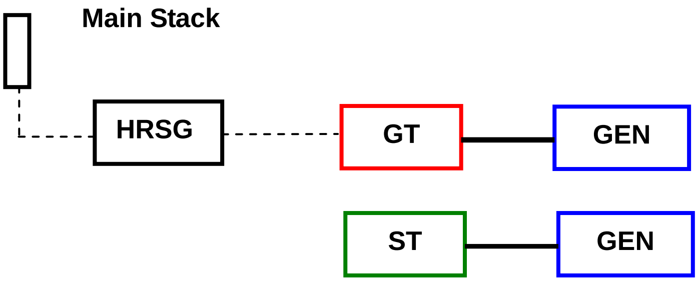


Figure 6.1.3-1 Shaft Configuration

As shown above, in case of the single-shaft CCCGP, one (1) large capacity generator common to both gas and steam turbines is employed. While in the case of the multi-shaft CCCGP, two (2) generators are individually employed for the gas and steam turbines. In this case, one is the plant configuration with the bypass system consisting of a bypass stack and a damper, which are installed between the gas turbine and HRSG to allow for the gas turbine/generator to operate as a simple cycle. The other one is the plant configuration without the bypass system.

The comparison study is performed from the viewpoints of thermal efficiency, operational flexibility, operability, start-up steam and auxiliary power requirement, application experiences, operating reliability, maintainability, installation footprint area requirement, construction cost, generation cost and transportation among above four (4) types of CCCGP shaft configurations.

(2) Plant Thermal Efficiency

The single-shaft configuration is equipped with one (1) larger size generator, while two (2) smaller sizes of generators are employed in the multi-shaft configuration. In case of the configuration with the bypass system, the leakage from the bypass system of the exhaust gas will influence the plant efficiency. It is reportedly said that the leakage over the life time of the plant is 0.5 to 1.5 %. This means that the steam turbine efficiency drops by 0.5 to 1.5 %. Consequentially, the thermal efficiency of the plant with the bypass system drops by 0.17 to 0.50 % compared with the plant without it. Therefore, the plant thermal efficiencies of the four (4) configurations are as estimated below considering that the efficiency of the larger capacity generator is higher by some 0.1 %. The heat loss due to the clutch is considered to be negligibly small.

Type of Configuration	SS CCCGP w SSS and BS	SS CCCGP w/o SSS and BS	MS CCCGP w BS	MS CCCGP w/o BS
Plant Thermal Efficiency (%)	Δ0.17~0.50	100	Δ0.27~0.60	Δ0.1

Where,

SS CCCGP w SSS and BS	Single-shaft CCCGP with Clutch and Bypass System
SS CCCGP w/o SSS and BS	Single-shaft CCCGP without Clutch and Bypass System
MS CCCGP w BS	Multi-shaft CCCGP with Bypass System
MS CCCGP w/o BS	Multi-shaft CCCGP without Bypass System

(3) Operational Flexibility

In case of the single-shaft CCCGP without the clutch, the plant could not be operated unless the components of the gas turbine, the heat recovery steam generator, steam turbine and the generator are all healthy. While, the single-shaft CCCGP with the clutch and bypass system could be operated on a simple cycle mode with isolation of the steam turbine by disengaging the clutch even if any components of the bottoming system consisting of a HRSG, a steam turbine and a steam turbine generator is out of order due to any reasons. The exhaust gas from the gas turbine can be discharged into atmosphere through the bypass system.

In case of the multi-shaft configuration, if the bypass system is equipped, the gas turbine/generator could be operated as a simple cycle similarly to the single-shaft configuration CCCGP with the clutch.

Unless the bypass stack is equipped, the plant behaves as if it were of a single-shaft type without the clutch. However, the plant could be operated on a simple cycle mode by exporting some parts of the generated steam externally as heat energy and dumping the remaining parts into the condenser in the situation whereby the HRSG and the condenser are both in healthy conditions even if the steam turbine is out of service. This is a specific feature of a multi-shaft configuration without a bypass stack.

Thus, the CCCGP with the bypass system, whichever the shaft configuration is, will be more flexible in terms of operability than without the bypass system. There is always no difference in terms of operational flexibility between both types of shaft configurations without the bypass system.

(4) Operability

The CCCGP could be operated only by automatic adjustment of the fuel flow into the gas turbine and the operation cycle of start-up, steady operation and shut-down could be fully automated irrespective of the type of the shaft configuration. The SSS clutch is of a self-shift and synchronous type. There is, therefore, no essential difference with the operability between both types of shaft configurations. The operational sequence of the multi-shaft CCCGP may be slightly complicated compared to the single-shaft CCCGP because of more numbers of components.

(5) Start-up Steam and Auxiliary Power Requirements

In case of the multi-shaft CCCGP or the single-shaft CCCGP with the clutch, the gas turbine can be started up together with the HRSG separately from the steam turbine/generator. After a certain period of the time, the necessary steam for start-up can be available from the HRSG and then the steam turbine/generator can be started up with own steam for flow passage cooling and gland sealing.

In case of the single-shaft configuration without the clutch, however, the steam for the flow passage cooling and gland sealing of the steam turbine which must be started up together with the gas turbine is required from any external sources. For the purpose, any auxiliary steam from the existing boilers or a standalone auxiliary boiler will be needed.

In case of the single-shaft configuration without the clutch, the power requirement for the starting device is approximately 2.5 % of the gas turbine power output, while it is approximately 2.0 % in cases of other three (3) types of CCCGPs.

There is no difference with the auxiliary power requirements among the types of CCCGPs except for the starting device of the shaft train.

(6) Application Experiences

There are many application experiences with both shaft configuration types of CCCGPs. It is understood that both types of shaft configurations are technically feasible without any technical difficulties.

(7) Operating Reliability

The plant operating reliability of each type of CCCGP could be evaluated by the plant reliability factor to be calculated with the reliability factors of the main equipment which are assumed as shown below:

Gas turbine:	A1 = 97.5 %
Bypass system:	A2 = 97.5 %
Heat recovery steam generator:	A3 = 98.0 %

Steam turbine:	A4 = 98.5 %
Gas turbine generator and transformer:	A5 = 99.0 %
Steam turbine generator and transformer:	A6 = 99.0 %
SSS clutch:	A7 = 99.0 %

The following calculations are the theoretically calculated plant operating reliabilities on an hourly basis operation of the single-shaft CCCGP without the clutch as $PORH_S$ and with the clutch as $PORH_{SS}$, the multi-shaft CCCGP without the bypass system as $PORH_M$ and the multi-shaft CCCGP with the bypass system as $PORH_{MB}$.

$PORH_S = A1 \times A3 \times A4 \times A5 = 0.9318 = 93.18\ \%$

$PORH_{SS} = A1 \times A2 \times A3 \times A4 \times A5 \times A7 + A1 \times A2 \times A5 \times A7 \times (1-A3 \times A4) = 0.9317 = 93.17\ \%$

$PORH_M = A1 \times A3 \times A4 \times A5 \times A6 = 0.9224 = 92.24\ \%$

$PORH_{MB} = A1 \times A2 \times A3 \times A4 \times A5 \times A6 + A1 \times A2 \times A5 \times (1-A3 \times A4 \times A6) = 0.9411 = 94.11\ \%$

By the above calculation results, the following relationship could be predicted among operating reliabilities on an hourly basis of the four (4) types of CCCGPs.

$PORH_{MB}\ (94.11\ \%) > PORH_S\ (93.18\ \%) = PORH_{SS}\ (93.17\ \%) > PORH_M\ (92.24\ \%)$

It is found from this relationship that the plant operating reliability of the multi-shaft CCCGP with the bypass system ($PORH_{MB}$) is slightly higher compared with other types of CCCGPs.

The PORH is the plant operating reliability on a basis of the operating hours. However, when the gas turbine is operated on a simple cycle mode, the plant total power output could be reduced to some two thirds. Therefore, the plant operating reliability on a basis of power energy (PORE) has to be evaluated. The PORE of each shaft configuration can be calculated as shown below.

$PORE_S = A1 \times A3 \times A4 \times A5 = 0.9317 = 93.17\ \%$

$PORE_{SS} = A1 \times A2 \times A3 \times A4 \times A5 \times A7 \times (2/3+1/3 \times 0.995) + A1 \times A2 \times A5 \times A7 \times (1-A3 \times A4) \times 2/3$
$= 0.9194 = 91.94\ \%$

$PORE_M = A1 \times A3 \times A4 \times A5 \times A6 = 0.9224 = 92.24\ \%$

$PORE_{MB} = A1 \times A2 \times A3 \times A4 \times A5 \times A6 \times (2/3+1/3 \times 0.995) + A1 \times A2 \times A5 \times (1-A3 \times A4 \times A6) \times 2/3$
$= 0.9257 = 92.57\ \%$

Therefore, the priority order of the PORE of each shaft configuration can be expressed as shown below:

$POREs\ (93.17\ \%) > PORE_{MB}\ (92.57\ \%) > PORE_M(92.23\ \%) \geq POREss\ (91.94\ \%)$

(8) Maintenance Cost

Compared with the single-shaft CCCGP, the multi-shaft CCCGP is equipped with additional components such as a generator, a step-up transformer, a lubricating and control oil systems, a bypass stack, a bypass stack silencer, and an exhaust gas damper. Therefore, it is envisaged that the maintenance of the multi-shaft CCCGP needs more man-hour requirement and is costly.

(9) Footprint Area for Instruction

As mentioned in the previous paragraph, since the multi-shaft CCCGP is equipped with more facilities than the single-shaft CCCGP, more footprint area is needed for their installation. In addition, the space utilization effect is inferior because the gas turbine/generator and steam turbine/generator are severally installed. It is foreseen from our experiences that the footprint area for installation of the multi-shaft CCCGP power train is more or less larger by 15 ~ 25 % than the single-shaft CCCGP depending upon installation of the bypass system.

The larger footprint area for installation of equipment means larger amount of civil, architectural and erection works, which in turn means higher cost. The Figure 6.1.3-2 and 6.1.3-3 attached hereon show the typical plan drawings of single-shaft CCCGP power train without the clutch and multi-shaft CCCGP power train with bypass system using F-class gas turbine.

In case of the single-shaft CCCGP power train with the clutch and bypass system, the length in the longer direction is supposed to be longer by some 20 m compared to the layout shown with Figure 6.1.3-1. Therefore, the footprint area for installation comes close to that of the multi-shaft CCCGP power train with bypass system.

(10) Phased Construction

The multi-shaft configuration with the bypass system has the special feature that the phased construction can be available. The completion time of the gas turbine package is normally faster than the bottoming system, which means that it will be put into commercial operation in advance. This feature is more advantageous for the project which must cope with steeply increasing power demand.

(11) Construction Cost

The multi-shaft CCCGP is constituted of a higher number of components than single shaft CCCGP as mentioned in previous paragraphs. Therefore, it is easily predicted that its construction cost will be higher compared with the single-shaft CCCGP. According to the construction estimation results by computer software, the relative cost difference between them could be shown below as referential values for this study.

SS CCCGP w/o SSS and BS	100 % (Base)
SS CCCGP w SSS and BS	plus 2.2 %
MS CCCGP w/o BS	plus 4.2 %
MS CCCGP w BS	plus 6.1 %

(12) Power Generation Cost

The power generation costs of other three (3) types of CCCGPs against the SS CCCGP w/o SSS and BS could be calculated as shown below. In this calculation, the heat supply amount shall not be considered.

1) Fuel cost

Fuel cost (fuel consumption) is proportional to the plant operating reliability on an hourly basis. Therefore, fuel costs of other three (3) types of CCCGPs against the SS

CCCGP w/o SSS and BS are estimated as tabulated below:

SS CCCGP w SSS and BS	minus 0.01 % (=93.18 – 93.17)
MS CCCGP w/o BS	minus 0.93 % (=93.17 – 92.24)
MS CCCGP w BS	plus 0.98 % (=93.17 – 94.11)

2) Capital recovery cost
The capital recovery cost proportional to the construction cost can be estimated as shown below referring to the results in the previous sub-section (11). Therefore, the relative values of other shaft configurations against the SS CCCGP w/o SSS and BS can be expressed as below:

SS CCCGP w SSS and BS	plus 2.2 %
MS CCCGP w/o BS	plus 4.2 %
MS CCCGP w BS	plus 6.1 %

3) Power energy sales
The power energy sale is proportional to the plant operating reliability on a power energy basis. Therefore, the relative values of other shaft configurations against the SS CCCGP w/o SSS and BS can be expressed as below:

SS CCCGP w SSS and BS	minus 1.24 % (=93.18 – 91.94)
MS CCCGP w/o BS	minus 0.94 % (=93.18 – 92.24)
MS CCCGP w BS	minus 0.61 % (=93.18 – 92.57)

Therefore, the power generation cost of SS CCCGP w SSS and BS against the SS CCCGP w/o SSS and BS can be calculated to be higher by 2.7 % (= ((1–0.0001)×1/3 + (1+ 0.022)×2/3))/(1 – 0.0124) – 1.0) = 0.027). In this case, the ratio of the fuel cost to the capital recovery cost is assumed to be 1.0 to 2.0. The generation costs of other two (2) types of CCCGPs can be similarly calculated. The calculation results are as follows:

MS CCCGP w/o BS	plus 3.5 %
MS CCCGP w BS	plus 5.0 %

(13) Inland Transportation

The site is located adjacent to the existing Navoi Thermal Plant in the southern part of Uzbekistan, referred to as a double-locked country. It is not easy to transport the large dimensioned and heavy cargos to the site.

The weights and dimensions of the generator and step-up transformer are different due to type of the shaft configuration, while other components are common irrespective of shaft configuration. The capacity size of the single-shaft CCCGP is larger by approximately 1.5 times that of the multi-shaft CCCGP. The heaviest cargo is deemed to be the generator being common for both types of shaft configurations depending upon the design of manufacturers. The gas turbine can be transported split into three (3) components of a rotating part, a lower casing and an upper casing. Therefore, the generator which is the heaviest cargo in case of the single shaft configuration is heavier by 1.5 times that of the multi-shaft configuration. Therefore, as far as the transportation is concerned, multi-shaft configuration is advantageous.

In this connection, the Study Team is told that large dimensioned and heavier cargos of No. 1 CCCGP have been transported to the site by road from Turkmenbasi on Caspian Sea coast in Turkmenistan. The similar transportation manner will be employed for No. 2 CCCGP, if the shaft configuration is of multi-shaft type.

(14) Study Summary and Recommendation

The study results described above are summarized in the Table 6.1.3-1 on the next page. The yellow colored cell shows that the shaft configuration of the cell is preferred in terms of the related comparison item. As shown in this table, the single shaft configuration without the clutch and bypass stack has the most priorities in terms of comparison items.

The multi-shaft configuration with the bypass stack has many priorities next to the shaft configuration stated above. This configuration is ranked highest in terms of the operating reliability on an operating hourly basis and is advantageous in more comparison items than the multi-shaft configuration without the bypass stack. In addition, this shaft configuration has a specific feature allowing for phased construction and that simple cycle operation can be done. For such reasons as stated above, the Study Team recommends the multi-shaft configuration with the bypass stack.

Table 6.1.3-1 Summary of Comparison Study Results on Shaft Configuration of CCCGP

Comparison Item		**Single-shaft CCCGP**		**Multi-shaft CCCGP**	
		Without a SSS clutch	**With a SSS clutch and a bypass stack**	**With a bypass stack**	**Without a bypass stack**
1. Thermal Efficiency		Base (100 %)	Δ 0.17 ~Δ 0.50 %	Δ 0.27 ~Δ 0.60 %	Δ 0.10 %
2. Operational Flexibility (Simple Cycle Operation)		Base (No)	More flexible (Yes)	More flexible (Yes)	Similar (No)
3. Operability		Base	Similar	Slightly complicated due to operation of more equipments	
4. Start-up Requirement	**Steam**	External auxiliary steam	Own steam	Own steam	External auxiliary steam
	Power for Starting device	App. 2.5 % of GT capa.	App. 2.0 % of GT capa.	App. 2.0 % of GT capa.	App. 2.0 % of GT capa.
5. Application Experiences		Base	Similar	Similar	Similar
6. Operating Reliability	**PORH**	Base (100 %)	Δ 0.0 %	+ 0.9 %	Δ 0.9 %
	PORE	Base (100 %)	Δ 1.2 %	Δ 0.6 %	Δ 0.9 %
7. Maintenance Cost		Base	Similar	Slightly higher because of more equipments	
8. Footprint Area of Power Train		Base (100 %)	+ 15 %	+ 25 %	+ 10 %
9. Phased Construction		No	No	Yes	No
10. Construction Cost		Base (100 %)	+ 2.2 %	+ 6.1 %	+ 4.2 %
11. Power Generation Cost		Base (100 %)	+ 2.7 %	+ 5.0 %	+ 3.5 %
12. Inland Transportation		Base	Similar	Better	Better

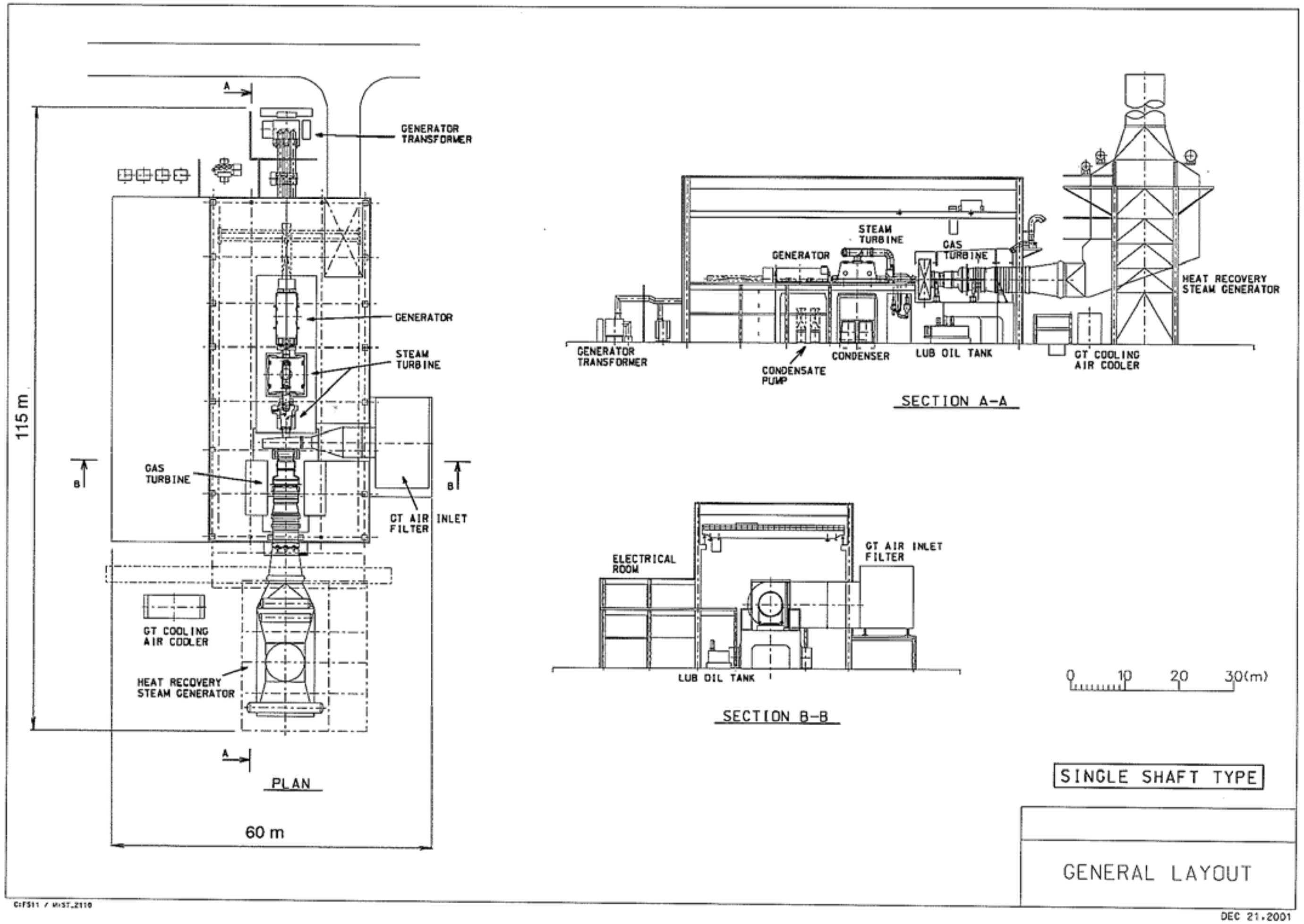


Figure 6.1.3-2 Typical Layout of Single-shaft Arrangement Combined Cycle Power Plant

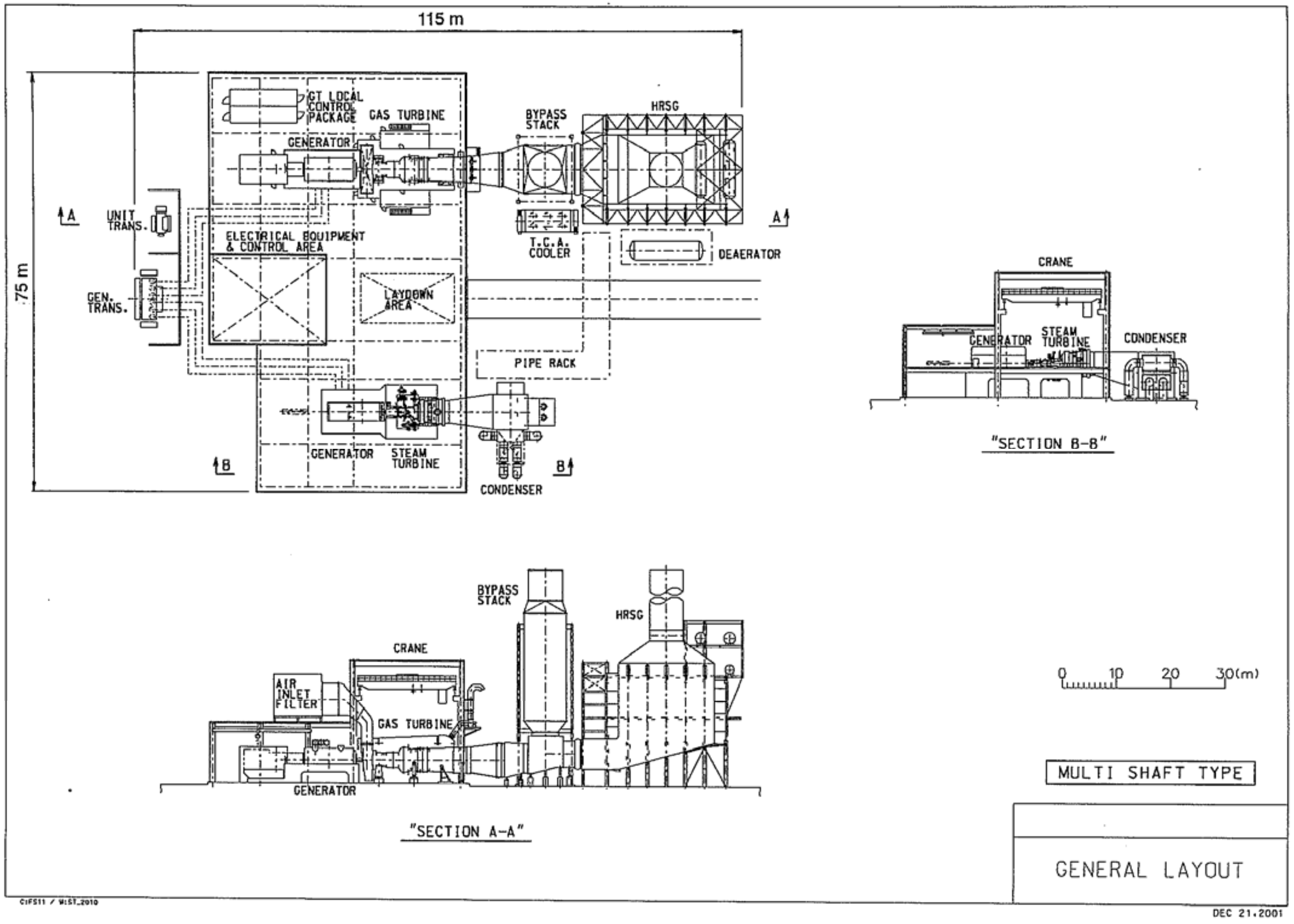


Figure 6.1.3-3 Typical Layout of Multi-shaft Combined Cycle Power Plant

6.1.4 Candidate Gas Turbine and Performance

(1) Design Codes and Standards

The gas turbine system shall be basically designed as per ISO 3977-3 “Gas turbines-Procurement-Part3: Design requirements” and ISO 21789 “Gas turbine applications-Safety” or equivalent codes and standards.

(2) Candidate Models

The gas turbine is the most important component to influence the operating reliability of the combined cycle power plant therefore is required to possess the highest operating reliability. Unlike custom-made steam turbines which are designed every time an order is placed, the gas turbine is normally of manufacturer’s standard design to avoid the longer development time before delivery and depress the cost due to custom design. It is a normal practice to select the proper gas turbine models to meet the requirements for the project among the standard lineups of gas turbine manufacturers.

The performance specifications of standard design gas turbines which are available in the present market are annually published as the Gas Turbine World Handbook. Their performances are not specified on the site conditions, but normally on ISO conditions. In the case of this project, the power output as a combined cycle cogeneration plant (CCCGP) can be supposed to be 400 MW plus 10 % and minus 10 % under a heat supply amount of 200 Gcal/hr on the site conditions of ambient dry bulb temperature of 15 ºC, 60 % relative humidity, and barometric pressure of 97.4 kPa on natural gas. To meet these heat and power capacity requirements, the gas turbine size shall be larger than F class model inclusive with a power output capacity from 280 MW to 320 MW on ISO and natural gas even if the supplementary duct firing is permitted up to 750 °C.

The gas turbine is always in the process of development and its design parameters are upgraded year by year. Nowadays, the gas turbine models with higher performances than F class of which turbine inlet temperature is specified to be of approximately 1,300 °C are made public. However, they are not always of matured machines with sufficient commercial operating hours. Therefore, confirmation is required as to whether the latest version of the same model which the manufacturer may offer has the commercial operating experience sufficient to verify the operating reliability of the model. For the purpose of confirmation of such a situation, the proposed gas turbine shall meet the criteria requirements. The criteria requirements shall be such that the proposed gas turbine shall be the machine technically similar to the reference gas turbines of which commercial operation experiences at the end of 2012 are as described below:

- The total successful commercial operating hours of at least three (3) reference gas turbines shall be not less than 20,000hours.
- The successful commercial operating hours of the unit having the longest operating hours out of them shall be more than 12,000 hours.

The data and information on the commercial operating experiences of the reference gas turbines shall be testified with the written confirmation letter(s) undersigned by the plant owner(s). The above criteria requirements and the time to be specified may be revised depending upon the progress of this project.

In consideration of above statements, therefore, the Study Team decided that the models of the gas turbines to be employed for this project shall be of F class as specified in the Gas Turbine Handbook 2010.

In selection of the candidate models of gas turbines, it shall be considered that the proposed gas turbine can be operated in a simple cycle mode taking into account that it may be put into a commercial operation in advance to solve the impending shortage of power supply in Uzbekistan. For example, Alstom can supply two (2) types of GT26 gas turbines. One is GT26 with an air quench cooler, while the other is GT26 with a once through cooler that uses the steam to cool the air extracted from the air compressor for internal cooling of hot parts of the gas turbine. Therefore, the latter type of GT26 gas turbine cannot be operated in a simple cycle mode without cooling medium of steam from the bottoming system. For such a reason, the GT26 gas turbine where ambient air is used as a cooling medium can be chosen as a candidate CCCGP for the plant.

General Electric (GE) has the two (2) versions of F class gas turbines of 9FA and 9FB to meet the requirements for this project. However, the former is inferior to meet the heat and power capacity specified above. Therefore, the latter model shall be excluded from consideration for this study.

Ansaldo Energia used to be a technical licensee of Siemens AG to manufacture the some models of gas turbines developed by Siemens AG. However, Ansaldo Energia has reportedly concluded the technical license agreement with Siemens AG and presently manufactures four (4) models of gas turbines according to previously mentioned Handbook. One (1) of them is the AE94.3A model which meets the power requirement of this project. This model can conceivably be one derived from the model SGT-4000F of Siemens.
From such circumstances, the five (5) models of gas turbines shall be eventually selected as candidate models for this project with the performance values shown in the Table 6.1.4-1 on ISO conditions as per said Handbook:

Table 6.1.4-1 Performance Figures of Five (5) Candidate Models of Gas Turbines

Model of Gas Turbine	GT26 (AQC)	AE94.3A	9FB	M701F4	SGT5-4000F
ISO base rating (MW)	292.1	285.0	288.2	312.1	292.0
Efficiency (%)	38.50	39.57	37.85	39.30	39.83
Pressure ratio	34.7	17.7	18.0	18.0	18.2
Air flow rate (kg/s)	653.2	689.9	655.1	702.6	692.2
Exhaust gas temp (°C)	615.0	572.0	641.7	596.7	577.2

(3) Gas Turbine Manufacturers

According to said Handbook, the gas turbine manufacturer(s) of above five (5) models of gas turbines are as tabulated in the following Table 6.1.4-2:

Table 6.1.4-2 Manufacturers of Five (5) Models of Gas Turbines

Model of Gas Turbine	OEM Manufacturer
GT26 (AQC)	Alstom
AE94.3A	Ansaldo
9FB	GE
M701F4	Mitsubishi
SGT5-4000F	Siemens

To make technical support for sophisticated gas turbine machine possible, the gas turbine shall be supplied by an original equipment manufacturer (OEM) of the gas turbine to be proposed who has developed, designed, manufactured and will be able to technically and substantially support its maintenance.

6.1.5 Plant Performance by Candidate Gas Turbine

The CCCGP No.2 shall be comprised of the candidate gas turbines which are available in the present world market and the bottoming systems suited to them. Therefore, the plant performance shall be naturally changeable depending upon the type of candidate gas turbine employed for this project. This section describes the plant performance calculated for every candidate gas turbine.

(1) Basic Calculation Conditions

Such basic calculation conditions as ambient conditions and export heat amounts are as specified as the site rated conditions in Table 6.1.1-1.

(2) Candidate Models of Gas Turbines

The plant performance shall be calculated for five (5) candidate models of gas turbines which are shown in the table 6.1.4-2 of the previous section. Their performances are as specified in the table 6.1.4-1.

(3) Type of Bottoming System

The combined cycle plant is a combination of “Topping System” of a gas turbine with Brayton Cycle and “Bottoming System” of a boiler-steam turbine with Rankine Cycle. The performance and construction cost of the combined cycle plant is changeable due to how the bottoming system is designed for the given Topping System of the gas turbine. In general, the more complicated the cycle of the bottoming cycle is, the higher the performance and construction cost of the combined cycle plant. In case of employment of the F class gas turbine, the triple-pressure and reheat cycle bottoming system is commonly employed. The two (2) types of steams for export are extracted from the intermediate and low pressure sections of the steam turbine respectively.

(4) Design Parameters of Bottoming System

The cycle parameters of the bottoming system may be individual depending upon design concepts of manufacturers of combined cycle power plants to be proposed. The design parameters of the bottoming system shall be specified in consideration of expected operating range of the heat export. For the purpose of calculation of heat and mass balances of five (5) candidate models of CCCGPs, therefore, the cycle parameters of the bottoming system are preliminarily assumed as tabulated below.

• GT Inlet Air Cooling System	Not considered
• GT Inlet Pressure Loss	1.0 kPa
• GT Exhaust Back Pressure	3.5 kPa
• Exhaust Gas Leakage from Bypass Stack	0.5 %
• Cycle Configuration	Triple-pressure, reheat
• HRSG	
Type	Supplementary Duct Firing Type
Temperature after Duct Firing	750 °C

• Steam Conditions at Turbine Throttle Valve Inlet at Rated Site Ambient Conditions	
HP Steam	
Temperature	565 ^{o}C
Pressure	13.7 MPa (140.0 ata)
IP Steam	
Temperature	565 ^{o}C
Pressure	3.4 MPa (35.0 ata)
LP Steam	
Temperature	Mixed temperature of LP SH and IPT outlet steams
Pressure	0.49 MPa (5.0 ata)
• Pre-heater Inlet Temperature	60 °C
• Export Steam Conditions	
IP Steam	
Temperature	350 °C
Pressure	1.2 MPa
Energy	50 Gcal/hr
LP Steam	
Temperature	200 °C
Pressure	0.25 MPa
Energy	50 Gcal/hr
• Return Water Ratio	0 %
• Make-up Water Temperature	25 °C
• Condenser	
Temperature Difference	5^{o}C
Temperature	31.9 °C
Pressure	4.7 kPa
• Cooling System	
Type	Mechanical draft wet type cooling tower cooling system
Approach Temperature	8 ^{o}C
Cooling Range	8 ^{o}C
Cooling Tower Inlet Temperature	26.9 °C

(5) Heat and Mass Balance Calculation Results

The heat and mass balances of the combined cycle cogeneration plants for the five (5) candidate models of gas turbines are calculated based on the site rated conditions stated in the previous sub-section. The results are summarized as tabulated in the Table 6.1.5-1.

Table 6.1.5-1 Predicted Plant performance by Candidate Gas Turbine

Type of Model of Gas Turbine	GT26	AE94.3A	9FB	M701F4	SGT5-4000F
Plant Gross Power Output (MW)	393.9	396.0	397.4	431.0	403.2
GT Gross Power Output (MW)	272.3	265.7	273.8	295.1	272.2
ST Gross Power Output (MW)	121.6	130.3	123.6	135.9	131.0
IP Steam Heat Export (Gcal/hr)	100	100	100	100	100

Type of Model of Gas Turbine	GT26	AE94.3A	9FB	M701F4	SGT5-4000F
LP Steam Heat Export (Gcal/hr)	100	100	100	100	100
Plant Gross Power Output Efficiency (%)	48.0	47.8	48.8	48.7	48.2
Auxiliary Power Requirement (MW)	14.4	12.8	13.1	14.0	13.1
Plant Net Power Output (MW)	379.5	383.2	384.3	417.0	390.1
Plant Net Power Output Efficiency (%)	46.2	46.3	47.2	47.1	46.6
Plant Gross Thermal Efficiency (%)	75.4	74.9	76.3	74.1	75.0
Plant Net Thermal Efficiency (%)	73.6	73.5	74.7	72.5	73.5

As can be seen in the above table, the plant net power outputs of five (5) CCCGPs are estimated to range from 379.9 MW to 417.0 MW under the heat export of IP steam and LP steam of each 100 Gcal/hr on the specified calculation conditions stated above. Therefore, the plant net power output requirement in the bidding documents should be specified as follows in consideration of certain allowance.

“The plant net power output under the rated heat export on the site rated conditions shall be within the range of 400 MW plus 10 % and minus 10 %”
The plant net power output can be fully influenced by the supplementary duct firing temperature. In this case, the said temperature is tentatively specified to be 750 °C that is supposed to be the maximum allowable value. However, this value shall be finally specified by the HRSG manufacturer.

From the above table, the plant net thermal efficiencies are predicted to be higher than 72.5 % under the rated heat export on the site rated conditions. Therefore, the plant net thermal efficiency requirement in the bidding documents should be specified as follows in consideration of certain allowance.

“The plant net thermal efficiency less than 70.0 % under the rated heat export on the site rated conditions shall not be considered”.

The following heat and mass balance diagrams corresponding to the above heat and mass balance calculation results are shown in the following Figures of pages to be continued.

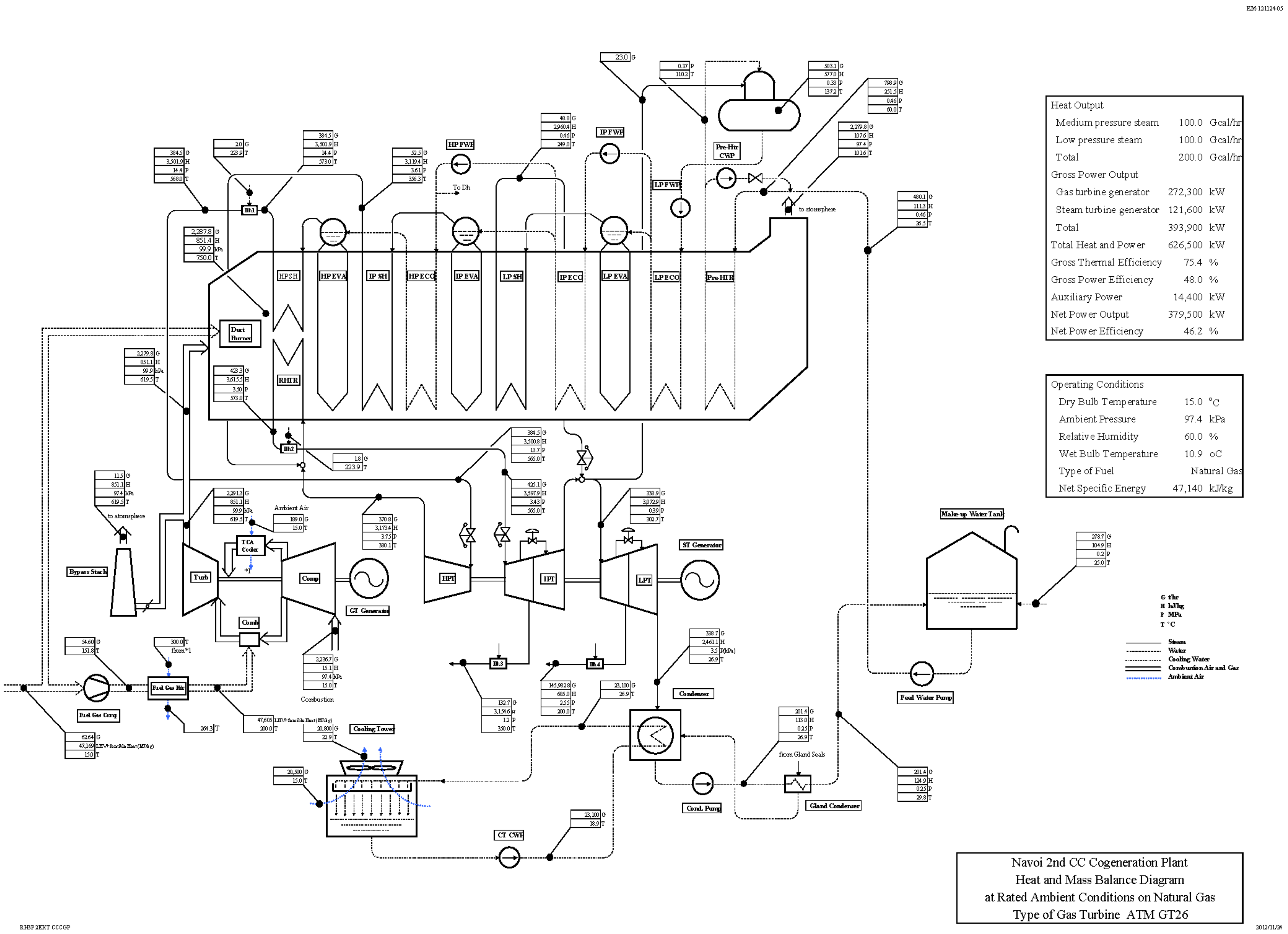
Figure 6.1.5-1 Heat and Mass Balance Diagram of CCCGP by Alstom GT 26 Gas Turbine.

Figure 6.1.5-2 Heat and Mass Balance Diagram of CCCGP by Ansaldo AE94.3A Gas Turbine

Figure 6.1.5-3 Heat and Mass Balance Diagram of CCCGP by GE 9FB Gas Turbine

Figure 6.1.5-4 Heat and Mass Balance Diagram of CCCGP by MHI M701F4 Gas Turbine

Figure 6.1.5-5 Heat and Mass Balance Diagram of CCCGP by Siemens SGT5-4000F Gas Turbine

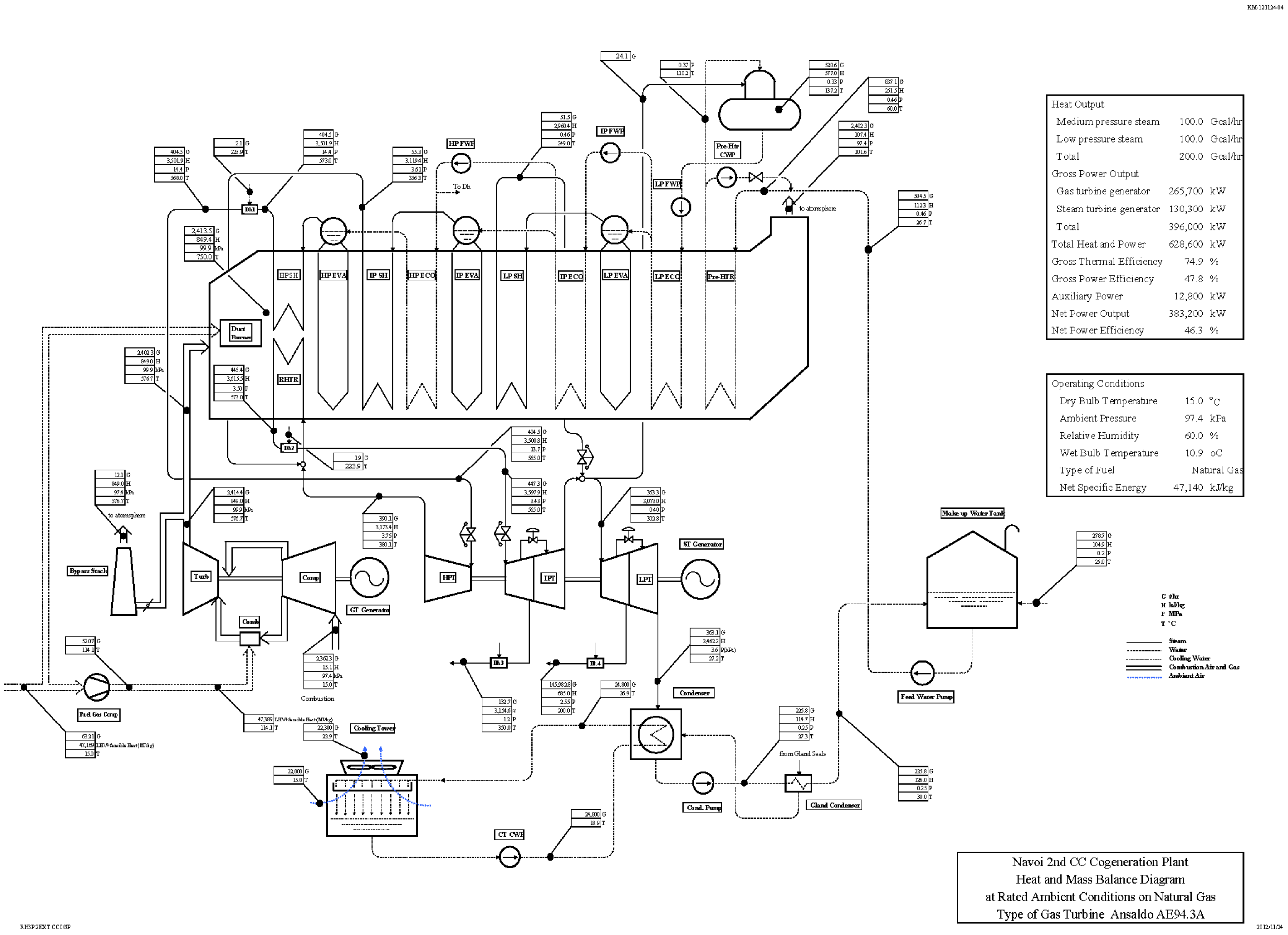


Heat Output		
Medium pressure steam	100.0	Gcal/hr
Low pressure steam	100.0	Gcal/hr
Total	200.0	Gcal/hr
Gross Power Output		
Gas turbine generator	272,300	kW
Steam turbine generator	121,600	kW
Total	393,900	kW
Total Heat and Power	626,500	kW
Gross Thermal Efficiency	75.4	%
Gross Power Efficiency	48.0	%
Auxiliary Power	14,400	kW
Net Power Output	379,500	kW
Net Power Efficiency	46.2	%

Operating Conditions		
Dry Bulb Temperature	15.0	°C
Ambient Pressure	97.4	kPa
Relative Humidity	60.0	%
Wet Bulb Temperature	10.9	oC
Type of Fuel		Natural Gas
Net Specific Energy	47,140	kJ/kg

Navoi 2nd CC Cogeneration Plant
Heat and Mass Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine ATM GT26

Figure 6.1.5-1 Heat and Mass Balance Diagram of CCCGP by Alstom GT26 Gas Turbine

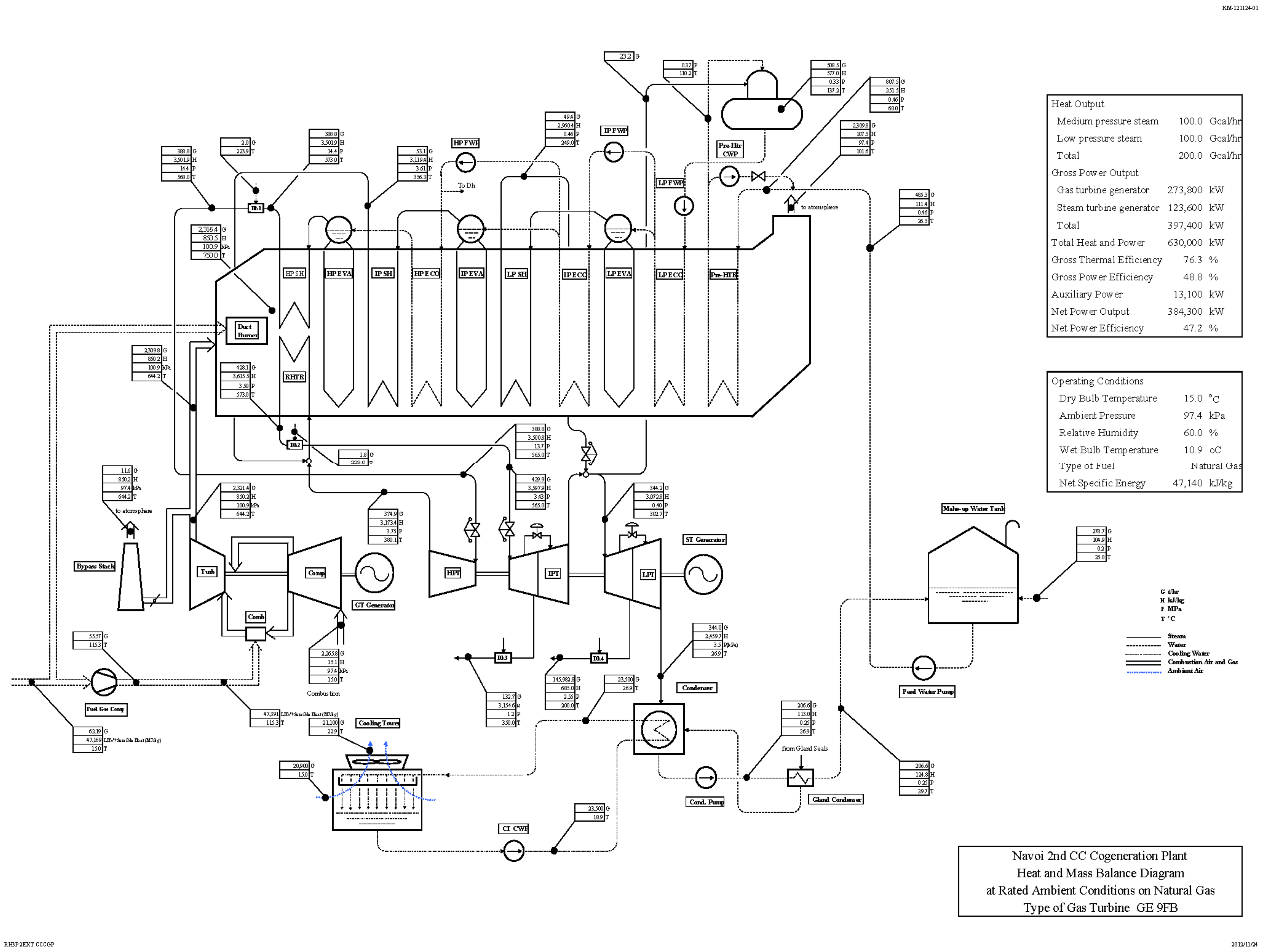


Heat Output		
Medium pressure steam	100.0	Gcal/hr
Low pressure steam	100.0	Gcal/hr
Total	200.0	Gcal/hr
Gross Power Output		
Gas turbine generator	265,700	kW
Steam turbine generator	130,300	kW
Total	396,000	kW
Total Heat and Power	628,600	kW
Gross Thermal Efficiency	74.9	%
Gross Power Efficiency	47.8	%
Auxiliary Power	12,800	kW
Net Power Output	383,200	kW
Net Power Efficiency	46.3	%

Operating Conditions		
Dry Bulb Temperature	15.0	°C
Ambient Pressure	97.4	kPa
Relative Humidity	60.0	%
Wet Bulb Temperature	10.9	oC
Type of Fuel		Natural Gas
Net Specific Energy	47,140	kJ/kg

Navoi 2nd CC Cogeneration Plant
Heat and Mass Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine Ansaldo AE94.3A

Figure 6.1.5-2 Heat and Mass Balance Diagram of CCCGP by Ansaldo AE94.3A Gas Turbine

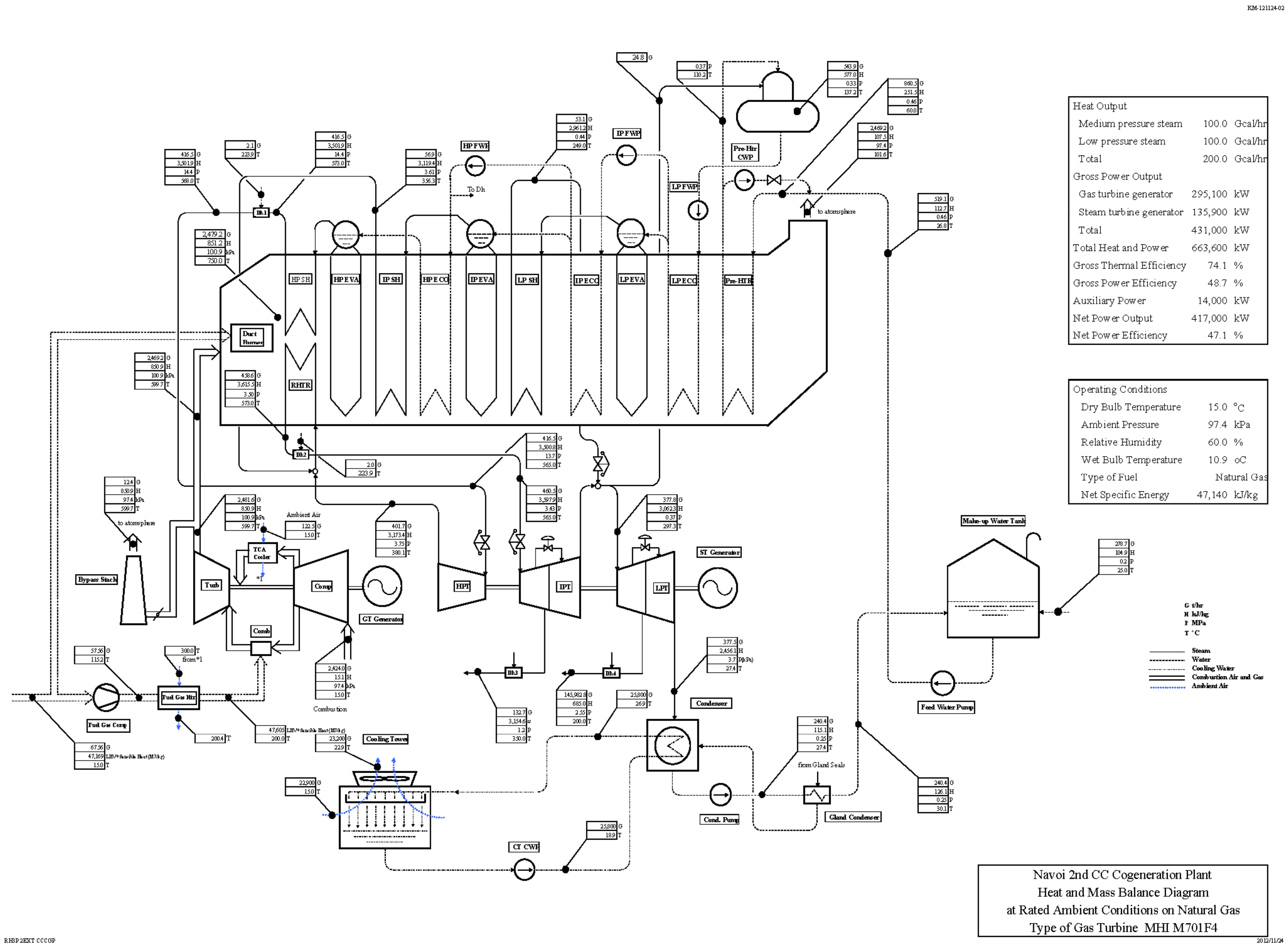


Heat Output		
Medium pressure steam	100.0	Gcal/hr
Low pressure steam	100.0	Gcal/hr
Total	200.0	Gcal/hr
Gross Power Output		
Gas turbine generator	273,800	kW
Steam turbine generator	123,600	kW
Total	397,400	kW
Total Heat and Power	630,000	kW
Gross Thermal Efficiency	76.3	%
Gross Power Efficiency	48.8	%
Auxiliary Power	13,100	kW
Net Power Output	384,300	kW
Net Power Efficiency	47.2	%

Operating Conditions		
Dry Bulb Temperature	15.0	°C
Ambient Pressure	97.4	kPa
Relative Humidity	60.0	%
Wet Bulb Temperature	10.9	oC
Type of Fuel		Natural Gas
Net Specific Energy	47,140	kJ/kg

Navoi 2nd CC Cogeneration Plant
Heat and Mass Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine GE 9FB

Figure 6.1.5-3 Heat and Mass Balance Diagram of CCCGP by GE 9FB Gas Turbine

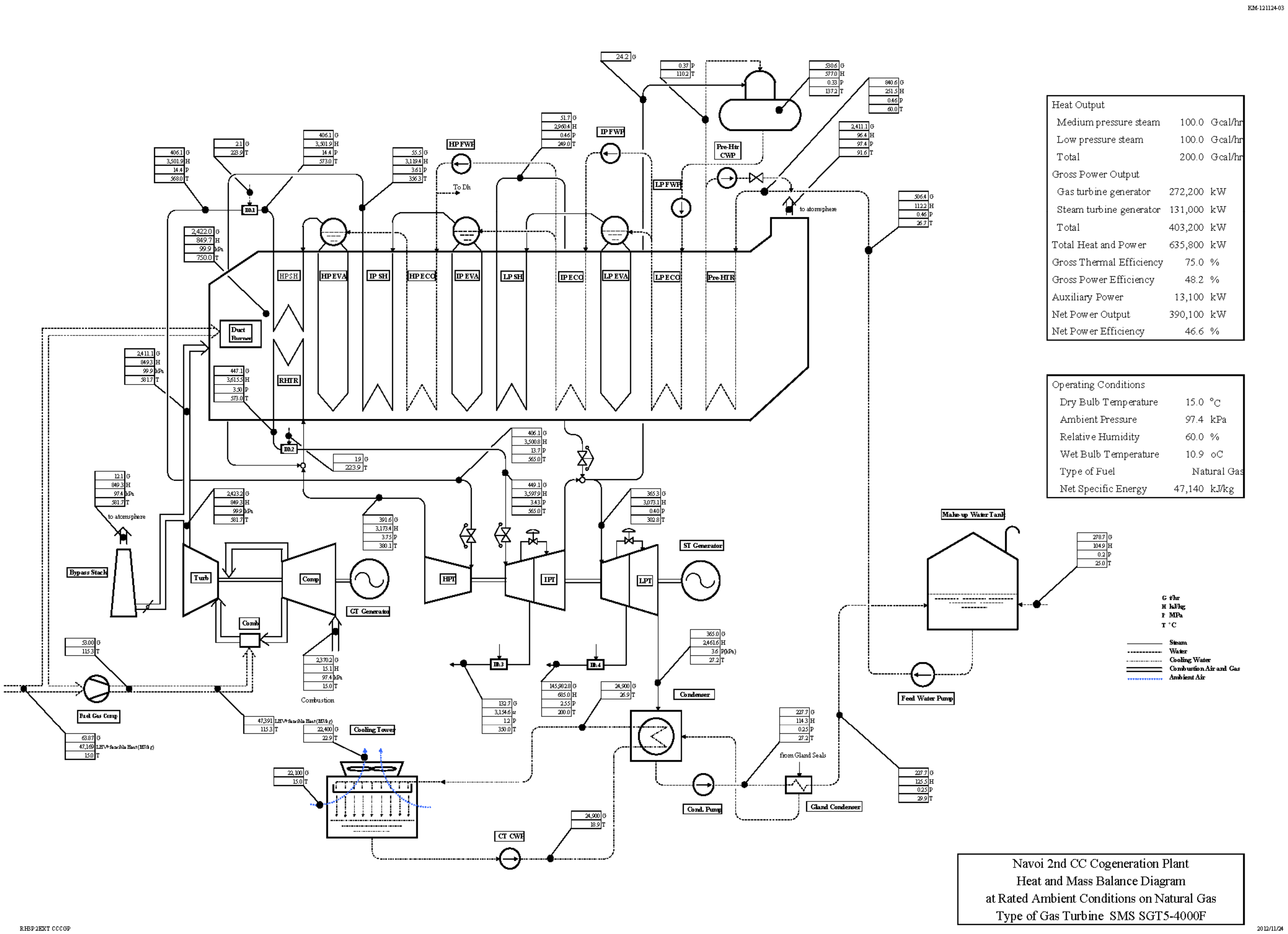


Heat Output		
Medium pressure steam	100.0	Gcal/hr
Low pressure steam	100.0	Gcal/hr
Total	200.0	Gcal/hr
Gross Power Output		
Gas turbine generator	295,100	kW
Steam turbine generator	135,900	kW
Total	431,000	kW
Total Heat and Power	663,600	kW
Gross Thermal Efficiency	74.1	%
Gross Power Efficiency	48.7	%
Auxiliary Power	14,000	kW
Net Power Output	417,000	kW
Net Power Efficiency	47.1	%

Operating Conditions		
Dry Bulb Temperature	15.0	°C
Ambient Pressure	97.4	kPa
Relative Humidity	60.0	%
Wet Bulb Temperature	10.9	oC
Type of Fuel		Natural Gas
Net Specific Energy	47,140	kJ/kg

Navoi 2nd CC Cogeneration Plant
Heat and Mass Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine MHI M701F4

Figure 6.1.5-4 Heat and Mass Balance Diagram of CCCGP by MHI M701F4 Gas Turbine



Heat Output		
Medium pressure steam	100.0	Gcal/hr
Low pressure steam	100.0	Gcal/hr
Total	200.0	Gcal/hr
Gross Power Output		
Gas turbine generator	272,200	kW
Steam turbine generator	131,000	kW
Total	403,200	kW
Total Heat and Power	635,800	kW
Gross Thermal Efficiency	75.0	%
Gross Power Efficiency	48.2	%
Auxiliary Power	13,100	kW
Net Power Output	390,100	kW
Net Power Efficiency	46.6	%

Operating Conditions		
Dry Bulb Temperature	15.0	°C
Ambient Pressure	97.4	kPa
Relative Humidity	60.0	%
Wet Bulb Temperature	10.9	oC
Type of Fuel		Natural Gas
Net Specific Energy	47,140	kJ/kg

Navoi 2nd CC Cogeneration Plant
Heat and Mass Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine SMS SGT5-4000F

Figure 6.1.5-5 Heat and Mass Balance Diagram of CCCGP by Siemens SGT5-4000F Gas Turbine

(6) Operating Rangeability of Plant

The steam turbine power output is changeable depending upon the heat amount extracted as steam from the steam turbine, the supplementary duct firing temperature and ambient temperature. The maximum allowable heat amount to be extracted is variable depending upon the supplementary duct firing temperature and ambient temperature if the model of the gas turbine has been specified and the bottoming system has been designed once. In other words, it shall increase as the supplementary duct firing temperature increased as the ambient temperature decreases. The Figure 6.1.5-6 shows the relationship between the heat extraction amount and the steam turbine power output with a parameter of supplementary duct firing temperature for the CCCGP by M701F4 gas turbine on the ambient temperature of 15 °C. In this case, it can be seen that the maximum power output of the steam turbine is 189.3 MW at no heat extraction and the supplementary duct firing temperature of 750 °C which is supposed to be the maximum allowable temperature. This figure is depicted for the range from 0 to 200 Gcal/hr of heat extraction. However, the maximum allowable heat extraction amount for every supplementary duct firing temperature is not specified. It shall be specified by the manufacturer at the bidding stage.

The Figure 6.1.5-7 shows the relationship between heat extraction amount and the plant gross power output. From this figure, the maximum plant gross power output of 484.4 MW is attained at no heat extraction and the supplementary duct firing temperature of 750 °C. The minimum plant gross power output is 367.2 MW at no supplementary duct firing and the heat extraction amount of 200 Gcal/hr. The power output of the gas turbine is constant at 295.1 MW over full range of this figure.

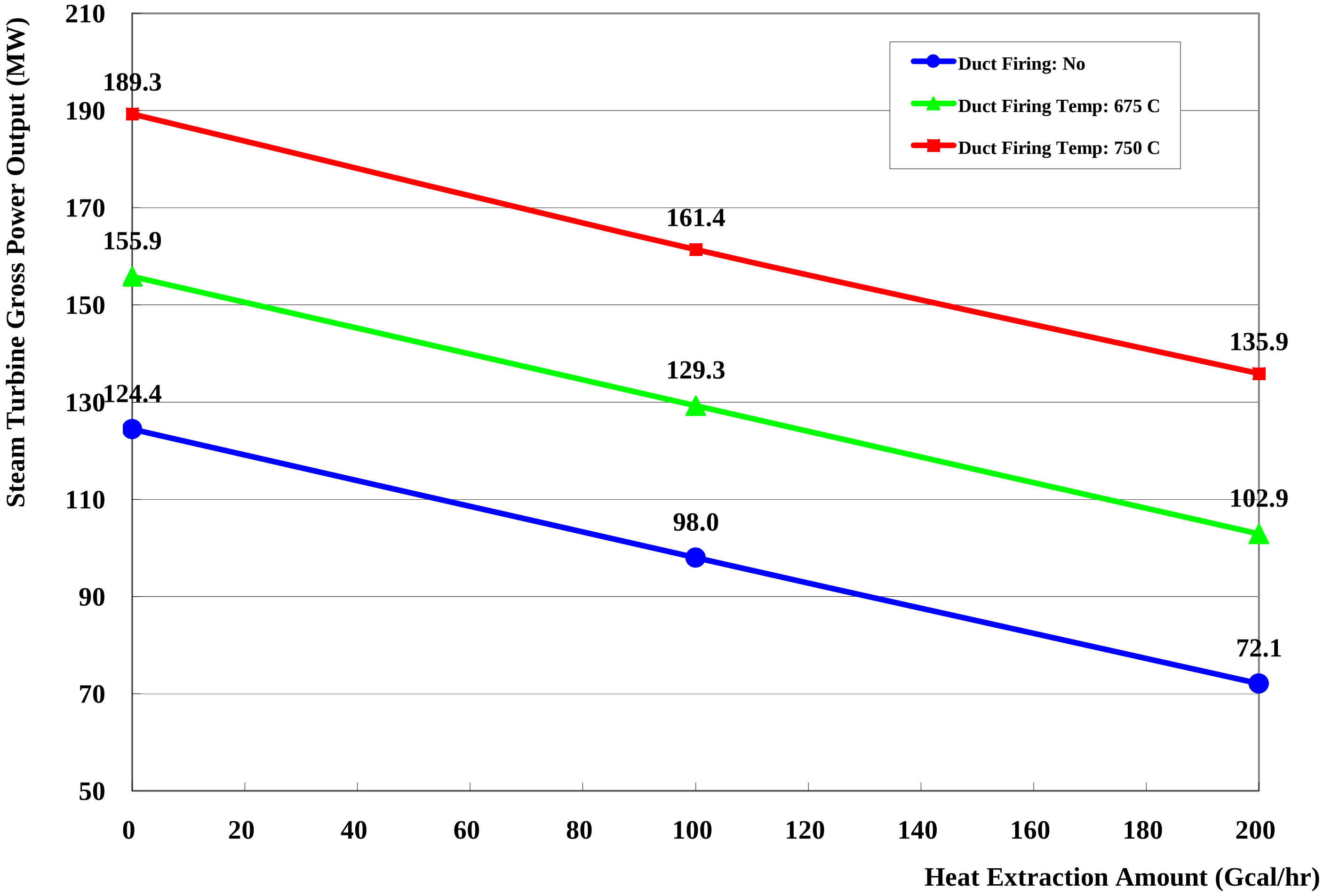


Figure 6.1.5-6 Relationship between Heat Extraction Amount and Steam Turbine Gross Power Output

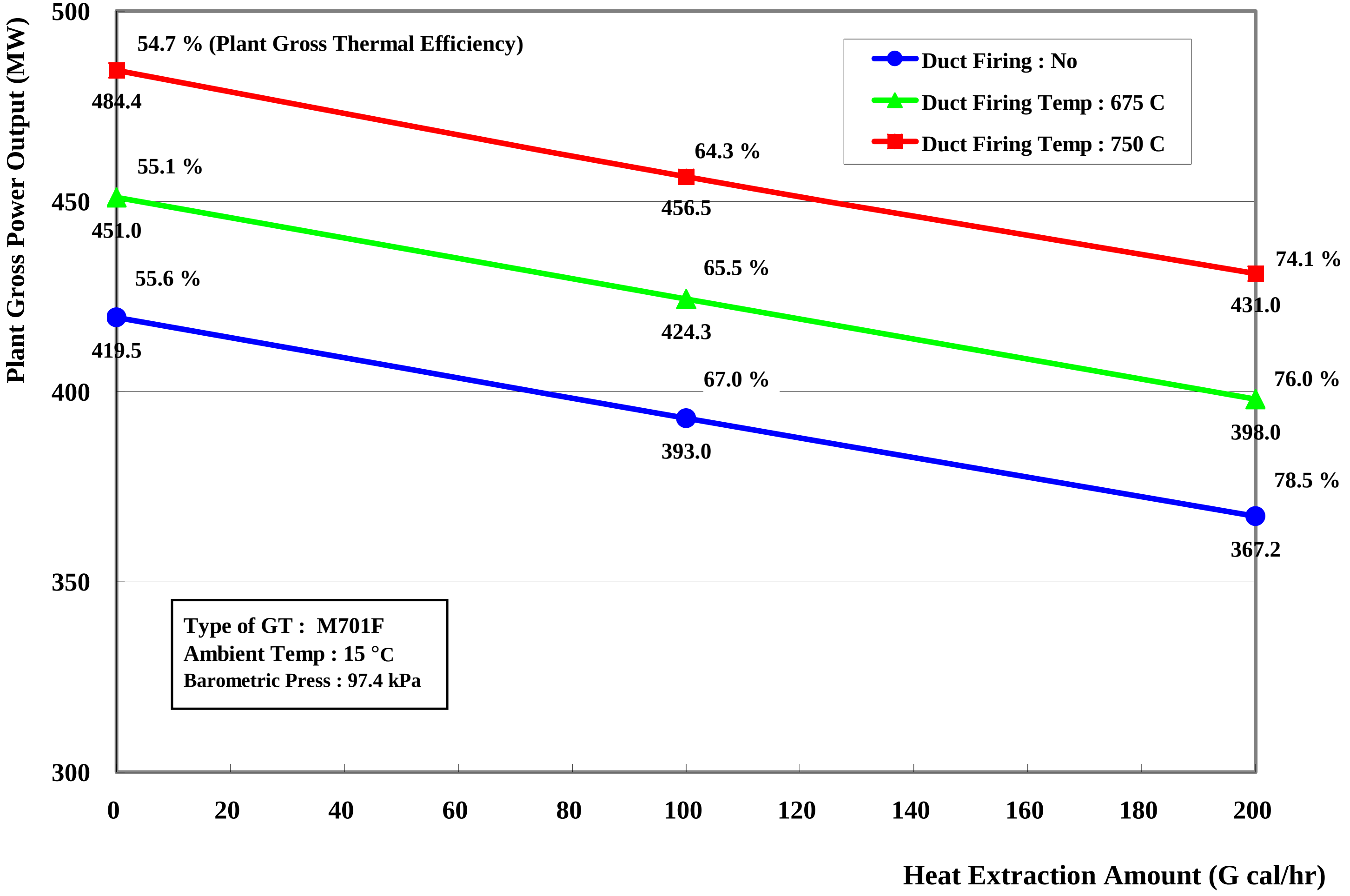


Figure 6.1.5-7 Relationship between Heat Extraction Amount and Plant Gross Power Output

(7) Definition of Maximum Capacity of Generator

The gas turbine commonly displays the characteristics that the power output increases up to the mechanical limit defined by the manufacturer as the ambient temperature decreases. In other words, the maximum capacity of the gas turbine is changeable depending upon the ambient temperature. However, the maximum capacity of the generator is not changed with the ambient temperature. Therefore, it shall be defined at which ambient temperature the generator should be designed so as to cope with the maximum capacity of the gas turbine. It is the common practice that the generator should be designed to meet the maximum capacity of the gas turbine at the monthly averaged value of the lowest ambient temperature of the coldest month of the site in consideration of the economy of the plant.

The data of ambient temperatures in Navoi site area is not currently available. In lieu of this, such data in Tashkent has been obtained from the internet. The Figure 6.1.5-8 shows the variation of the monthly averaged lowest, mean and highest ambient temperatures for 2001 through 2010. According to this figure, the average of the monthly averaged values of daily lowest ambient temperatures of the winter season of December, January and February is calculated at minus 0.5 ^{o}C.

Therefore, the maximum capacity of the gas turbine generator shall be so designed as to meet the maximum capacity of the gas turbine at the ambient temperature of 0 ^{o}C rounded up. The related electrical equipment such as a main transformer, main cables and a main circuit breaker shall also be designed to cope with the maximum capacity of the gas turbine generator.

In the case of the steam turbine generator, its maximum capacity shall be defined in consideration of the heat extraction amount and the supplementary duct firing temperature in addition to the lowest ambient temperature discussed above. At this stage, the Study Team considers that the maximum capacity of the steam turbine generator shall be defined at no heat extraction amount and the supplementary duct firing temperature of 750 ^{o}C for the performance parameters of the gas turbine at the ambient temperature discussed above.

Above discussion results shall be revised accordingly at a later stage when the appropriate data of Navoi area is available.

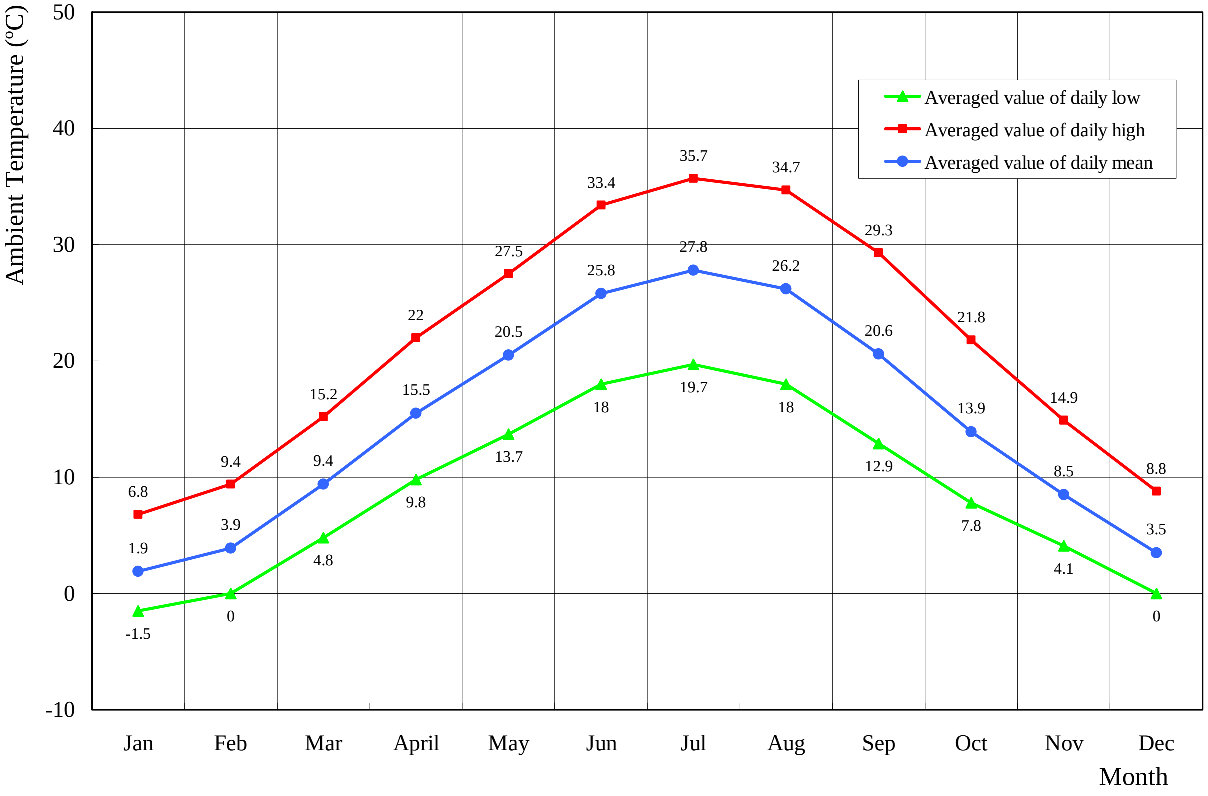


Figure 6.1.5-8 Monthly Averaged Values of Daily Lowest, Mean and Highest Ambient Temperatures

6.1.6 Study on Cooling System

In the Pre-feasibility Study Report, the system using the mechanical draft cooling tower is studied to cool the steam turbine condenser of the CCCGP No.2. In this connection, the CCCGP No.1 and Nos 11 and 12 existing thermal power units are equipped with the cooling system by the cooling tower. However, the Study Team is told that the cooling system using the cooling tower is possessed with inherent problems due to the quality of the make-up water.

For such reason, the Study Team was required to do the technical and economical comparison study between the mechanical draft cooling tower cooling system (MCTCS) and the mechanical draft air cooled condenser system (MACCS) by Uzbekenergo. The natural draft cooling tower and air cooled condenser could be conceived, these types, however, are precluded from the study because a huge area is necessary for installation of equipment. Figure 6.1.6-1 is the schematic diagram of the mechanical draft cooling tower cooling and mechanical draft air cooling systems.

(1) Comparison Study of Condenser Cooling Systems

1) General

The merits and demerits of the cooling system are variable depending upon the site ambient conditions, operating conditions and economic conditions such as an electric power sales price and a fuel cost. This study is carried out from technical and economical points of view for selection of the most suitable cooling system for the Project. The impact on circumferential environments is also examined. The schematic diagrams of the above two (2) types of cooling systems are shown in the next page. In the combined cycle plant, the performances of the gas turbine which is a topping cycle are not affected by the type of cooling system, but those of the steam turbine of a bottoming cycle are affected. Therefore, it is effective enough for technical and economic evaluation if the performance differences due to the type of cooling system of only the steam turbine are examined.

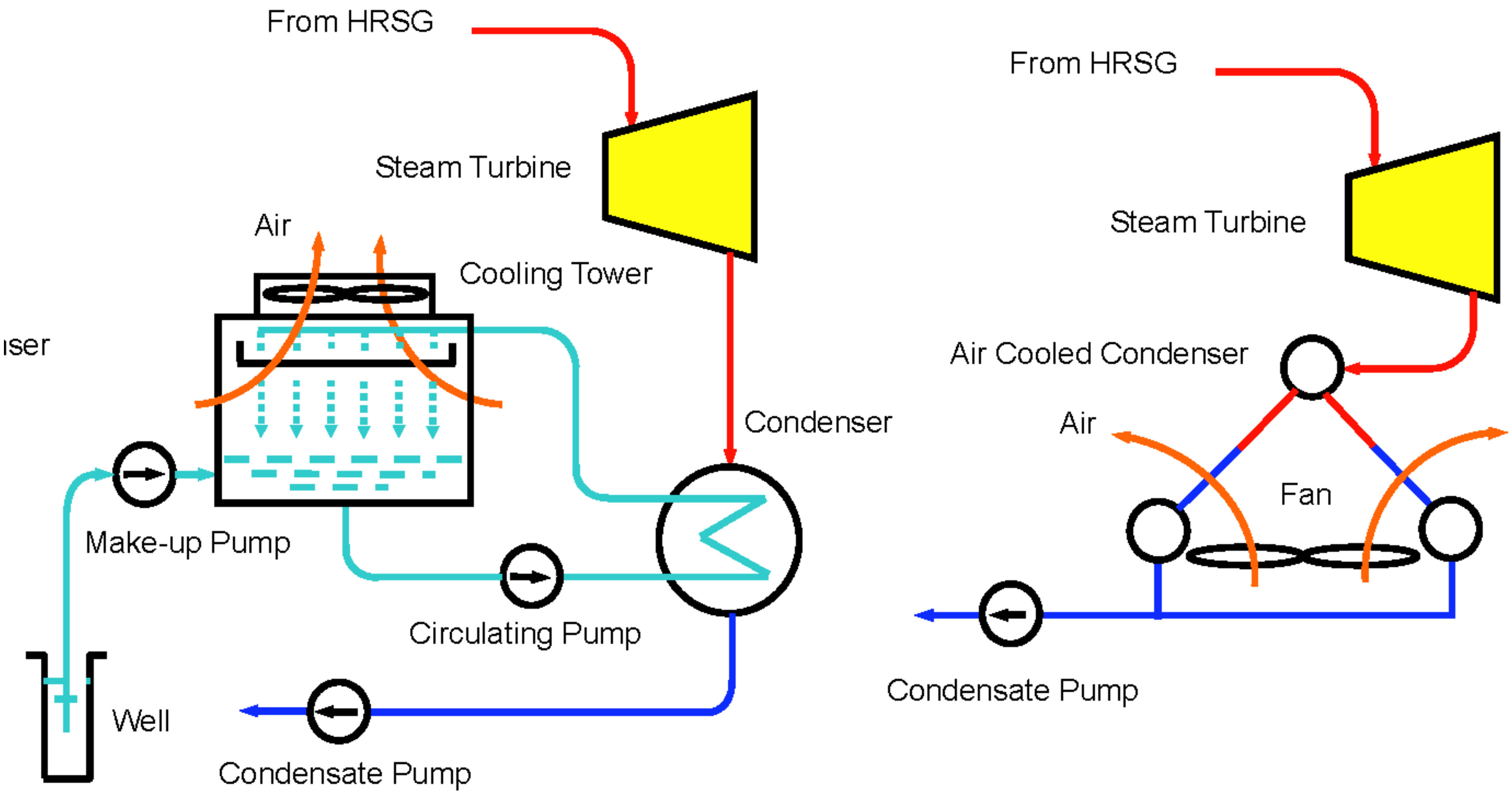
2) Conditions

a. Type of Combined Cycle Cogeneration Plant

This study shall be conducted for the combined cycle cogeneration plant (CCCGP) which uses the F-class gas turbine presently available in the worldwide market. Out of five (5) candidate Models of CCCGPs, that using M701F gas turbine is used as the case for selection study of the cooling system. As for the parameters of the bottoming system, the sub-section 6.1.5 should be referred to.

b. Site Ambient Conditions

The heat load of the cooling system of the CCCGP is significantly changeable depending upon the ambient conditions. Therefore, the study shall be performed at the averaged ambient conditions through the year.



Mechanical Draft Cooling Tower Cooling System

Mechanical Draft Air Cooled Condenser System

Figure 6.1.6-1 Schematic Diagram of Both Types of Cooling Systems

For the purpose, the following site ambient conditions are assumed as averaged values through the year because such data is not given.

Averaged dry bulb temperature	15.0 ^{o}C
Averaged relative humidity	60.0 %
Averaged wet bulb temperature	10.9 ^{o}C

c. Operating Conditions of Plant

The comparison study is conducted provided that the plant is scheduled to be run at a full power output load with the heat supply of 100 Gcal/hr where the heat load for the cooling system is worse than the case of the rated heat supply of 200 Gcal/hr under duct firing at 750 oC on a natural gas with an annual availability factor of 85 % (7,446 hours) through the year.

d. Economic Conditions

The economic evaluation of the cooling system is conducted comparing the construction cost for the condenser and cooling system plus the loaded costs as the net present values due to the shortage of the annual power sales of the steam turbine and the difference of the maintenance costs among the two (2) types of cooling systems. For the purpose, the following economic indexes are utilized:

Power sales tariff	0.0209 $/kWh (41.8 Sum/kWh)
Maintenance cost of MCTCS	5.0 % of construction cost of it
Maintenance cost of MACCS	1.5 % of construction cost of it
Escalation rate of power sales tariff	1.5 %
Escalation rate of maintenance cost	1.5 %
Discount rate	10.0 %
System loss	8.0 %
Evaluation periods (year)	25.0 years
Construction period (year)	3.0 years

3) Shortage of Annual Net Sales Power (GWh) due to Type of Cooling System

The steam turbine gross power output at the generator terminals can be obtained from the heat mass balance calculation result by estimating the steam turbine exhaust pressure which will be defined at the used energy end point (UEEP) of the steam turbine. The said pressure will be determined for each type of cooling system on specified site ambient conditions. It is normally deemed that the said pressure is equal to the condenser pressure except for the air-cooled condenser. In case of the air-cooled condenser, pressure loss will occur in the steam duct between the steam turbine and the air-cooled condenser. The net power output at the power station is defined as the value after the auxiliary powers related to the cooling system are deducted from the gross power output. The annual net sales power is estimated by multiplying the net power output by the annual operating hours and deducting the system power loss. The shortage of the annual net power is defined as the difference against the maximum net annual net power sales.

a. Estimation of pressure at UEEP

The pressure at UEEP can be estimated from the commonly acceptable characteristic values for each type of cooling system on the site ambient conditions specified above.

The estimated pressures for each cooling system are as tabulated in the table shown below:

Description	Temperature and Pressure
1. MCTCS	
a. Approach temperature (^oC)	8.0
b. Cooling range (^oC)	8.0
c. Temperature difference (^oC)	5.0
d. Condenser saturated temp. (^oC)	=10.9+8.0+8.0+5.0 = 31.9
e. Condenser saturated pressure (kPa)	4.73
f. Estimated pressure loss (kPa)	0
g. Estimated pressure at UEEP (kPa)	4.73
2. MACCS	
a. Air temperature rise (^oC)	12.0
b. Temperature difference (^oC)	8.0
c. Condenser saturated temp. (^oC)	=15.0+12.0+8.0 = 35.0
d. Condenser saturated pressure (kPa)	5.62
e. Estimated pressure loss (kPa)	2.45
f. Estimated pressure at UEEP (kPa)	8.07

b. Gross power output of steam turbine

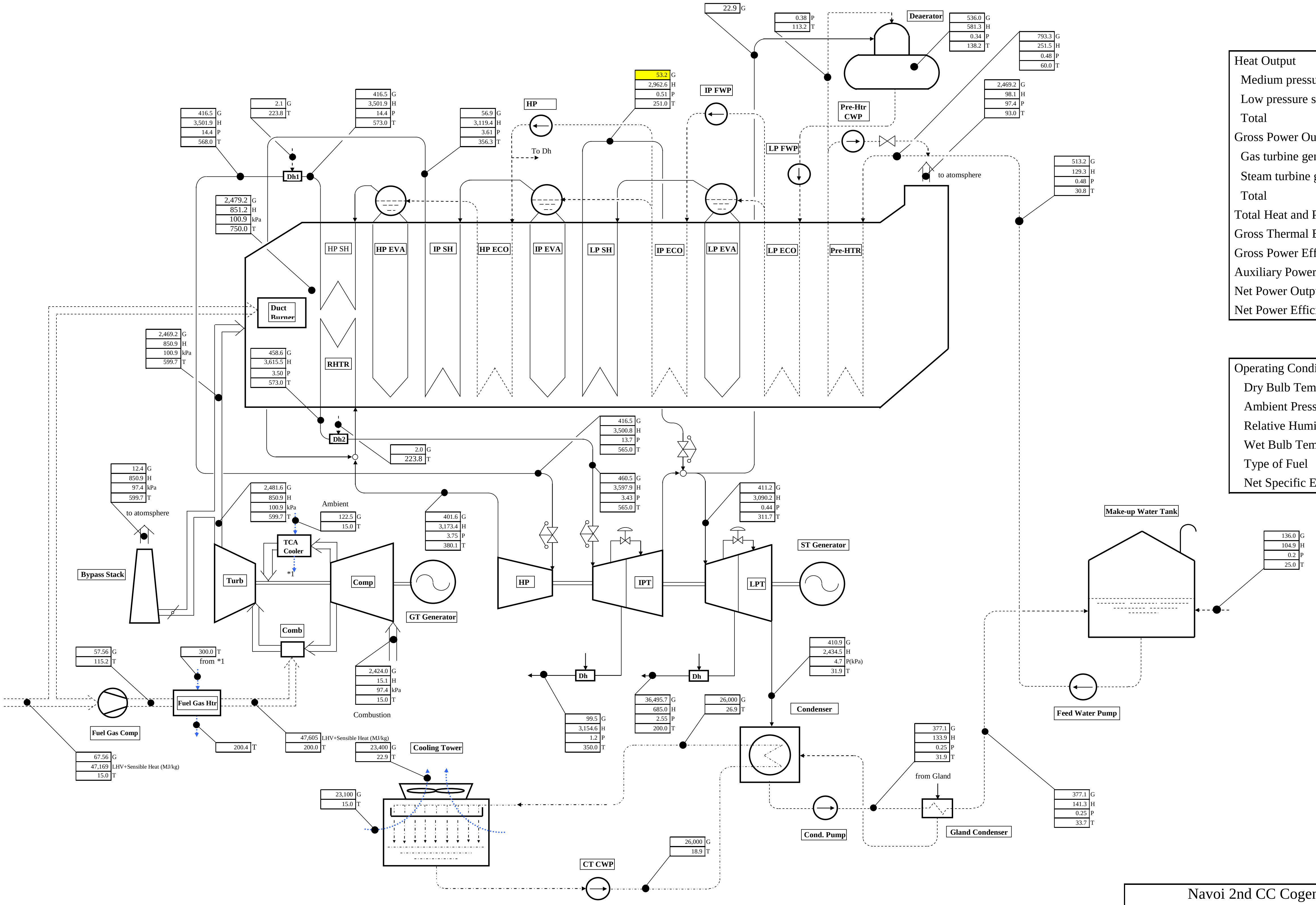
The gross power outputs of the steam turbine for two (2) types of cooling systems can be obtained from the heat mass balance calculation results for the specified exhaust pressures at UEEP. They are as tabled below:

Type of Cooling System	Gross Power Output (kW)
Mechanical draft cooling tower system	159,300
Mechanical draft air cooling system	153,700

The following heat balance diagrams for two (2) types of cooling systems are shown in the following pages.

Figure 6.1.6-2 Heat and Mass Balance Diagram for Mechanical Draft Cooling Tower Cooling System

Figure 6.1.6-3 Heat and Mass Balance Diagram for Mechanical Draft Air Cooled Condenser System

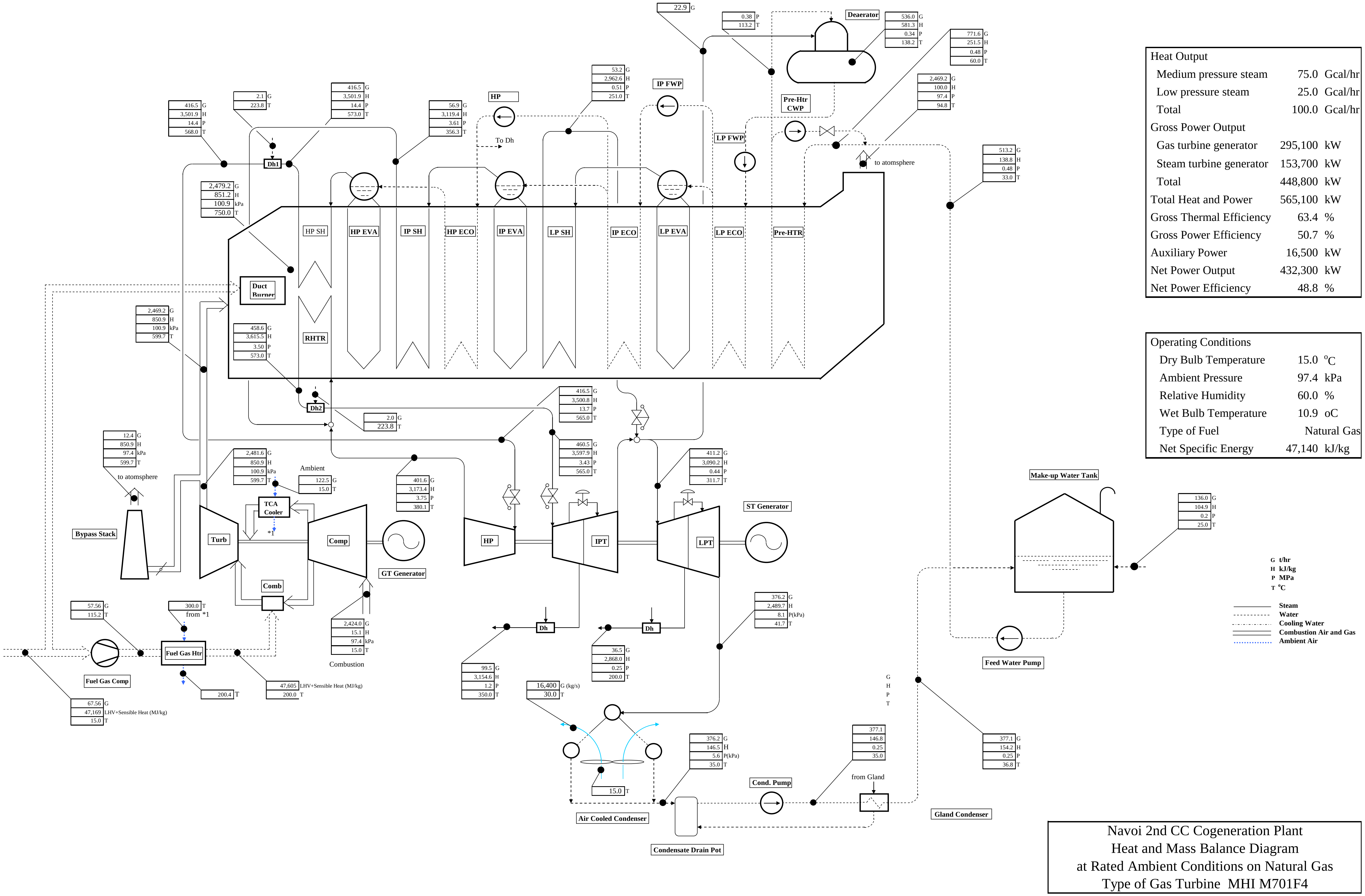


Heat Output		
Medium pressure steam	75.0	Gcal/hr
Low pressure steam	25.0	Gcal/hr
Total	100.0	Gcal/hr
Gross Power Output		
Gas turbine generator	295,100	kW
Steam turbine generator	159,300	kW
Total	454,400	kW
Total Heat and Power	570,700	kW
Gross Thermal Efficiency	64.0	%
Gross Power Efficiency	51.3	%
Auxiliary Power	14,700	kW
Net Power Output	439,700	kW
Net Power Efficiency	49.7	%

Operating Conditions		
Dry Bulb Temperature	15.0	°C
Ambient Pressure	97.4	kPa
Relative Humidity	60.0	%
Wet Bulb Temperature	10.9	oC
Type of Fuel	Natural Gas	
Net Specific Energy	47,140	kJ/kg

Navoi 2nd CC Cogeneration Plant
Heat and Mass Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine MHI M701F4

Figure 6.1.6-2 Heat and Mass Balance Diagram for Mechanical Draft Cooling Tower Cooling System



Heat Output		
Medium pressure steam	75.0	Gcal/hr
Low pressure steam	25.0	Gcal/hr
Total	100.0	Gcal/hr
Gross Power Output		
Gas turbine generator	295,100	kW
Steam turbine generator	153,700	kW
Total	448,800	kW
Total Heat and Power	565,100	kW
Gross Thermal Efficiency	63.4	%
Gross Power Efficiency	50.7	%
Auxiliary Power	16,500	kW
Net Power Output	432,300	kW
Net Power Efficiency	48.8	%

Operating Conditions		
Dry Bulb Temperature	15.0	°C
Ambient Pressure	97.4	kPa
Relative Humidity	60.0	%
Wet Bulb Temperature	10.9	oC
Type of Fuel	Natural Gas	
Net Specific Energy	47,140	kJ/kg

Navoi 2nd CC Cogeneration Plant
Heat and Mass Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine MHI M701F4

Figure 6.1.6-3 Heat Mass Balance Diagram for Mechanical Draft Air Cooled Condenser System

c. Auxiliary power related to cooling system

The auxiliary power of the equipment pertaining to the cooling system is different depending upon its type. The auxiliary powers for the foresaid two (2) types of cooling systems are roughly estimated by correcting the relevant data of similar plants to the site conditions of this Project. The study results are summarized as described below.

MCTCS	
Cooling water circulating pump (Q=27,300 m^3/hr, H=12 mH_2O)	1,260 kW
Make-up water supply pump (Q=560 m^3/hr, H=15 mH_2O)	40 kW
Draft fan in total (Q=4,700 m^3/s, H=12 mmH_2O)	1,200 kW
Total	2,500 kW

MACCS	
Draft fan for condenser in total (Q=13,900 m^3/s, H=15 mmH_2O)	2,600 kW
Draft fan for other air radiators in total (Q=530 m^3/s, H=15 mmH_2O)	130 kW
Total	2,730 kW

d. Net power output

From the gross power outputs and auxiliary required powers estimated above, the net power outputs are calculated as shown below:

Type of Cooling System	Net Power Output (kW)
MCTCS	156,800
MACCS	150,970

e. Annual net sales power

The annual net sales power for two (2) types of cooling systems are estimated as shown below in consideration of net power output, annual availability factor and system loss.

Type of Cooling System	Annual Net Sales Power (GWh)
MCTCS	1,074.1
MACCS	1,034.2

f. Shortage of annual net sales power

In accordance with the previously prescribed definition, the shortage of annual net sales power for each cooling system is calculated as shown below:

Type of Cooling System	Shortage of Annual Net Sales Power (GWh)
MCTCS	± 0
MACCS	39.9

4) Technical Evaluation

a. Mechanical draft cooling tower cooling system

This system is common to the power or heat and power plants to be built in the area This system is common to the power or heat and power plants to be built in areas where the water source with necessary amount of flow rate capacity for a once-through type is not available. The circulating cooling water flow rate of the cooling tower is estimated to be some 27,300 m^3/hr including the cooling water for equipment other than a condenser.

In case of use of the cooling tower, some percentage of the circulating water flow rate must be made up to compensate for the blow-down water and evaporation and water drift losses depending upon the design parameters of the cooling tower. The evaporation loss can be calculated as 1.05 % (290 m^3/hr) of the circulating water flow rate for the cooling tower design parameters previously specified and the heat and mass balance previously shown. Some part of the circulating water must be so blown down that the solid concentration in the circulating water is 2 or 4 times that in the make-up water. If the concentration is 2 times, the make-up water flow rate shall be 2.05 % of the circulating water flow rate. Therefore, the required make-up water flow rate can be calculated at some 560 m^3/hr (=0.0205×27,300). The blow-down water rate can be calculated as 240 m^3/hr. The drift loss is approximately 30 m^3/hr.

Depending upon the quality of the make-up water and the contamination of ambient air, any kinds of slime and algae may occur in the cooling system and the tower fills may be scaled. Therefore, any measures by dosing of suitable chemicals must be taken to protect this system from them. However, these matters shall be engineered at the detailed design stage of the project in consideration of types of chemicals which will be locally available.

The Study Team is told that the existing plants of No. 11 and 12 units face serious maintenance difficulties due to use of river water as a make-up when visiting Navoi TPP site. Considering such situations, the maintenance cost of the MCTCS is assumed to be 5.0 % of the construction cost of it. According to preliminary study results, the cooling tower is of a counter flow type and is configured of nine (9) cells of which each is sized at approximately 14 m in length, 14 m in width and 16 m in height with a fan of 9 m in diameter. The total footprint area is approximately 16 m by 130 m. This type of cooling tower is technically matured and many installation experiences exist for various types of power and heat and power plants.

The make-up water shall be supplied through the city water storage tank to be provided under this project. In case of No. 1 CCCGP, the city water is also used as the make-up water in place of the river water which is used for existing Nos 11 and 12 units. The study team is told that the existing units are suffering from some problems caused by improper make-up water quality. In this connection, slime, algae and scaling may happen on the parts in contact with the circulating water. In order to protect from such problems, water quality control and chemical dosing may be required. Cleaning of the condenser tubes must be carried out off-line.

The mechanical sounds from the axial flow fans and water circulating pumps and dripping sounds of water drops could be supposed as noise sources of this system. The sounds from the axial air fans can be attenuated by employment of low noise type of fans and cylindrical hood at the air exit. The circulating pumps could be covered with the noise attenuation enclosure for reduction of noise as required. The dripping sounds could be minimized by installation of the air inlet louvers. By such noise protection measures as described above, the sound pressure levels around the cooling tower could be suppressed to less than 80 dB(A). As the noise simulation analysis results (the detail of analysis results in the sub-section 8.4.1 to be referred) based on noise data of the main equipment consisting of the plant, the sound pressure levels on the border of the plant was found to be less than the prescribed value.

The cooling tower may be confronted by any inherent problems which occur in freezing weather conditions. Examples include visible plume, ice formation inside the air intake structure and formation of ice board on the ground in the vicinity around the tower. For instance, the installation of the cooling tower is prohibited in the vicinity of highways in the northern parts of USA.

b. Mechanical draft air cooled condenser system

This type of system has been used for the power or heat and power plants which are built in areas where water sources are not available in the vicinity of plants as inland and desert areas. The steam from the steam turbine is directly condensed by ambient air through the finned tubes. For this purpose, large amount of surface area is required for the heat transfer finned tubes because of less heat transfer coefficient between the air and steam.

As described in the previous sub-section, the net power output of the steam turbine with the MACCS is less than that with the MCTCS.

The finned tubes can be kept clean by employment of automatic water wash devices which will be periodically operated on-line. The cleaning interval shall be decided, depending upon the fouling tendency of them. In case of clean air condition, the cleaning interval is said to be commonly a half year. The site for this Plant belongs to a clean, uncontaminated area, unlike other industrial areas. It is supposed for the finned tubes to be less contaminant. The air leakage into tubes could be detected by use of an infrared camera. The finned tubes where the leakage will be detected could be blinded with plugs and be replaced when the plant is at standstill. Therefore, any routine maintenance is basically not required.

In consideration of above statements, the maintenance cost of MACCS is assumed to be 1.5 % of the construction cost of it.

The air cooled condenser may also confront any inherent troubles which happen in the freezing weather season. However, according to our study results, many air cooled condensers are installed in areas where the ambient temperature is far lower than minus 20 ^{o}C. Table 6.1.6-1 shows a sample application experience with air cooled condensers installed in areas where the lowest ambient temperature is lower than minus 20 ^{o}C.

According to study results, the air cooling system is configured of twenty four (24) modules with four (4) streets. Each module is approximately sized at 12 m by 13 m with a fan of 9 m in diameter of 140 kW power requirements. The totally required footprint area for installation of the air cooling system is approximately 60 m by 80 m. The height is some 20 m.

The MACCS is technically matured and there are many installation experiences with such large capacity systems as required for this Plant as shown in the Table 6.1.6-1 This table shows the worldwide reference list of one (1) major air cooled condenser manufacturer for combined cycle plants installed in sites where the minimum ambient temperature is lower than minimum 20 °C. From this table, it is definitely clear that there are many experiences with air cooled condensers for the combined cycle plants, which have been installed in sites of freezing weather conditions. In addition, many MACCSs are installed in desert areas where there is no cooling water. This means that the MACCS is applicable for ambient conditions as high as 40 °C.

The mechanical sounds from the axial air fans are supposed to be the noise source of the

mechanical draft direct air cooled condenser. It is possible that the sound pressure levels around the condenser will be allowable from the environmental consideration point of view by employment of lower noise fans and installation of noise protection skirts at the air inlet. For example, it is confirmed that the noise levels on the ground level around the similar mechanical draft air cooled condenser located in Japan are less than 80 dB(A).
As the noise simulation analysis results in accordance with the noise data of the main equipment consisting of the plant, the sound pressure levels on the border of the plant are found to be less than the prescribed value.

5) Economic Evaluation

a. Loaded cost due to shortage of annual net sales power

The loaded cost is defined to be equal to the net present value (NPV) due to the shortage of the annual net sales power by the steam turbine between MCTCS and MACCS. In this case study, the maximum annual net sales power is 1,074.1 GWh of MCTCS as shown in the previous sub-section (3) e. The cost to be loaded against MACCS can be calculated with the following formula.

$$NPW=(1+ERP/100)^{P}/(1+DR/100)^{P}\times(1+ERP/100)\times((1+DR/100)^{S}-(1+ERP/100)^{S})/(DR/100-ERP/100)/(1+ERP/100)^{S}\times PST\times(1{,}074.1-APG)\times(1-SL/100)\quad(MMUS\$)$$

Where,
ERP: Escalation rate of power sales tariff (%)
DR: Discount rate (%)
P: Period of construction (year)
S: Service period (year)
PST: Power sales tariff (US$/kWh)
APG: Annual sales (GWh) of power generation by steam turbine for the mechanical draft air cooling system
SL: Transmission and Distribution System Loss (%)
1,074.1: Annual net sales power (GWh) of the steam turbine with the mechanical draft cooling tower system

Substituting the said preconditioned values in previous sub-section (2) d and annual net sales power (1,034.2 GWh) of MACCS into the above equation, the loaded cost can be calculated as shown below:

Type of Cooling System	Loaded Cost (MMUS$)
Mechanical draft cooling tower system	±0.0
Mechanical draft air cooling system	+6.8

As shown above, the loaded cost due to shortage of annual power sales of MACCS is 6.8 MMUS$.

b. Loaded Cost due to Difference of Maintenance Cost

The maintenance cost difference happens between MCTCS and MACCS with the preference of the latter to the former. Therefore, the NPV of the annual maintenance cost difference should be considered as the loaded cost for MCTCS. The formula to calculate it could be expressed as well as that of the previous sub-section.

$$NPW=(1+ERM/100)^{P}/(1+DR/100)^{P}\times(1+ERM/100)\times((1+DR/100)^{S}-(1+ERM/100)^{S})/(DR/100-ERM/100)/(1+ERM/100)^{S}\times(0.90-0.32)\quad(MMUS\$)$$

Where,

ERM:	Escalation rate of maintenance cost (%)
0.90:	Annual maintenance cost of MCTCS (MMUS$)
0.32:	Annual maintenance cost of MACCS (MM US$)

Substituting the said preconditioned values in previous sub-section (2) d into the above formula, the cost to be loaded is calculated as shown below.

The loaded cost against MCTCS	+4.7

c. Construction cost for both cooling systems

The construction costs for both cooling systems are estimated through the computer software referring the relevant cost of similar projects and hearing from certain manufacturer of the air cooled condenser. The estimated costs are summarized as shown below:

MM US$

Type of Cooling System	Cooling Tower	Air Cooling
Water Cooled Condenser and accessories	4.1	-
Circulating Water System	13.4	-
Cooling Tower		-
River Water Supply and Pre-treatment System	0.5	-
Air Cooled Condenser	-	21.2
Total	18.0	21.2

As shown in this table, the construction cost of MACCS is higher by 3.2 MMUS$ than MCTCS.

d. Construction cost plus loaded cost

The construction cost plus loaded cost for both types of cooling systems are as tabulated below from values estimated above.

Type of Cooling System	Construction and Loaded Costs (MMUS$)
MCTCS	22.7 (= 18.0 + 4.7)
MACCS	28.0 (= 21.2 + 6.8)

As can be seen from above figures, the MACCS is more advantageous by 5.3 MMUS$ compared to the MCTCS.

Table 6.1.6-1 Reference List of Air Cooled Condensers for Combined Cycle Plants with Minimum Ambient Temperature less than Minus 20 °C

Project Name	Country	Plant Capacity (MW)	Steam Flow Rate (t/hr)	Number of Units	Start-up Year	Min.Operating Temp (°C)
Dominion-Front Royal	USA	1,329	1,467	1	2013	-28.9
Deer Creek	USA	300	395	1	2011	-41.0
Nikiski	USA	80	145	1	2011	-43.9
Dominion-Sait Paul	USA	585	1,353	1	2010	-20.0
Haibowan	China	400	480	2	2009	-32.6
Torino North	Italy	400	374	1	2009	-20.0
Turano Lodigiano	Italy	800	680	1	2009	-25.0
Halton Hils	Canada	670	766	1	2009	-31.0
Goreway Ontario	Canada	800	942	1	2007	-31.0
Astoria, Newyork	USA	500	460	1	2005	-25.0
Poletti, NY	USA	650	490	1	2004	-25.0
Ravenswood, NY	USA	250	278	1	2002	-25.0
Fore River, MA	USA	800	658	1	2002	-25.0
Mystic I & II, MA	USA	1,600	658	2	2002	-25.0
Bellingham, MA	USA	250	256	2	2001	-30.0
Blackstone, MA	USA	250	256	2	2000	-30.0
Lake Road, CT	USA	250	256	3	2000	-30.0
Quetta	Pakistan	130	145	1	1997	-25.0

(1) Selection of Cooling System

1) Mechanical draft cooling tower cooling system (MCTCS)

The cooling towers have been used for cooling system of condensers of existing Nos 11 and 12. In such a case, the source of the make-up water to compensate for evaporation, drift and blow-down water losses was Zeravshan River. However, the study team is told that inherent problems have happened so far because of improper quality of the make-up water. Therefore, it can be understandable that Energo have requested the study on the air cooled condenser system not to use any water. According to the preliminary study results, the make-up water quantity for compensation of evaporation, drift and blow-down losses is calculated at 560 m^3/hr. This disadvantage is equivalent to the net present value of 7.5 MMUS$. In addition, some 240 m^3/hr of water must be blown down into the river to keep the quality of the circulating water within proper conditions. This is considered environmentally disadvantageous against the MCTCS.

The water used as the cooling media is closed-circulating though small part of it is made up for compensation of evaporation, blow-down and drift losses. Therefore, slime, algae and scale may occur on the parts in contact with the water. To protect from such things, any maintenance works of water quality control, chemical dosing and cleaning are required. In addition, the cleaning of the condenser tubes must be carried out off-line. These are considered on of the disadvantages of MCTCS.

The installation footprint area of MCTCS is 16 m by 130 m and smaller by 2,720 m^2 than MACCS. This is an advantage of MCTCS.

In the freezing weather conditions, ice formation in the tower fills and ice board formation in the vicinity of grounds are foreseen. The former disturbs proper operation of cooling tower and the latter poses a slipping hazard. This is a disadvantage of MCTCS.

It is confirmed that the plant with MCTCS meets the prescribed noise requirements at the perimeter of the plant.

The construction cost of MCTCS is 18.0 MMUS$ with preference to MACCS.

The total evaluation cost of MCTCS including the loaded costs is 22.7 MMUS$.

2) Mechanical draft air cooled condenser system (MACCS)

This system is technically matured and has been used for various types of thermal plants which are built in inland areas such as deserts with no water sources available.

As mentioned in the previous sub-section 3) of section 1, the net power output of the steam turbine with MACCS is less by 5,870 kW than that with MCTCS. This is disadvantageous to MACCS and equivalent to the net present value of 6.8 MMUS$.

The cleaning of the finned condenser tubes must be performed. However, the cleaning can be done on-line. Therefore, the MACCS is advantageous from a maintainability point of view.

The installation footprint area of MACCS is 60 m by 80 m. It is confirmed that the plant with MACCS can be arranged within the given site area.

In freezing weather conditions, a concern is that the steam inside the finned tubes may be frozen. However, it is said that this problem has been completely remedied through the many experiences so far and no longer happens. According to the reference list of one (1) major air cooled condenser manufacturer, air cooled condensers have been operated or are being operated in as many as 70 sites where ambient temperature is less than minus 20 °C. In the freezing weather sites, the MACCT is technically preferable to the MCTCS. On the other hand, there are also many experiences with air cooled condensers that have been operated or are being operated in high ambient temperature areas of countries in the Middle East.

It is also confirmed that the plant with MCTCS meets the prescribed noise requirements at the perimeter of the plant.

The construction cost of MACCS is 21.2 MMUS$ and is higher by 3.2 MMUS$ compared to MCTCS.

The total evaluation cost of MACCS including the loaded costs is 28.0 MMUS$.

3) Recommendation

For selection of cooling system for this project, two (2) possible candidates of MCTCS and MACCS were studied and compared.

The total evaluation cost of the MCTCS is lower by 5.3 MMUS$ than the MACCS. This cost difference is said not to be crucial for selection of the type of cooling system in consideration of the project cost of some 500 MMUS$. On the other hand, the MACCS is advantageous from the maintainability and less environmental impact points of view, which may not be expressed in terms of monetary value.

For the reasons stated above, the Study Team will recommend the MACCS as the type of cooling system of this project where there is no water suitable for make-up available in the project site.

6.2 Scope of the Project

6.2.1 General

The scope of this Project includes the design, manufacture, transportation and delivery to the Site, construction at the Site, testing and commissioning, and maintenance for a period of one (1) year after Taking Over of the plant herein described.

The combined cycle cogeneration plant to be installed shall be of nominal 450MW highly efficient combined cycle block in a one on one multi-shaft configuration comprising one (1) low-NOx gas turbine, one (1) triple pressure reheat, indoor type heat recovery steam generator (HRSG) equipped with duct firing burners, one (1) reheat, two-extraction, condensing type steam turbine, two (2) electric generators, and miscellaneous auxiliary equipment.

The cooling water system for the condenser of steam turbine and for the closed circuit cooling water of plant auxiliary equipment shall be of mechanical draft wet cooling tower type.

The gas turbine and duct firing system shall be designed for natural gas exclusive firing. Gas supply is from Navoi Gas Distribution Station to the site at 1.0~1.2 MPa (g) at the terminal point. Booster gas compressors shall be included in the scope of work, to boost the pressure to the required pressure in the gas turbine combustion chamber. The plant does not need to be capable of starting on blackout condition.

Transmission lines for CCCGP No. 2 to the existing Navoi substation and 220kV bay and bus to be installed in the existing Navoi substation shall be included in the scope of this project. Furthermore, a part of the existing transmission lines which are passing the area of CCCGP No.2 shall be reconstructed as a scope of this project.

The power plant shall supply the industrial steam of 0.8~1.3 MPa (abs) and 300ºC for neighboring chemical companies and the steam of 0.07~0.25 MPa (abs) and 170 ºC to heat the hot water for district heating. These steam supplies shall be extracted from the steam turbine and their heat capacities shall be 100Gcal/h and 100 Gcal/h respectively. The industrial steam supply system and the hot water supply system including steam and hot water piping to the connection points with the existing main piping as well as their make-up water treatment systems shall be included in the scope of this project.

6.2.2 Scope of works

The facility and equipment, as described herein, shall include the following:

(1) Power generation equipment
  (a) One set of Gas Turbine and Auxiliaries and Flue Gas Exhaust System including HRSG Bypass Stack, Dampers, Silencer, etc.
  (b) One set of Steam Turbine, Condenser, and Auxiliaries
  (c) One set of Heat Recovery Steam Generator and Auxiliaries
  (d) One set of Gas Turbine Generator and one set of Steam Turbine Generator, and their Step-up Transformers, Unit Transformer, Auxiliary Transformer and Auxiliaries
  (e) One set of Main Stack
  (f) 220kV Substation, Interconnections and Auxiliaries

(2) Transmission Lines and Substation
  (a) 220kV Transmission lines to the existing Navoi Sub-station
  (b) 220kV bay and bus in the existing Navoi substation
  (c) Reconstruction of existing 220kV transmission lines

(3) Heat supply system
  (a) Industrial steam supply system
  (b) Hot water supply system
  (c) Hot water supply and return piping and valves
  (d) Water treatment system for hot water make-up water

(4) Mechanical Equipment of Auxiliaries and Balance of Plant (BOP)
  (a) Cooling water system for steam turbine condenser and auxiliary cooling system.
  (b) Gas skid and instrument air facilities
  (c) Gas pipe from metering station to plant and booster compressor station
  (d) River water supply facilities
  (e) Water treatment plant
  (f) Waste water treatment facilities

- (g) Cranes and miscellaneous hoist
- (h) Fire fighting protection and detection system
- (i) Heating, Ventilation, and Air Conditioning (HVAC) system
- (j) General service air system and instrument air system
- (k) Workshop and chemical laboratory equipment and miscellaneous items
- (l) Service and potable water system

(5) Electrical Equipment of Auxiliaries and Balance of Plant (BOP)

- (a) Station electrical supply system comprising unit and station transformers, bus duct connections, medium/low voltage boards, auxiliary transformers, motor control centers, etc.
- (b) 110V station DC supply system
- (c) 240V AC station UPS system
- (d) Distributed control system (DCS)
- (e) Station earthing / grounding system
- (f) Telecommunication system
- (g) Lightning protection system
- (h) Emergency diesel generator
- (i) Cathodic protection system
- (j) Lighting and small power supply system including emergency lighting
- (k) Compound / perimeter lighting system
- (l) External lighting

(6) Civil and Building Works

- (a) Preliminary works comprising soil investigation, hydraulic and hydrographic survey and model studies, site survey and setting out, etc.
- (b) Demolition works (if necessary)
- (c) Piling works (if necessary)
- (d) Foundation and superstructure works
- (e) Construction of the administration building, the gas turbine building including the central control room, steam turbine building, HRSG building, and other buildings
- (f) Building of shower for staff
- (g) Canteen for staff
- (h) Storage for spare parts, tools, etc.
- (i) Miscellaneous civil works

(7) Environmental

- (a) On-line emission continuous monitoring system
- (b) On-line ambient air continuous monitoring system
- (c) Sampling and analysis
- (d) Other equipment
- (e) Landscaping and environmental blending

(8) Miscellaneous

The scope of this Project also includes the following:

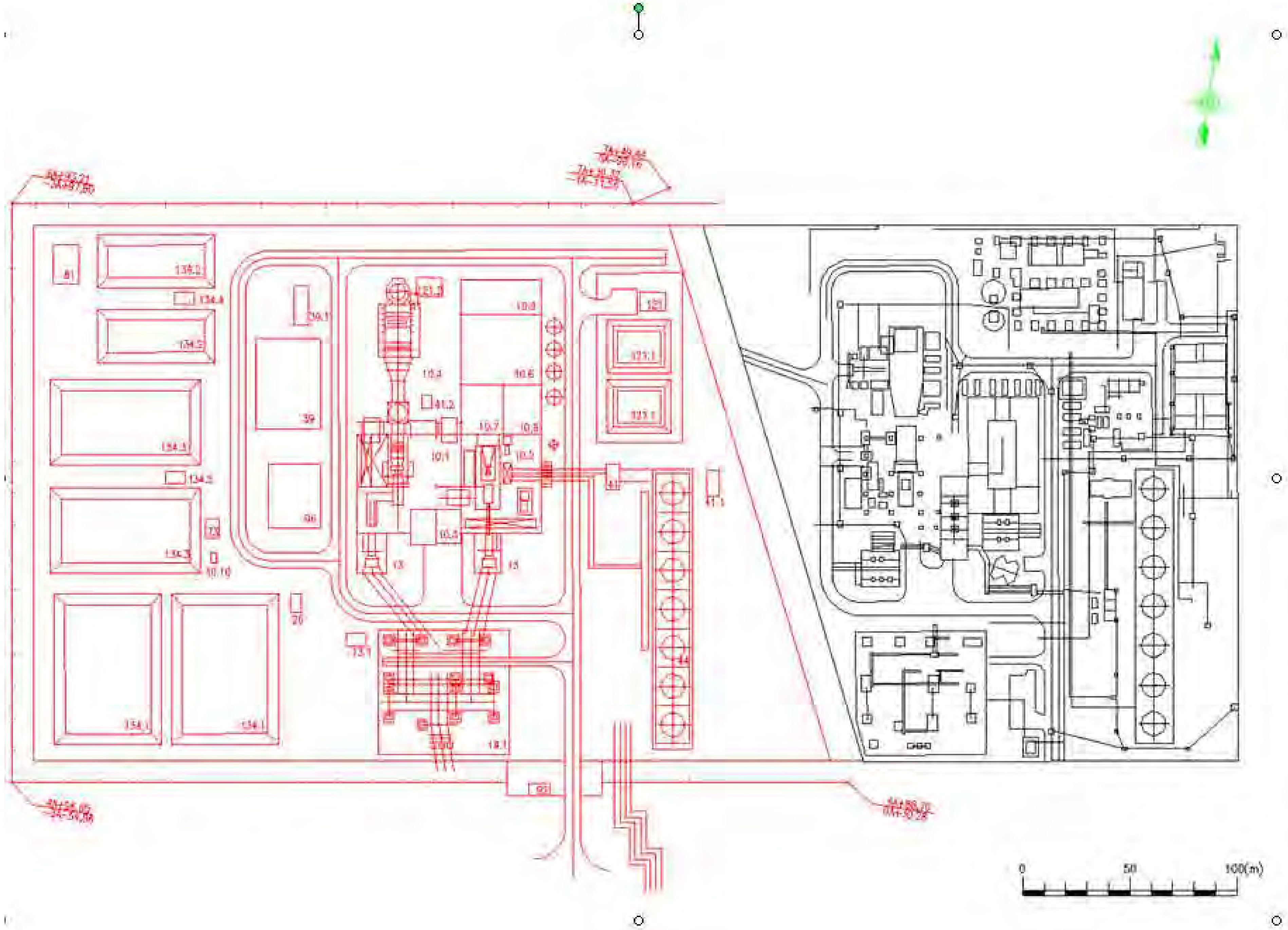
- (a) Tools and appliances
- (b) Spare parts for two (2) years continuous operation
- (c) First fill of oils and greases, and flushing oil and chemicals.
- (d) All consumable items for the one (1) year maintenance period.
- (e) Fire barrier installation conforming to the Fire Services Department requirement
- (f) Training of Power Plant’s staff

(g) Keys and key cabinets system for all plant and equipment
(h) Supply of operation and maintenance (O & M) manuals
(i) Air pollution study and determination of stack dimensions
(j) Statutory and local authorities approval

6.3 Plot Plan

Candidate site is situated in the area adjacent to the west side of the CCCGP No.1 in the west of the existing Navoi thermal power plant.

The conceptual arrangement of CCCGP No.2 is as shown in Figure 6.3-1.



Number	Equipment/Facility Name
	[10. Main Building]
10.1	Gas turbine
10.2	Steam turbine
10.3	Electrical equipment
10.4	Heat recovery steam generator (HRSG)
10.6	Water treatment and wastewater treatment
10.7	Deaerator, Boiler feed water pump, condensate make-up pump, and chemical dosing pump
10.8	Heater and deaerator for hot water supply system
10.9	Utility building
10.10	Emergency turbine lubrication tank (underground)
11.	Stack
13.	Step-up transformers (GT & ST)
19.1	220 kV switchyard
26.	Emergency diesel generator
39.	Natural gas boost-up compressor
39.1	Natural gas distribution station
41.	Circulating water pump station
41.1	Cooling tower blow down tank
41.2	Drainage pump
44.	Cooling tower (7 units)
73	Air compressor with receiver
81.	Electro hydraulic control (EHC) station
92.	Security gate
96.	Oil storage (oil in packages)
121.	Fire pump station
121.1	Reserve water tanks for fire fighting (2 tanks)
121.2	Boost-up station for fire fighting
	[134. Sludge dump area for waste water treatment system]
134.1	Evaporating pond for hot water heater chemical wash
134.2	Sludge dump for oil contaminated water (2 sections)
134.3	Sludge dump for waste water treatment (2 sections)
134.4	Treated water return pump station for oil contaminated water
134.5	Pump station for chemical water treatment

Figure 6.3-1 Plot plan

6.4 Basic Systems for Plant Design

6.4.1 Gas Turbine System

(1) Design Codes and Standards

The gas turbine system shall be basically designed as per ISO 3977-3 “Gas turbines-Procurement-Part3: Design requirements” and ISO 21789 “Gas turbine applications-Safety”

(2) Gas Turbine

The gas turbines shall be of single shaft configuration, open cycle, heavy duty F class temperature level type with dry low NO_x design suitable for the specified natural gas.

The gas turbine design shall be with a minimum number of bearings, and shall be located on a steel frame or on adequate steel structures and concrete foundation, so sized as to withstand the transient torque imposed on the shaft in case of short circuit of the generator or out-of-phase synchronization, whichever is larger. The power output shall be taken out at the cold end of the shaft.

Any type of power augmentation due to the inlet air cooling shall not be considered.

The gas turbine shall be complete with all auxiliary systems such as starting system, lube oil supply system, inlet air filtration system, inlet air anti-icing system, fuel gas supply system, turning device, control and monitoring equipment necessary for safe, reliable and efficient operation with the fuel specified. The gas turbine shall be designed for indoor installation in an enclosure suitable for specified noise requirements.

The gas turbine shall be designed for continuous base load operation according to the manufacturer’s standard, burning the natural gas with the specified composition range. The gas turbine shall be capable of start-up, loading and shut down on the specified natural gas.

The gas turbine shall be provided with an automatic start-up and control system capable of being operated from the central control room of the Plant.

The control system of the gas turbine shall be such that is capable of performing the following operations as a simple and combined cycle:

- Constant load operation at all loads between the minimum and full loads regardless of variation of heat export amount
- Governor free (droop) operation
- Turbine inlet temperature constant operation
- No load operation for certain periods of time without being synchronized as a simple cycle
- Minimum load operation not more than 30% of the full load as a combined cycle on the full power of the steam turbine keeping all the bypass valves closed.
- Automatic purging cycle to ensure that specified natural gas is removed from the gas turbine and entire exhaust system up to the exit of the stacks. Purging time shall be adjustable.
- The load rejection from the full load without tripping for easy re-synchronization.

The gas turbine shall be of horizontally split case construction for convenience of maintenance and shall permit easy access to stationary and moving blades without undue difficulties.

The entire gas turbine casing shall be heat and sound insulated in such a manner so as to allow easy removal and replacement for overhaul and inspection. The insulation material shall be of asbestos free non-combustion and chemically inert material and shall be covered by sheet metal. The design of the heat and sound insulation shall be in a manner so as to avoid that the lube oil from soaking in.

Around the gas turbine there shall be working space of at least 0.8 m width without any interference by piping, cabling, walls etc.

The journal bearings shall be of sleeve bearing type. The axial thrust force shall be oriented in one direction during all steady state operating conditions and shall be absorbed by an adjusted axial thrust bearing. All main bearings of hydrodynamic type shall be equipped with bearing oil outlet temperature indicators and monitors and vibration indicators and monitors. The monitors shall be capable of actuating alarm and/or trip as per manufacturers’ practices.

Borescope ports for inspection of all critical inner parts shall be provided.

Figure 6.4.1-1 shows the longitudinal section of the typical F-class gas turbine which may be applicable to this project.

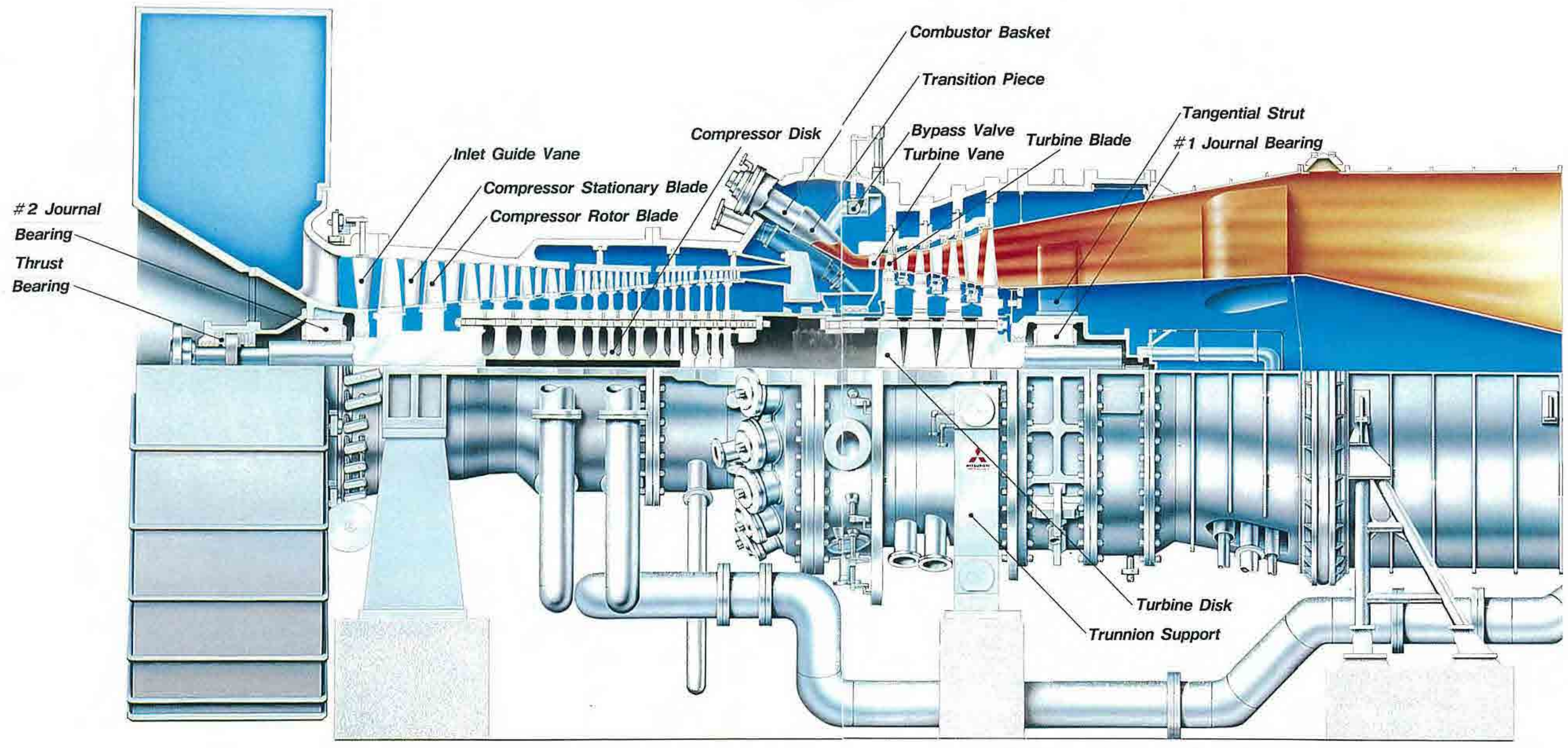


Figure 6.4.1-1 Longitudinal Section Drawing of Typical F-class Gas Turbine

(3) Starting System

The starting device and associated power supply equipment shall be suitable for the acceleration of the gas turbine/generator and the extended operation during purge and compressor cleaning cycles. The rating of the starting device shall be determined so as to produce the starting and acceleration torque with a proper margin to allow for the gas turbine/generator to accelerate to the rated speed from standstill within 25 minutes (excluding the purge and synchronization time) on all machine state conditions without any difficulties throughout the specified ambient temperature range. The starting device and starting power supply capacity shall be minimized as long as the train will be accelerated within the specified time.

The following two (2) types of starting devices can be conceivable for such a large capacity gas turbine and generator of the separate shaft type CCCGP as required for this plant.

- a synchronous generator/motor with a static frequency converter
- a squirrel cage type motor with a torque converter

The starting system should preferably be rated without limit on the number of starts attempted in succession and without restricting the rate of starting.

Interlocks shall be provided to prevent the gas turbine/generator from starting in case the lube oil pressure is not sufficient to rotate the gas turbine/generator rotor.

Any starting device shall disengage automatically and shut down before its reaching to the maximum allowable speed. The starting device is normally disengaged at the self-sustaining speed or idle speed and is at rest during operation. Failure of the disengagement shall automatically abort the starting sequence.

The gas turbine/generator shall be capable of starting instantaneously from any standstill conditions as long as it is on reserve condition.

The starting control system, including any pre-start actions such as turning, shall be of manual and automatic as defined below:

Manual start:	The start-up sequence shall be held and advanced at the events such as cranking, purging, firing and at the minimum governor setting speed.
Automatic start:	The start-up sequence shall be automatically advanced to the minimum governor setting speed or the readiness to synchronizing or to the pre-set load.

The starting control system shall be provided with an automatic purge function to ensure safe operation.

(4) Lube Oil Supply System

The lube oil supply system shall be basically designed as per the requirements of the latest version of API 614. Any a complete lube oil system shall be provided and shall be fully integrated with jacking oil system (if applicable), oil purification system and dirty oil drains for the gas turbine/generator. The lube oil system shall have sufficient capacity to accommodate the requirements of the systems that will be supplied with the lube oil.

The system shall include sufficient standby equipment to allow any items of equipment within the lube oil system to be taken out of service for maintenance without restricting in operation of the plant.

The lube oil system shall be preferably separated from that of the steam turbine/generator.

The retention time of the oil reservoir shall not be less than eight (8) minutes based on normal flow rate of oil and the retention capacity which is the total volume below the minimum operating level.

Alarms shall be at least made on occurrence of following situations:

- Lube oil supply pressure low
- Lube oil reservoir level low
- Lube oil discharge temperature high
- Lube oil supply temperature high
- Lube oil filter differential pressure high

All bearing drain lines and oil wells are to be provided with visual indicators capable of being observed from a local platform or operating floor level.

The outlets of relief valves shall be routed to the oil reservoir tank.

In the event of AC power failure, the emergency DC oil pump to be operated for rundown of the rotating shafts and bearing cool-down shall be automatically put into operation. A combined AC/DC tandem motors-driven pump shall not be accepted.

Where oil is supplied from a common system to two or more machines, the characteristics of the oil shall be specified by the Contractor. The Contractor shall ensure that the specified oil meets the requirements of the different machines and is locally procurable.

(5) Fuel Gas Supply System

The gas turbine combustion system shall be of a single fuel design so that the specified natural gas indigenous in Uzbekistan can be fired without any difficulties.

The natural gas pipe line terminal point is located adjacent outside the boundary fence in the north-east direction of the plant site. The pressure at the terminal point is specified at 1.0-1.2 MPa (g). The nominal size of the branch pipe is 20 inches. The dust particle distribution data necessary for design of the pre-treatment facility will be examined in due course of time.

The fuel gas supply system shall be such that it can supply the gas turbine with the specified natural gas on the acceptable conditions to it with a proper pre-treatment and necessary pressurization of supplied natural gas.

The fuel supply system shall cover all the equipment required for the start-up, shutdown and continuous operation of the gas turbine. A gas compressor station, flow metering devices, a pre-treatment system, and a gas pressure-regulating device, but not limited to them, shall be also included in the scope.

Any fuel gas heating facility where the fuel gas may be heated with hot air extracted from the gas turbine compressor as a turbine cooling media for improvement of the thermal efficiency of the plant may be provided depending upon the gas turbine manufacturer.

Any other conditions necessary for design shall be examined at the detailed design stage.
In case of firing the specified natural gas, the NOx concentration level shall not be more than 25 ppmv 15 % O_2 on dry conditions without injection of water or steam.

(6) Air Intake System

1) General

The air supply for a gas turbine shall be taken from a high-level atmospheric air inlet external to the gas and steam turbine building. The air intake shall also be positioned to avoid the ingress of exhaust gases from the main stack of the heat recovery steam generator.

The design of the hood shall permit ready access to the air filtration system. After filtration the air shall be directed to the inlet flange of the gas turbine compressor.

The intake system shall be complete with inlet screen and louvers, filters, airtight duct from filters to compressor inlet, foreign object damage protection screen, sound attenuators and all controls and instrumentation necessary for safe control.

The number of access points and penetrations into the air inlet system for maintenance and inspection shall be minimized. Any door or hatch shall be capable of being securely locked, and interlocks shall be provided to prevent any attempted start with any door or hatch not properly closed.

2) Air Filtration System

The air intake filtration system shall be accomplished by a multi-stage dry system. The filter elements shall be preferably of washable reuse type to minimize the industrial waste. The air filtration system shall be so designed that its dust collection efficiency will not fall below 99.5 % in the weighing method for ISO fine dust while in service and shall be such that particles remaining in the filtered air shall not exceed 5 microns diameter.

The replacement interval of filter elements shall not be shorter than 6,000 hours for use of ISO fine dust.

The air intake shall be equipped with a silencer downstream of the filtration system and the whole of the ducting shall be sealed to avoid ingress of unfiltered air.

The air filters chosen shall be suitable to reduce the sand, dust and salt content in the atmospheric air to a level which is not detrimental to the life of the gas turbine unit and under the most adverse atmospheric conditions of the site.

A self-cleaning type air filtration system shall be acceptable as an alternative. The filter system shall be composed of high efficiency media filter cartridges, which can be cleaned automatically by reverse pulses of compressed air taken from the intermediate stage of the gas turbine air compressor. The sound pressure level during the reverse cleaning operation shall not exceed 80 dB (A) at the distance of 1 m from the system.

The design shall minimize the inlet system pressure drop. The instrumentation and control equipment shall also be kept to a minimum but must include a differential pressure monitor across every stage of the filtration system.

3) Air Inlet Ductwork

The ductwork shall be complete with all the necessary expansion joints, guide vanes, supports and supporting steelwork, vibration isolators, flanges, silencing equipment, cladding and any other items necessary to complete the system.

The expansion joint shall be such that no loads or forces are transmitted to the gas turbine inlet flange.

Sliding joints shall not be used in the ductwork. All expansion joints shall be flanged for removal without disturbing the main sections of the ductwork.

No entrapped nuts, bolts or rivets shall be used inside the ductwork downstream of the filtration system.

Bypass doors shall be provided in the ductwork to allow the air filtration system to be bypassed in the event of excessive differential pressure across the filtration system. The construction of the bypass door shall be preferably of a counter weight type. An alarm in the control room shall be initiated on high filter differential pressure. On further increase in differential pressure, a further alarm shall be initiated together with automatic opening of the bypass doors.

4) Silencer

The silencer shall be provided to control the noise from the air compressor to the specified level. The silencer acoustic panels shall be designed for the service life of 30 years at the full load condition of the gas turbine. The silencer shall be capable of being removed from the ductwork without dismantling or removing any other ductwork than that containing the silencer. The silencer acoustic panels shall be constructed from stainless steel. The infill and panels shall be fully resistant to the worst atmospheric conditions anticipated on the site. Precautions shall be taken to prevent settling or packing of the infill material. The infill material shall be vermin proof.

5) Foreign Object Damage (FOD) Protection Screen

Since there is a possibility of foreign objects entering the gas turbine and causing any damage to rotating parts, the FOD protection screen shall be installed at the compressor inlet to reduce the size of objects that can enter to a size that is not liable to cause such damage. The location of the screen shall be sufficiently upstream to avoid the potential for large objects to cause significant localized flow blockage that may induce blade failure.

6.4.2 Steam Turbine System

(1) Design Codes and Standards

The steam turbine system shall be basically designed as per the latest version of ISO 14661 “Thermal turbines for industrial applications” or equivalent codes and standards.

(2) Steam Turbine

The steam turbine shall be of a reheat, three-admission, two-extraction, two-casing, condensing type directly connected to the generator. The steam shall be downward exhausted to a surface condenser which is cooled by fresh circulating water which is in turn cooled with a mechanical draft wet type cooling tower. The steam turbine shall be of a three (3) pressure-level turbine with HP, IP and LP sections. The medium pressure level of steam may be extracted from the IP section for export to adjacent industrial companies. The low pressure level of steam may be extracted from the LP section for production of hot water for district heating.

The steam turbine and ancillary systems shall be designed to run continuously under all specified conditions over the specified lifetime of the plant.

The steam turbine maximum capability shall be defined so as to cope with such parameters as steam pressure, temperature, flow rate to be developed by the HRSG under conditions of full condensing with no steam extraction and maximum allowable supplementary duct firing temperature when the gas turbine is operated on the maximum capability ambient temperature.

The steam turbine shall be complete with all auxiliary systems such as a steam condenser, a lube oil supply system, a control oil supply system, admission steam stop and throttling valves, a governing system, a steam bypass system, a turning device, control and monitoring equipment necessary for safe, reliable and efficient operation. The steam turbine shall be designed for indoor installation in an enclosure suitable for specified noise requirements.

The steam turbine design shall be with a minimum number of bearings, and shall be located on a steel frame or on adequate steel structures and concrete foundation, so sized as to withstand the transient torque imposed on the shaft in case of short circuit of the generator or out-of-phase synchronization, whichever is larger. The power output shall be taken out at the LP turbine section side.

The turbine blading shall be designed so that it withstands the continuous operation under any loads at any network frequency from 48.5 to 51.5 Hz with any allowable time limitation for under frequency less than 48.5 Hz.

Blades shall be thoroughly protected against erosion from moisture. The last stage blades shall be protected against erosion by flame hardening or by erosion shields of satellite or other suitable material. Other erosion protection provisions such as drain grooves on the last few stator blades and turbine casing will also be considered if such provisions are proven to be effective.

The steam turbine shall be designed so that the expected life expenditure of the main components shall not exceed 75% of the expected lives of them through the specified service hours when it will be operated on the specified conditions.

The turbine shall be provided with necessary number of borescope ports to inspect the conditions of the blades at periodical intervals.

The steam turbine shall be designed with proven materials having a wealth of commercial operating experiences on the similar operating conditions. Especially, special attention shall be paid to the material of integrated single rotor where operating conditions are different at front and rear parts of it.

As for design of the casing and its pipe connections, it shall be taken into account that the most severe conditions of pressure and temperature may simultaneously act upon them. In addition to the calculated minimum thickness of the casing, allowance shall be made for corrosion if the casing is not of a corrosion-resistant material.

The rotor shall be designed to be safe against the speed at least 10 % above the momentary speed which may happen under the maximum operating temperature. If the rotor is of built-up construction, the disc shall remain secure at the speed mentioned above.

The figure 6.4.2-1 is a longitudinal section of typical steam turbine which may be applicable for this project.

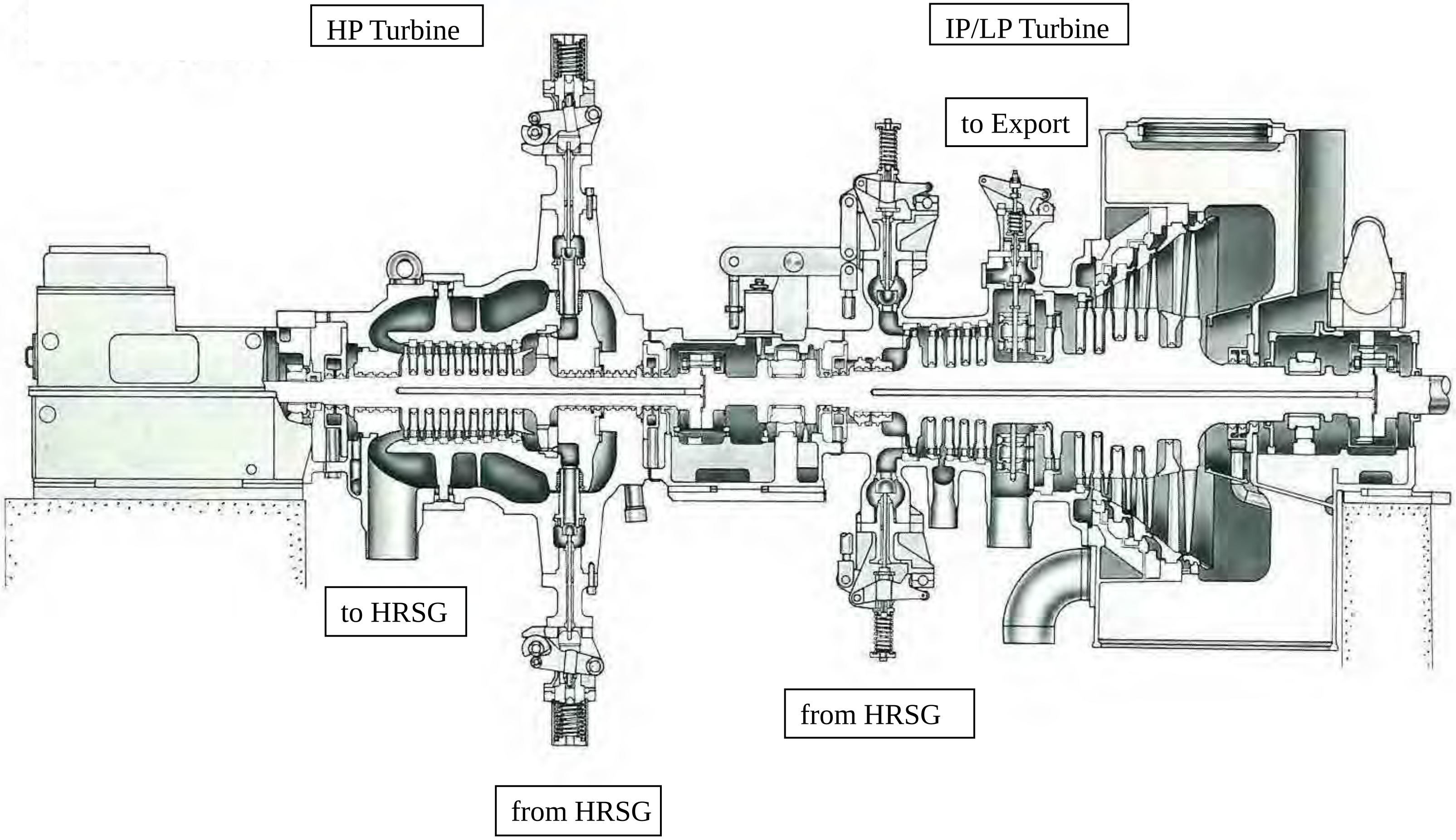


Figure 6.4.2-1 Longitudinal Section of Typical Steam Turbine

6.4.3 Heat Recovery Steam Generator (HRSG) System

(1) Introduction and Scope

This part of the specification covers the one Heat Recovery Steam Generator (HRSG) complete with ducting, mountings, integral valves and pipes, and other specified items associated with the one gas turbine generator of the combined cycle block.

The HRSG shall be of the fired, three-pressure, natural or forced circulation, reheat type of proven design in accordance with the requirements of BS 1113 or equivalent, where applicable.

The HRSG shall be designed to accept the maximum exhaust gas mass flow from a gas turbine at base continuous output with minimum specified ambient temperature and the heating surfaces shall be designed to take into account, the variation on the temperature/flow profile which will occur in the gases leaving the gas turbine under differing loads and ambient conditions.

The HRSG shall be capable of following the inherent rapid start-up and shut down of the gas turbine without undue thermal stress.

The HRSG shall be designed to operate on the exhaust gas of the gas turbine fired with natural gas. Furthermore, the HRSG shall be designed to operate with a duct burning system fired with natural gas. The purpose of the duct firing system is to maximize the quantities of extraction steam from the steam turbine for the industrial steam supply system and the hot water supply system especially in the winter season. The capacity of the duct firing system shall be determined carefully by the manufacturer taking into consideration the maximum allowable temperature of the hot gas duct as well as adverse effects on HRSG steam temperature control and others, however, the maximum firing rate shall be limited to the flue gas temperature rise to 750 ºC.

An exhaust gas bypass system with bypass stacks shall be incorporated to improve flexibility of combined cycle operation.

In the case of steam turbine trip, the HRSG shall be able to continue operation using the steam turbine bypass system and supply the heating steam instead of the steam turbine extraction steam.

The HRSG design shall be such as to minimize the back-pressure on the gas turbine while maintaining the rated output and steam conditions.

The HRSG should be constructed of large, factory-tested, shippable modules to reduce installation time. Following heat transfer modules shall be considered, as applicable, for the HRSG design:

- High Pressure Superheater Section
- High Pressure Evaporator Section
- High Pressure Economizer Section
- Reheater Section
- Intermediate Pressure Superheater Section
- Intermediate Pressure Evaporator Section

- Intermediate Pressure Economizer Section
- Low Pressure Superheater Section
- Low Pressure Evaporator Section
- Low Pressure Economizer Section
- Condensate Preheater (if required)

To minimize the outage time for inspection and maintenance, provision shall be made to allow ready access to the flue gas path, tubing, and other pressure parts. Access doors with integral seals to prevent gas leakage to atmosphere shall be provided.

The HRSG shall be designed for indoor installation to protect both personnel and equipment from the external environment and in particular offer freeze protection during the winter season.

The steam drums shall be sized sufficiently large to accommodate water level variations during start-up and during operating transient conditions without resorting to wasteful water dumping or risk of carry over. The drum capacity shall also be sufficient such that tripping of any one operating boiler feed water pump shall not cause HRSG trip prior to standby feed water pump reaching its operating load. Particulars of the general layout of the water circulating system including the number and internal diameter of feeders and mains for each circuit shall be provided.

The HRSG shall be arranged with the total pressure parts comprising steam drums, superheaters, reheaters, evaporators, economizers, headers, down comers and integral pipe work in the form of a self-contained unit supported by its own steel structure. This structure is to be quite independent of any building except for normal points of interconnection with access galleries, platforms, or stairways.

The design of the HRSG and associated ancillary and auxiliary systems shall have been developed for both base load and cycling service in particular where component material stress and structural design are concerned. Any special features for the HRSG necessary to permit both constant and variable pressure operation for the turbine steam temperature matching shall be incorporated. The capacity in terms of interval at maximum continuous steaming rate between normal water level, low water level, low water level alarm, low water level trip and minimum level at which the HRSG will not sustain damage shall be not less than ten seconds.

(2) Design and Operating Conditions

HRSG shall be suitable for the normal and abnormal operating conditions to suit the proven combined cycle plant design and as per the Heat Balance Diagrams.

The gas side of the HRSG passages shall be designed for the maximum temperature, pressure and mass flow that can be anticipated under all operating conditions (including trip situation). The maximum values will not necessarily be concurrent.

The HRSG shall be able to meet the requirements of sustained base load as well as two shift operation.

The HRSG shall be capable of automatic variable pressure operation both for sustained base load as well as two cycling regimes, to minimize the turbine thermal stress levels and obtain the desired flexibility and efficiency. The manufacturer shall define the variable pressure characteristics of the HRSG including the minimum load at which variable pressure operation can be sustained.

Under conditions of total load rejection, the operation of the HRSG shall be rapidly transferred to the steam turbine bypass operation mode by means of the high pressure, intermediate pressure and low pressure steam bypass system as well as the exhaust gas bypass modulating control dampers and the thermal load of the HRSG shall be reduced in accordance with the gas turbine shut down characteristics. In the case of the steam turbine generator trip, the gas turbine and HRSG shall be able to continue operation in the steam turbine bypass operation mode to supply steam for the neighboring industries and the hot water supply system instead of the steam turbine for at least a few days until the back up from the existing power plants becomes available.

The starting and loading to full load of the gas turbine shall not be restricted in combined cycle operation. It is intended that the diverter damper shall be capable of being operated in a number of pre-fixed intermediate positions to cater for hot, warm and cold starts of the HRSG with the gas turbine operating at full load as well as during HP/LP bypass operation.

The HRSG is to be designed such that it can be started-up in following two operating modes:-

- Start-up together with GT
- Start-up of HRSG when the GT is already operating at full load. Flue gas regulation shall be achieved by regulating the diverter damper.

The HRSG design shall be optimized for continuous efficient operation over the entire operating range of the gas turbine. The efficiency between 70% and 100% MCR shall be maximized.

The feed water quality shall meet the requirement of the HRSG and steam turbine as per applicable code.

(3) Design Standards and Codes of Practice

All materials, designs, manufacture, construction, and inspection and testing shall conform to criteria and recommendations of the relevant codes and standards.

All pressure parts, mountings, fittings and sub-assemblies shall be designed, constructed, and tested to conform to the requirements of the approved Inspection Authority.

(4) Design and Construction of HRSG

1) HRSG Gas Path

The gas turbine exhaust gas path through the HRSG shall be horizontal or vertical with water and steam tubing located horizontally/vertically across the gas stream to suit the plant layout and as per the manufacture’s standard design.

The heating surfaces of various modules in the gas stream shall reduce the gas temperature to the lowest value practicable, with each of the fuels available to the gas turbine, without risk of damage from corrosive sulfur products at the economizer outlet or within the stack. Control of the feed water temperature to ensure that metal temperatures in any part of the economizer remain above the dew point shall be achieved via the deaerator.

The tubes and headers in each plenum shall be completely drainable and provision shall be provided to gain access to the tubing for inspection and maintenance.

2) Tubes

The tubes shall be of solid drawn or electrical resistant welding (EWR) steel as per the manufacturer’s experiences. The design, manufacture and testing of the tubes shall be in accordance with the relevant standard specification.

Adequate circulation ratio shall be provided to minimize circulation upsets that may occur during rapid start-up or load change.

Fins added to the heat exchanger tubing to improve the heat transfer characteristics must be continuously welded to the outside surface of the tubes.

All welds and tube connections to headers shall be outside the gas passage and readily accessible for inspection and maintenance.

3) Superheaters and Reheaters

The H.P superheater tubing shall be designed and located in the HRSG unit such that the steam temperature at delivery to the steam turbine will not exceed the H.P steam chest and rotor stated limits, with the gas turbine at base continuous output with highest anticipated ambient temperature, without recourse to desuperheating the steam. The design will be compatible with the requirements of constant and variable pressure operation and the variable characteristics of the gas turbine exhaust gas flow.

The design of the H.P., I.P and L.P superheater within the HRSG units shall ensure even distribution of steam through the tubes at all loads.
Superheaters and reheaters shall be in the form of fully drainable elements.
Superheater and reheater tubes are to be designed for with no steam flow in tubes during start-up. Material selection shall conform to the same.
Austenitic stainless steel shall not be used anywhere in the superheater.

4) Evaporators

The HP., IP and LP evaporator plenums will be designed to achieve a steam generation rate such that the gas leaving the zones is not more than 17.5ºC above the steam saturation temperature in that zone. (i.e. temperature difference at the pinch point: maximum 17.5ºC).

The evaporator shall be designed to operate over the full load range of the HRSG without drumming or vibration and the design will ensure an even distribution of water through the tubes. The evaporator elements shall be drainable completely.

5) Economizers

The HP, IP and LP economizers shall be designed to ensure stable non-steaming operation/single phase flow throughout the full operating range of the HRSG. Connections shall be arranged between the steam drum and the economizer inlet to enable circulation of water to be maintained through the economizer during start-up. Should recirculation of water through the economizer be necessary during start-up or low load conditions, the connections shall be arranged complete with a pump to allow this. The economizer elements shall be drainable completely.

6) Condensate Preheater (if applicable)

A condensate preheater for HRSG as the last heat recovery module shall be provided, if necessary for maximum heat recovery. The condensate preheater shall be designed for the condensate extraction pump shut off head. Material selection for the preheater shall be suitable for undeaerated condensate water.

7) Steam Temperature Control

The steam temperature at the outlet of the superheaters and reheaters shall be controlled using direct spray type desuperheaters.

The capacity of each desuperheater shall be selected taking all operating conditions especially operations with the duct firing system into consideration.

Spray water control station shall have a motorized isolation valve in the common line, interlocked to close automatically when the steam temperature reaches below a set point and to prevent water induction into steam turbine.

8) Safety Valves

Safety valves of approved number, design, and capacity shall be mounted in approved locations in accordance with the requirements laid down by the relevant regulations.

The safety valves at the superheater outlet shall be sized to have a discharge capacity equal to at least 20% of the maximum steam quantity generated by the HRSG. The safety valves at the steam drum shall have total discharge capacity equal to at least the remaining of the maximum steam quantity required for the protection of the HRSG.

Safety valves on the reheater must be sized to pass the maximum reheater flow without a rise in reheater inlet pressure of more than 10% of the highest set pressure.

9) HRSG Insulation and Cladding

The whole of HRSG shall be insulated internally and/or externally and all external insulation shall be cladded in accordance with the Specification to provide an entirely weatherproof unit suitable for indoor operation.
The insulation shall be of proven material and suitable for continuous service at the maximum operating temperature.

10) Access and Inspection Doors

Adequate access and inspection doors of an approved type and size shall be provided to allow free entry for maintenance and cleaning of the HRSG gas-path, and pressure parts.

11) Blowdowns and Drains

The steam drum shall be provided with a continuous drum water blowdown connection, located to ensure preferential discharge of concentrated drum water, complete with parallel slide isolating and regulating valves in accessible positions adjacent to the drum connection, capable of controlling the rate from 0.05% minimum to 4% maximum of the HRSG steam rating.

Intermittent blowdown and drain piping shall be included where necessary from all drainable sections of the HRSG down to the intermittent blow down tanks.

HRSG shall be provided with a continuous and intermittent blowdown tanks.

An adequate number of electrically operated blowdown valves and superheater and reheater drain valves shall be provided for automatic operations during start up, load operation, and shut down of the HRSG.

12) Economizer/Condensate Preheater Recirculation System (if applicable)

Economizer/condensate preheater recirculation pumps shall be provided if the overall plant design demands such an arrangement for the safe and efficient operation with the desired flexibility and reliability of the plant as specified in the Design Consideration under start-up and low load operation.

(5) HRSG Control & Instrumentation Requirements

1) General

The control and protection requirements for the HRSG are principally bounded by the following:

- On the gas side by the gas turbine exhaust and HRSG diverter damper position
- On the feed/steam side by the HP/IP and LP feed pumps discharge and the HRSG HP/IP and LP steam stop valves.

The control system for the HRSG shall be implemented in the Distributed Control System (DCS). All necessary control functions and interlocks required for safe and efficient operation of the HRSG shall be incorporated within the DCS. Separate DCS Field Control Stations/Remote I/O Stations shall be provided for interlock and protection related parameters and signals meant for control and monitoring purpose.

The control functions of HRSG shall comprise of the following as minimum:

- HP, IP and LP feed water control
- Start-up/load rate control
- Superheated steam temperature control
- Reheated steam temperature control etc.

The main protection/interlock associated with HRSG shall be implemented by utilizing the signals associated with the following as minimum:

- Gas Turbine Trip
- High-High and Low-Low Drum Level
- Steam Turbine Trip
- Steam Turbine steam bypass failure
- Local and Remote Emergency Trip, etc.

The start up, operation within the normal load range and shut down of the HRSG shall be fully automated up to the functional group level. However, the initial HRSG filling operation and the establishment of initial HRSG drum level shall be manually controlled and supervised from the Central Control Room and only local control may be provided for minor drain and vent valves, where these are not automatic and which are not required during normal steam rating.

The HRSG shall be capable of constant pressure operation up to 60% load and thereafter on variable pressure operation.

In the incidence of a steam turbine trip (at any load), excessive rate of increase of the HP/IP superheater temperature within the HRSG or a HRSG trip due to say a loss of feed water supply shall initiate the appropriate interlocks to move the diverter flap to the blast stack position and not trip the gas turbine unless the diverter flap fail to move to the correct position within a preset time.

HRSG permissive signals shall be required for moving the diverter flap from the bypass stack position to the HRSG position.

The following as a minimum shall move the diverter flap to the bypass stack position:

- Gas Turbine Trip
- Low-Low Drum Level
- Steam Turbine steam bypass failure
- Local and Remote Emergency Trip
- In the case of a steam turbine trip, the <<diverter flap>> shall be moved to a predetermined intermediate position to maintain the HRSG in a ready condition for reloading.

In the case of a steam turbine trip, the steam turbine bypass system shall be functioned to maintain the HRSG in a ready condition

MTBF (Mean Time Between Failure) of HRSG control & protection system, except for the transmitter, detecting elements and regulating devices, shall be more than 100 thousand hours of design.

The manufacturer shall supply the following instrumentation, control and protection system with all necessary components and accessories, but not be limited to:

- HRSG modulating control system
- HRSG system sequence control
- HRSG autonomous control system
- HRSG instrumentation etc.

2) Turbine Exhaust Gas Control Requirements

All control and instrumentation systems required for the regulation and supervision of the heat input to the HRSG shall include the controls for the turbine exhaust gas (TEG) diverter flap position for the direct regulation of TEG flow through the HRSG as well as all temperature and pressure measurement both on the gas and feed/steam sides.

The control system shall regulate the TEG flow into the HRSG to achieve the maximum rate of initial steam raising, steam load and delivery temperature variation compatible with the design thermal stress limitations associated with the critical HRSG and steam turbine components. Automatic HRSG start up shall be possible under the full spectrum of operating conditions which shall include the following:

- The parallel run up and loading of the two gas turbine generators and HRSG's

- The start up of the HRSG from any initial temperature condition (i.e. cold to full load temperature) with the associated gas turbine generator operating under part or full load conditions.

To control the temperature and pressure rise of the HRSG and steam piping during start-up, the diverter flap shall be set to predetermined positions based on the gas turbine load as well as the condition of the HRSG at start-up. This function may not be necessary if the HRSG can accommodate the full exhaust gas flow for all conditions of start-up and during transient operating conditions without the need to set the diverter flap to intermediate positions.

In addition to the start up requirements, the control system shall meet the following disturbance conditions:

- It shall maintain maximum steam generation compatible with the turbine bypass capacity in the event of the steam turbine tripping to permit the reloading of the latter with the minimum of delay.

- It shall minimize the effect of a partial or total block load rejection and maintain the HRSG in a state, which shall minimize the delay in the subsequent re-connection and loading of the steam turbine.

The control and supervisory functions of the following plant items shall be considered:

- The TEG diverter flap
- The gas passage between the inlet diverter flap and the HRSG exhaust.
- The HRSG LP economizer, drum, evaporator and superheat sections
- The HRSG HP/IP economizer, drum, evaporator and superheater sections

The principal sequence and protection control functions shall include the following as minimum:

- The start-up and HRSG Loading Control

The requirement for these control functions, is sequential in nature. In addition to the TEG diverter flap, the sequence controls of HRSG stop valves and associated bypass valves including all necessary state monitoring shall be controlled by these control functions.

A check to ensure that the diverter flap is fully closed in the bypass stack position shall form a pre-check in the HRSG start-up sequence. Only local controls are considered necessary for the operation of the diverter flap, to be restricted by a Permit-to-Work system.

- Shut-down

This function shall be capable of being initiated both manually and automatically from the central control system. The shut down function shall initiate co-ordinated closing of the TEG inlet and closing of HRSG stop valves after an appropriate delay. The stopping of HRSG feed pumps and circulation pumps may be regarded as manual action.

This sequence function shall initiate the tripping of the gas turbine if the diverter flap fails to move to the bypass stack position within a preset time after the HRSG is tripped and the operation of the diverter flap initiated.

The HRSG supervision shall not exercise any direct control functions but shall comprise of all measurement hardware required for the monitoring of the operational state of the HRSG.

3) Feed Control Requirement

The control and instrumentation system required to regulate feed water supply to HRSG shall include feed water regulation valves, instrumentation associated with drum, main steam and feed water together with feed water pumps.

Feed control system shall comprise of single element drum level control operating on low load feed water control valve and three element control operating on the full load feed water control valve nominally rated for 0% to 100% MCR feed water flow. Differential pressure across the feed water control station shall be maintained at constant value by varying the scoop position of the feed water pumps.

The system shall be designed to maintain the drum level within acceptable limits under all anticipated HRSG load changes and disturbances such as transfer from the duty feed water pump to the standby feed water pump etc.
The principal modulating control functions to be associated are:

(a) Start up feed water control
(b) Normal load feed water control

4) Drum Level/Feed Water Control

The control system shall comprise of single element drum level control operating on low load feed water control valve and a three element control operating on full load control valve (in case of HP & IP on one of the full load control valve). Low load feed water control valve is envisaged for controlling the drum level during plant start-up and low load operation upto 30% MCR. For normal load upto 100% MCR, full load control valve is envisaged to maintain the drum level. A stand-by full load feed water control valve (in HP & IP feed water control stations) shall be provided for improving the availability during on-line maintenance of the main valve. Facility shall be provided for both manual and automatic changeover from single element to three element control and vice versa.

The three element function shall consist of the steam flow, feed water flow and drum level. Steam flow measurements shall be pressure and temperature compensated and the drum level measurements shall be pressure compensated.

The feed water control shall develop the flow control signal for matching between feed water flow and steam flow using drum level deviations from the drum level set-point.

5) Main Steam Temperature Control

The steam temperature shall be designed to maintain the main steam temperature at the turbine inlet by means of the spray control valves. One or more stages spray control based on HRSG design shall be used for the control of superheater temperature.

The spray desuperheater shall be provided with shut-off valves. The feed forward circuit shall be used for the sufficient control response.

6) HRSG Autonomous Control System

The HRSG autonomous control system shall interface with the data highway of the Distributed Control System (DCS) through process I/O interface devices. The process I/O system shall have duplicated system architecture

The interface type shall be of either the conventional hardwired I/O interface (I/O) or the remote I/O interface (R-I/O)

The following ACS of the HRSG auxiliaries shall be interfaced to the data highway through I/O interface devices but not be limited to:

- HRSG metal temperature measurement system
- Environmental measurement system
- Water/steam sampling system
- Instrument air compressor system
- Service air compressor system

7) Instrumentation

The manufacturer shall provide all necessary instruments for HRSG and auxiliaries to allow centralized control and monitoring facilities from the operators’ consoles in Central Control Room, through microprocessor based Distributed Control System (DCS).

The following field control and instrument devices shall be provided:

- Gauges, Transmitters, etc.
- Detecting elements such as flow element, thermocouple, pressure switches and temperature switches, etc.
- Regulating devices such as control valves, vanes, dampers, and drives, etc.
- Local instrument panels (if necessary)
- All piping, tubing and wiring necessary for satisfactory operation shall be provided.

This shall include instruments for measuring the following minimum process parameters:

(a) Feed water
(b) Drum
(c) Steam

HRSG metal temperature, drum level viewing system including indicator (optical fiber system) and all other necessary pertinents.

The manufacturer shall provide all local instruments.

- Pressure gauges
- Thermometers
- Flow indicator
- Level gauges
- Limit switches, etc.

6.4.4 Heat Supply System

6.4.4.1 Steam Supply System and Hot Water Supply System

(1) Introduction

Supply of processing steam for neighboring industries (industrial steam supply) and supply of hot water for district heating (hot water supply) shall be carried out, using two adjustable steam extractions from the steam turbine of CCCGP No. 2.

In accordance with Preliminary Feasibility Study of the project, the capacities of the industrial steam supply and the hot water supply are 230 Gcal/h and 120 Gcal/h respectively. However, the Study Team would like to recommend that the capacities should be 100 Gcal/h and 100 Gcal/h. The reasons are as following:

i) The capacity of 350 Gcal/h (230Gcal/h + 120 Gcal/h) seems to be too large for a single unit to shoulder. Since the heat supply capacity is more than two (2) times larger than the maximum unit capacity of the existing facilities (maximum 150 Gcal/h), and the heat capacity can cover the whole heat demand in Navoi TPP, in case that the unit should trip due to some trouble, it is difficult for the existing units to start up soon and back up the deficiency. The existing units and the new plant should share the heat demand to prevent such a fault.

ii) The heat supply capacity shall be specified at 200 Gcal/hr (100 Gcal/h+100 Gcal/h), which would be optimum to realize the reliable operation of heat supply system.
The Study Team also proposed to supply the required heat in accordance with operation mode as per shown in Table 6.4.4-2 “Heat demands and combination of operating plants”.

The existing plants were all constructed 30 to 50 years ago and their life spans have almost expired. However, in order to manage the heat supply systems in Navoi city, the existing plant must continue their operation with CCCGP No. 2 until the day when another new back up plant should be constructed. Therefore, it seems indispensable that the renovation plan of these plants should be planned and carried out urgently.

Table 6.4.4-1 Current Situation of Heat Supply Capacity

Name of Plant	Industrial Steam (Gcal/hr)	Hot Water (Gcal/hr)	Total (Gcal/hr)
Existing plants			
Unit No.4		33	33
Unit No.5	150		150
Unit No.7	113		113
Unit No.9		33	33
CCCGP			
Unit No.1		43	43
Unit No.2	100	100	200
Total Capacity	363	209	572

Table 6.4.4-2 Heat demands and combination of operating plants

	Steam (Gcal/hr)	Hot Water (Gcal/hr)	Total (Gcal/hr)
Heat Demand (*1) -High (Nov. ~ March) -Low (April ~ Oct.)	 231~**250** 139~**192**	 131~**194** 16~**47**	 362~444 163~224
Typical combination of operating units to satisfy the heat demands	High season: -No. 5+CCCGP2: 250 -No. 5+No. 7: 263 Low season: -No. 7+CCCGP2: 213 -No. 5: 150	High season: -No.4, 9+CCCGP1, 2: 209 -No. 9 + CCCGP1, 2: 176 Low season: -CCCGP2: 100 -No.4, 9: 66 -CCCGP1: 43	

Remarks: *1: Steam and hot water demands are based on the data collected at the 3rd site survey. Please refer to Fig 4.2.1-5 "Record of Monthly Heat Supply in 2011" for detail.

(2) Description of industrial steam and hot water supply system

Schematic thermal diagram of the unit for steam and hot water supply system from equipment of power unit of CCCGP No. 2 is given in Fig 6.4.4-1 ~ Fig. 6.4.4-3.

Thermal energy supply in steam is carried out to general station header from processing extraction of the steam turbine with 8-13 kg/cm2 abs. pressure. Steam conduit from steam discharge unit of processing extraction passes through the hot water supply system house.

In accordance with letter of "Navoi TPP" OJSC No. 9/875-GRP dated 03.10.2012, return of condensate from the process steam consumers is 27% of the quantity of supplied steam.

Hot water heaters in hot water supply system are intended for heating return water from the hot water return mains as well as hot water make-up water with the extraction steam of steam turbine. The heating steam is supplied to distributing header and then to main heaters of hot water (hereinafter as HHSW). Selection of the quantity and schemes of the heaters had been carried out based on requirements of the paragraph 11.7 of Departmental standards of process engineering 81 "Process engineering standards of thermal power plants". Total number of HHSW is four (4). In the state of moderate realization of thermal energy three (3) HHSW are used as operating units and one (1) HHSW is used as standby unit. In the state of maximal realization of thermal energy all four (4) HHSW may be used in operation. Taking into account of availability of peak-load hot water heaters in Navoi TPP as well as for avoidance of wasteful operation mode of power unit of CCCGP No. 2, peak-load heaters of hot water supply system water are not provided.

Condensate of heating steam after integrated condensate cooler and level controller in HHSW is supplied to suction header of condensate pumps (hereinafter as CP). In accordance with the paragraph 11.8 of Departmental standards of process engineering 81, number of CP is to be taken as two (2) units without standby. After CP condensate of heating steam is received to discharge header and further returned to circuit of turbine condensate (TC) of power unit of CCCGP No. 2.

In start-up conditions condensate of heating steam from HHSW through additional cut-ins is received to general header by gravity flow and then through hydraulic loop is branched to tank of low points (TLP) of power unit of CCCGP No. 2.

Return water is supplied to general inlet header before HHSW of φ630 x t8 after hot water supply system pumps. Return water for input of each of four (4) HHSW is received by separate pipelines ofφ325 x t8. After heating in HHSW up to 110°C hot water is branched from each HHSW to general header of direct hot water supply system water. For enabling water temperature control special control unit is provided in direct line of hot water supply system with adequate fitting. The main flow of hot water from the header is supplied to consumers (including heating of working area of CCCGP No. 2 and utility module).

Part of the water from header of direct hot water supply system water is supplied through pipeline as heating medium to a column of vacuum deaerator. The remaining part of the water is supplied through pipeline to plate heater of chemically treated water before vacuum deaerator.
For removing of corrosive gases (oxygen and free carbon dioxide) from chemically treated makeup water, vacuum deaerator (hereinafter as VD) is provided.

Capability and number of hot water supply system pumps are accepted in accordance with paragraphs 5.21, 523 of KMK 2.04.07-99 “Heating systems” as well as according to the paragraph 11.8 of Departmental standards of process engineering 81:

- One (1) x 100% capacity winter hot water supply pump is installed for operation and one (1) backup winter hot water supply pump with the same capacity is provided in warehouse;
- One (1) x 100% capacity summer hot water supply pump is installed and one (1) backup summer hot water supply pump with the same capacity is provided in warehouse.

In winter conditions two (2) winter hot water supply pumps are operating simultaneously. In winter conditions the following are received to suction header of hot water supply pumps:

- Return hot water from consumers;
- Water after makeup pumps plus heating water after DV-300;
- Hot water make-up water chemically treated and heated by plate heaters

Water from discharge header of hot water supply system pumps is received to general inlet header before HHSW. Capability and number of makeup pumps are accepted in accordance with paragraphs 5.22, 5.23 of KMK 2.04-07-99 “Heating systems” as well as according to the paragraph 11.8 of Departmental standards of process engineering 81 “Process engineering standards of thermal power plants”:

- Two (2) winter make-up pumps where one is operating and another is standby;
- One (1) summer make-up pump.

In winter conditions or in summer period of peak load one winter makeup pump is in operation. The second pump is in standby condition. Summer makeup pump is intended for operation within off-peak periods of hot water supply. Water from deaerator tank (deaerated chemically treated water plus heating water after DV-300) at 70°C is received to suction header of makeup pumps. Water at 70°C is received to suction header of hot water supply pumps from discharge header of makeup pumps. Two water-jet ejectors (hereinafter as WJE) are used as gas-suction unit for VD, one as operating and one as standby. Widespread closed circuit of water-jet ejectors is used. Power water is supplied to ejectors by special pumps of power water NRV-1, NRV-2 with constant pressure head.

In normal conditions, one ejector and one pump of power water are in operation. In this case the second ejector and second pump are standby. After suction and condensation of gas-vapor mixture, power water is returned to power water tank. For avoidance of power water overheating, its cooling is provided in plate-type heat exchanger which functions as cooler of power water. Raw water serves as cooling medium in cooler which is supplied to water treatment plant from raw water pumps.

Additional cooling of power water is carried out by raw water makeup of power water tank for making up of its losses. Part of the water from header of direct hot water supply system water at 110°C is supplied to inlet of plate-type heater as heating medium for heating of raw water before water treatment plant (heater of raw water – HRW).

For providing of hot water circulation, two recirculation pumps are provided for its heating in summer conditions, one as operating, and one as standby.

In summer conditions one (1) recirculation pump is in operation.

In summer conditions the followings are received to suction header of recirculation pumps:

- Hot water chemically treated and heated to 60°C by plate-type heater;
- Raw water heated to 60°C by plate-type heater;
- Water after makeup or hot water supply system pumps (depending on required pressure head in hot water supply system of consumer);
- Make-up water deaerated and heated to 70°C by DV-300.

Water from discharge header of recirculation pumps is received to general inlet header before HHSW according to special collected summer scheme. In summer conditions one (1) of four (4) HHSW is in operation.

After heating in HHSW up to 110°C, hot water is branched to Hot water supply general header from operating HHSW.

Part of the water at 110°C from the supply header is supplied through pipeline to column of vacuum deaerator as heating medium. Another part of the water at 110°C is supplied through pipeline to plate-type heater of chemically treated water before vacuum deaerator and to plate-type heater of raw water.

Water for hot water supply (HWS) of consumer is supplied after makeup or hot water supply system pumps (depending on required pressure head in hot water supply system of consumer) at design temperature of 70°C. Water to HWS may be supplied both through direct and through return pipeline of main hot water supply system.

Description of the main processing equipment layout

Boiler house with deaerator of hot water supply system and other auxiliary equipment is directly adjoined to turbine hall of steam turbine.

All pumping equipment is located at the mark of 0.000 of boiler house.

- Hot water supply system pumps for winter conditions (position 2) are longitudinally placed – 2 pumps;
- Hot water supply system pump (position 1) for summer conditions is longitudinally placed;
- Makeup pumps (position 4) for makeup in winter conditions and summer conditions of extensive flow for HWS are longitudinally placed – 2 pumps;
- Makeup pump (position 3) for makeup in summer conditions within off-peak period of HWS is longitudinally placed – 1 pump;
- Recirculation pumps (position 12) for summer conditions are transversally placed – 2 pumps;

- Condensate pumps (position 13) for pumping out of condensate of heating steam from HHSW are longitudinally placed – 2 pumps;
- Power water pumps (position 5) are longitudinally placed – 2 pumps;

The following processing equipment is located at the mark of 0.000:

- Water-to-water plate-type heat exchanger (position 11) for power water cooling of ejectors and simultaneous preheating (first stage) of raw water further to be supplied to HRW;
- Water-to-water plate-type heat exchanger (position 15) for heating of raw water – HRW for its subsequent supply to water treatment plant;
- Power water tank (position 6) for power water pumps of ejectors.

Four (4) vertical heaters of hot water (position 10) are installed at the mark of 9.000 of hot water heater house. The following processing equipment is installed at the mark of 18.00 of hot water heater house:

- Column vacuum deaerator (position 7) with deaerator tank (position 8);
- Water-jet ejectors (position 9) – 2 ejectors;
- Water-to-water plate-type heat exchanger (position 14) – heater of chemically treated water before vacuum deaerator.

Installation of hoisting device is provided for carrying out of repair and maintenance work – supporting bridge crane with lifting capacity of 12.5 tonnes based on weight of detachable part of HHSW.

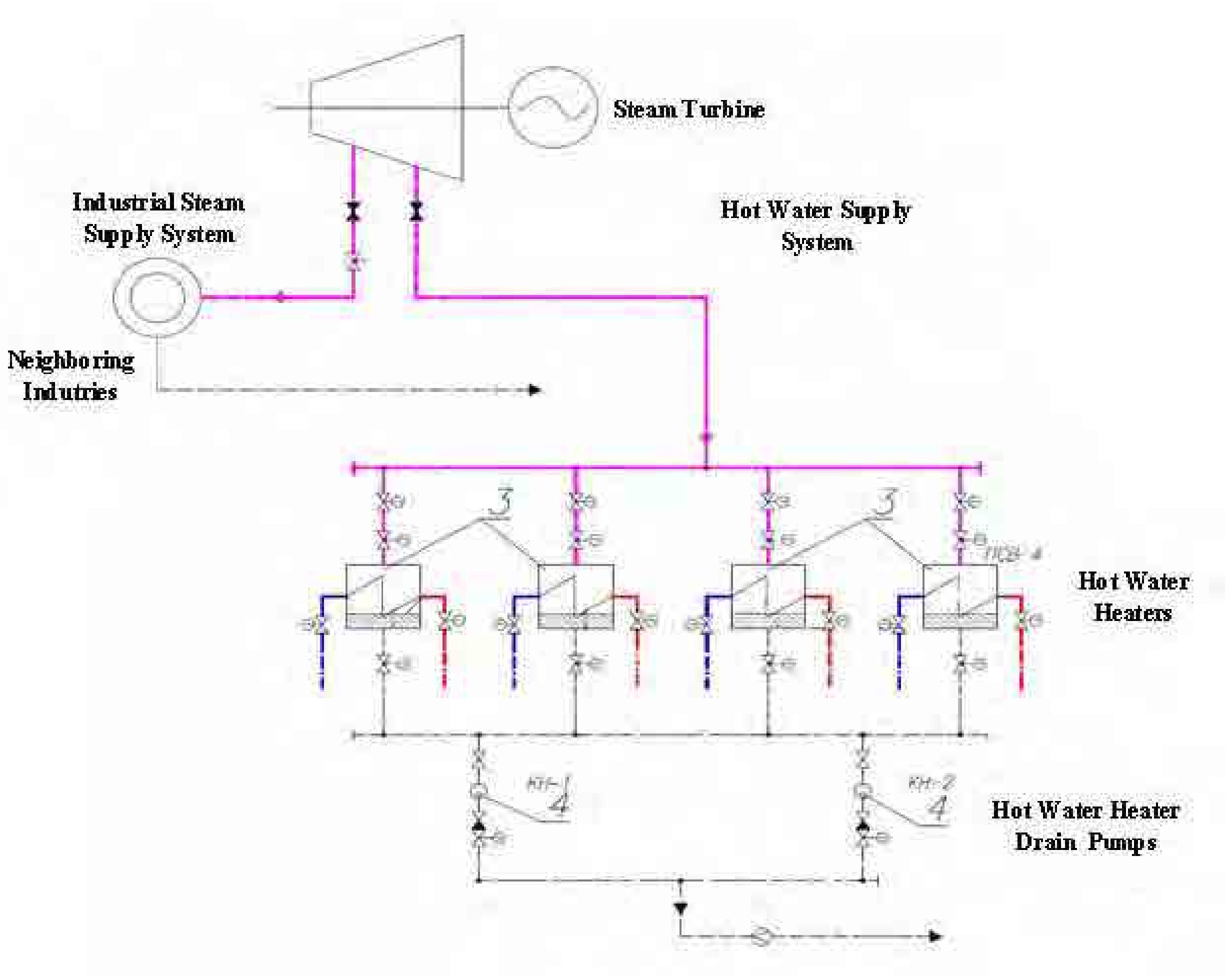


Figure 6.4.4-1 Flow Diagram of Steam and Condensate for Heat Supply System

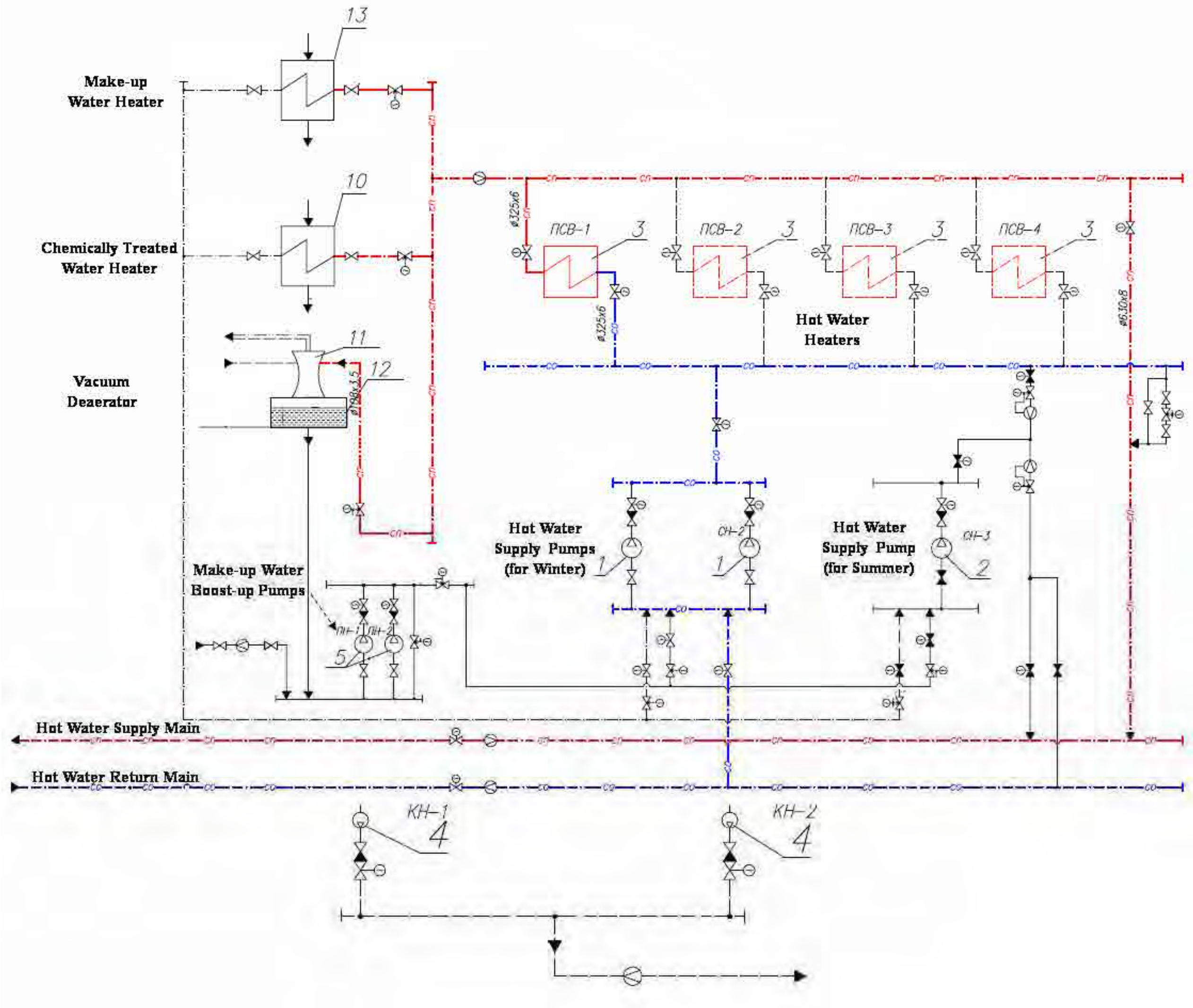


Figure 6.4.4-2 Flow Diagram of Heaters and Water Pipes for Hot Water Supply System

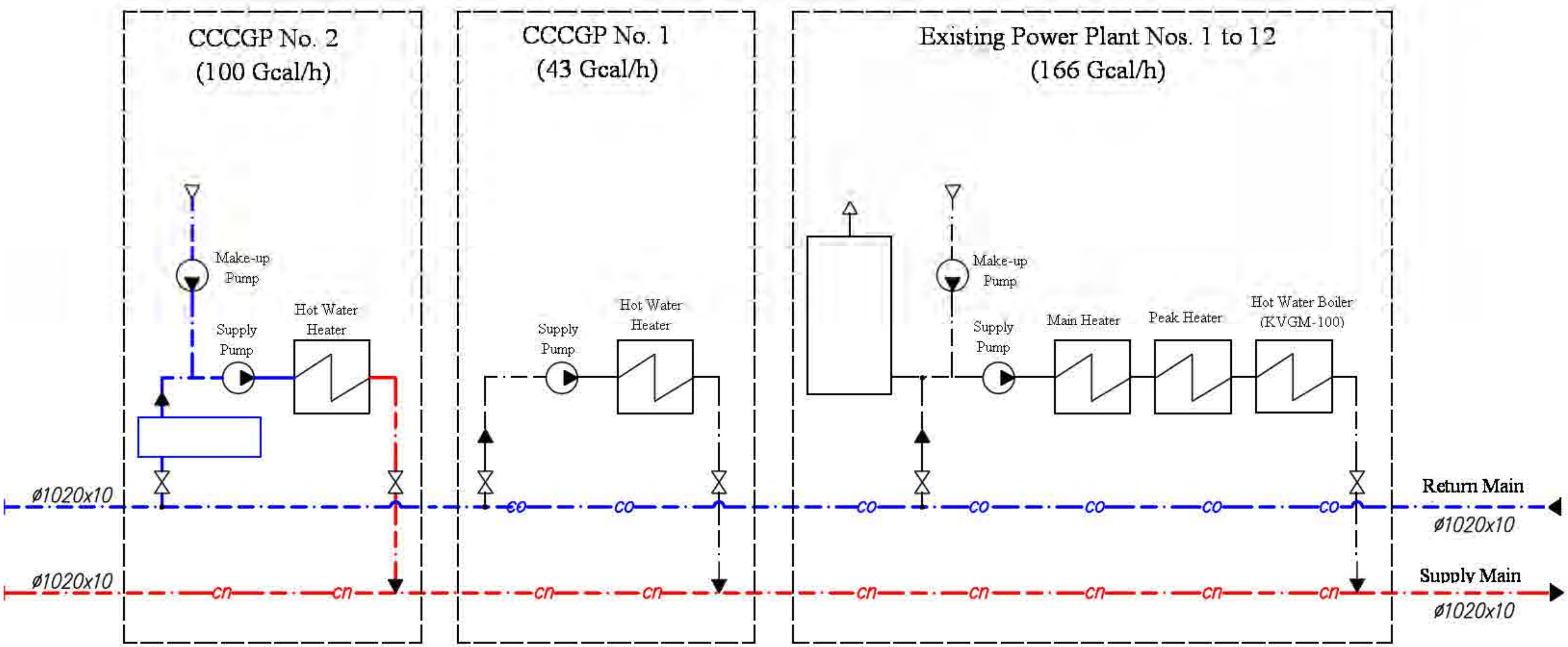


Figure 6.4.4-3 Block Diagram of Connections for Hot Water Heaters for CCCGP No. 2 and Existing Hot Water Mains

6.4.4.2 Water Treatment System for Hot Water Make-up

(1) General

A complete water treatment system shall be provided, comprising one set of water pre-heater, two trains of uniflow H-Na-cation exchangers, decarburizer, and auxiliary equipment and water storage tanks to supply the make-up water required for the hot water supply system of CCCGP No. 2.

Regarding the industrial steam make-up water, it is provided as make-up water for the steam turbine and HRSG cycle through the demineralized water plant described in Section 6.4.5 "Water Treatment System".

Raw water for water treatment system shall be drawn from the main piping of town water supply system. A typical analysis of raw water (town water) is as shown in Table 6.4.4-3.

Table 6.4.4-3 Chemical Analysis of Raw Water (town water)

Description of parameter	Molecular weight or in conversion per 1 mole (kg/kmol)	Minimal value		Maximal value	
		mg/l	mg-eq./l	mg/l	mg-eq./l
Alkalinity	-	-	3.2	-	4.4
Dissolved solids	-	1300	-	2000	
Total hardness		-	11.9	-	18
Bicarbonates	61.02	195.2	3.2	268	4.4
Chlorides	35.48	77.9	2.2	110.0	3.1
Sulfates	48.03	500	10.41	680	14.16
Nitrates	62.01	6.0	0.1	10.4	0.17
Calcium	20.04	107	5.34	200	9.98
Magnesium	12.16	83.9	6.9	96	7.9
Sodium	23.0		3.59		
Iron total	56.0	5.0			
SiO_2^-		8.3		13.0	
pH		8.3		8.3	

The hot water shall conform to requirement of Russian National Standards GOST 2874-82 "Drinking water. Hygienic requirements and quality control" as well as the requirements of RD 34-37-10-504 for water of hot water supply system as shown in Table 6.4.4-4.

Table 6.4.4-4 Requirements of Hot Water

Description of parameter	Required Value	Codes and Standards
Alkalinity	0.7 to 1.5 mg-eq./l	GOST 2874-82
Hardness	< 7 mg-eq./l	"
Heated up temperature	Up to 110°C in hot water heaters	RD 34-37-10-504
Carbonate index	3 mg-eq./l	"

(2) System Description of Water Treatment Plant

The version of operating scheme of water-treatment plant shall be parallel H-Na-cation-exchange of raw water followed by decarburization of general flow. In selection of treatment method the required amount of H-cationic water and Na-cationic water shall be taken into account for their mutual neutralization based on alkalinity index of the raw water followed by decarburization of overall flow treated by cationic water.

The plant is intended for water treatment of hot water supply system makeup with open water pumping. The chemical composition of raw water is given in Table 6.4.4-1. Plant capacity based on auxiliaries is 223.0 m^3/h.

Water treatment is carried out according to the scheme: uniflow H-Na-cation exchange, and decarburization. This scheme provides scale-free operation of hot water heaters by margin of calcium sulfate solubility and carbonate index.

In the period of high heat loads, design water temperature in hot water heaters based on heat development and near-wall boiling will be 150°C (110° + 20° + 20° = 150°). For preventing calcium sulfate deposit 16.9% of water is exposed to H-cation exchange and 83.1% of water to Na-cation exchange followed by decarburization of overall water mix. In this case product solubility of calcium sulfate will be PSCaSO4 = 1.05 x 10-6 (mg-eq./l) and equals to tolerable PSCaSO4 for 140°C temperature.

Structurally the plant consists of six (6) Na-cation-exchange filters: (four (4) in operation, one (1) in standby, one (1) under repair), three (3) H-cation-exchange filters (one (1) in operation, one (1) in standby and one (1) under repair).

Water treatment plant is located in the main building and consists of the following premises:

- Filtering room with filters of water treatment plant for hot water makeup;
- Two pumping lines where all pumping outfit is installed.
  Heater of raw water is installed in the main hot water heater house.
- Gauge tanks are mounted on stacks, level is 5.0 m.
- External tank facilities

(3) Layout of Water Treatment Plant for Hot Water Makeup

Raw water from consolidated power system of Navoi Mining and Metallurgical Complex flows to tank of raw water (position 1) with 400 m^3 capacity and then supplies to suction pumps of raw water (position 2). Pump thrust is 62 m of water column with 300 m^3/h capacity. Line of recirculation pumps is planned for flow control of raw water to be supplied to raw water tank.

Line from raw water pumps is provided for filling of washing water tanks of Na-cation-exchange filters (position 21).

Then water supplies to heat exchanger (position3) which is located in boiler house for heating up to 35°C. Heated water in the control unit is separated into two flows: 16.9% of water supplies to H-filters and 83.1% of water to Na-filters.

Both flows of softened water are combined in pipeline and supplied to decarbonator (position 9). Further the water is collected in decarbonated water tank with 250 m3 capacity (position10) where pumps for decarbonated water (position 11) are pumped to vacuum deaerator at the mark of 18. Line of decarbonated water has adjustable branch pipe to salt warehouse for preparation of regenerant solution as well as recirculation line of decarbonated water pumps to decarbonated water tank (position 10).

Dosing unit of regenerant saline solution consists of two gage tanks with 10 m^3 capacities each (position 4) and two pumps for salt (position 5) (pump capacity – 50 m^3/h, head – 32 m of water column).

Gage tanks have: control unit for supplying of 6% saline solution from the warehouse of salt depending on their operation; discharge and pouring pipe directed to drainage pit with 18 m3 capacity (position 20).

Salt feeding pumps are equipped with recirculation line (self adjustable) directed to gage tanks.

Recovery of Na-cation exchange filters is uniflow, regenerant solution – 6% saline solution.

Recovering waters and 25% of washing waters of Na-cation exchange filters are received to drainage pit (position 20) and simultaneously pumped out to equipment set for processing of industrial drain by pumps of drain water of Na-cation exchange filters (position 19) (pump capacity – 50 m^3/h, head – 32 m of water column), and the remaining 75% of washing waters are sent to washing water tank of Na-filters (tank volume 160 m3) (position 21). Scheme of washing water tanks of Na-filters is provided for capability of washing water reuse for loosening of Na-filters by loosening pumps of Na-filters (position 22) (pump capacity – 160 m^3/h, head – 30 m of water column) followed by water accumulations after loosening and pumping them out by above mentioned pumps to feeding line to clarifier or to equipment set for processing of industrial drain.

Pumps of backwash water (position 22) have self adjustable recirculation line to washing water tanks of Na-filters (position 21).

Recovering of H-cation exchange filters:

Recovering unit of H-cation exchange filters consists of: gage tank of concentrated sulfuric acid (92%) with 1 m^3 capacity (position 6), two dosing pumps (position 7) (pump capacity – 400 l/h, head – 16 kg-force/cm). Gage tank of sulfuric acid (92%) has a pouring and discharging line directed to drainage pit of H-filters (position 16) with 18 m^3 capacity. Filling of gage tank by sulfuric acid is carried out by pumping-over of sulfuric acid from ibc-container once per day. Dosing pumps of sulfuric acid have recirculation line which is directed to gage tank of (92%) sulfuric acid. Dosing of the acid is carried out for general recovering header to which the decarbonated water is simultaneously supplied by pressure pumps (position 8) (pump capacity – 100 m^3/h, head – 32 m of water column) from decarbonated water tank with 250 m^3 capacity (position 10).

Recovering of H-cation filters is uniflow. Recovering acid solution is fed by portions with 0.3%, 0.6%, 1%, 3% and 6% concentrations. The first two portions of the acid with 0.3% and 0.6% concentrations after regenerant filter are received to drainage pit with 18 m3 capacity (position 16) and simultaneously pumped out by drainage pumps of H-filters (pump capacity – 50 m^3/h, head – 32 m of water column) (position 15) to equipment set for processing of industrial drain. The remaining three portions of the acid with 1%, 3% and 6% concentrations after regenerant filter and part of the washing water are collected in tank for loosening of H-filters with 100 m^3 capacity (position 17) for reusing, i.e., for loosening of H-filters by loosening pumps of H-filters (pump capacity – 200 m^3/h, head – 32 m of water column) (position 14). The major part of the washing water is collected to washing water tank of H-filters with 250 m^3 capacity (position 18) to which the waters after loosening of H-filters are also collected where the scheme is provided for pumping out of these waters by group of pumps stated above to equipment set for processing of industrial drain or to feeding line of water to clarifier. Loosening pumps of H-filters (position 14) have self adjustable recirculation lines to a loosening tank of H-filters (position 17) and a washing water tank of H-filters (position 18).

6.4.5 Water Treatment Plant

(1) General

A complete water treatment system comprising water settling ponds, water pre-treatment plant and demineralized (DM) water plant to supply the make-up water required for the steam turbine and HRSG cycle of CCCGP No. 2 shall be provided.

Since the industrial steam is extracted from the steam turbine and consumed in the neighboring chemical companies, its make-up water needs to be provided through the demineralized water plant.

On the other hand, the make-up water of hot water, of which water quality is different from that of the demineralized water, shall be provided through the other water treatment facilities in the hot water supply system as described in Section 6.4.4 “Heat supply system”.

Raw water for water treatment system shall be drawn from Zarafshan River. The result of water quality survey of the river water is shown in Section 8.1.2 “Table 8.1.2-1 Comparison of water quality in Zarafshan River with the environmental standard”.

(2) Scope of Work

The scope of work shall include design, manufacturing, supply, delivery to site, installation at site, commissioning and testing of complete water treatment system comprising the following:

1) Settling ponds comprising two (2) sets x 100% capacity ponds, two (2) sets x 100% capacity raw water pumps and two (2) sets x 100% capacity sediment removing equipment.
2) Water Pre-treatment (Filtration) Plant comprising two (2) sets x 100% capacity raw water pumps, two (2) streams x 50% capacity multi-media filters (2 x 530t/h), two (2) sets x 100% capacity backwash pumps, two (2) sets x 100% capacity blowers for filter air scouring, and one filtered water storage tank to store filtered water required for backwash.
3) Demineralization Plant comprising two (2) set x 50% capacity activated carbon filters (ACF) with 10 micron cartridge filter, and two (2) streams x 50% capacity demineralizers (2 x 480t/h) including resins, and two (2) DM water storage tanks (2 x 34,000m^3), and two (2) x100% capacity DM water transfer pumps
4) Chemical regeneration system including storage tanks, regeneration pumps backwash tower and measuring equipment.
5) Pipe work and valves, supports, fittings and interconnections.
6) Electrical equipment.
7) Instrumentation and control system.
8) Instrument air supply system.
9) Spare parts required for two year operation and specified in the specification
10) Special tools and standard tools set

(3) Applicable Standards and Codes

The water treatment plant shall be designed and constructed in accordance with the requirements of international standards and codes.

(4) Design and Performance Requirements

1) Capacity of water treatment plant

The consumptions of demineralized water and pre-treated water are estimated as 19,050m^3/day and 20,990m^3/h respectively. The consumption of the Zarafshan River water is 20,990t/day for this treatment plant. On the other hand, the consumption of the city water (tap water) is 6,000t/day for the hot water make-up water of CCCGP No. 2. The break downs are as shown as following:

i) Demineralized water consumption

Industrial steam supply capacity shall be 100 Gcal/h (13 ata, 300 ºC, 140.4t/h). Cycle loss shall be taken account as much as 4% of main steam flow.

The make up water for the mechanical draft wet type cooling tower 560t/h shall be provided from the deminerarized water, since the river water contains dissolved solid exceeding the allowable limit and the pretreated water is not applicable for the make-up water.

Table 6.4.5-1 Demineralized water consumption

Item	Unit	Consumption	Remark
Industrial steam	t/day	3,370	13ata x300ºC, 100Gcal/h 140t/h
Steam cycle loss	t/day	450	Max 4 % of main steam
Closed cooling water	t/day	30	1.0t/h
Cooling tower	t/day	13,440	560t/h
Miscellaneous	t/day	20	
Demineralizer washing	t/day	1,740	10 % of the above total
Total	**t/day**	**19,050**	**794t/h**

ii) Service water consumption
Make up water for the mechanical draft wet type cooling tower is estimated as 440t/h.

Table 6.4.5-2 Service water consumption

Item		Consumption	Remark
Demineralized water	t/day	19,050	From item i) above.
Miscellaneous	t/day	30	
Pre-treatment washing	t/day	1,910	10 % of the above total
Total	**t/day**	**20,990**	**875t/h**

iii) Hot water consumption (for reference)
The total consumption of hot water in Navoi city is estimated as 26,400t/day, among which 6,000t/day shall be provided from CCCGP No. 2 and the remainder will be provided from the existing Navoi Thermal Power Plant. Since the tap water will be treated and supplied to the hot water system, the make-up water shall be provided from the other water treatment plant using the Navoi city water as a raw water. He details of the system are as described in Section 6.4.4 “Heat supply system”.

Table 6.4.5-3 Hot water consumption

Item	Max	Winter	Summer	Remark
Supply water	6,500 t/h	5,800 t/h	850t/h	
Return water	5,400 t/h	4,700 t/h	0t/h	
Consumption	1,100 t/h 26,400t/day	1,100 t/h 26,400t/day	800~900t/h	
Make-up water by CCCGP No. 2	250t/h 6,000t/day			Max. 100Gcal/h

iv) Capacity of water treatment plant
The capacity of each water treatment plant shall be determined based on the operating time of twenty (20) hours a day excluding regenerating or cleaning time of four (4) hours a day.

Table 6.4.5-4 Capacity of water treatment plant

Item	Pretreatment	Demineralizer	Remark
Consumption	20,990t/day	19,050t/day	
Operating hour	20h/day	20h/day	
Required capacity	1,050t/h	953t/h	
No. of Train x Capacity	2 x 50%	2 x 50%	
Selected capacity	**2 x 530m^3/h**	**2 x 480 m^3/h**	

v) Capacity of Treated Water Tank

The capacity of each water storage tank shall be determined taking account of three days storage and effectiveness factor of 0.85.

Table 6.4.5-5 Capacity of water storage tank

Item	Unit	Service water	Demi water	Potable water	Fire Tank
Water Flow Rate	t/day	20,990	19,050	45	-
Storage day	day	3	3	3	-
Effective storage capacity	m^3	62,970	57,150	135	1000
No. of tanks	**tank**	**2**	**2**	**1**	**1**
Capacity per tank	**%**	**50**	**50**	**100**	**100**
Effective capacity	m^3/tank	31,485	28,575	135	1,000
Effectiveness factor	-	0.85	0.85	0.85	0.85
Required storage capacity	m^3/tank	37,041	33,618	159	1,176
Selected storage capacity	m^3/tank	**38,000**	**34,000**	**160**	**1,200**

Water balance of CCCGP No.2 is as shown in Figure-6.4.5-1 attached hereinafter.

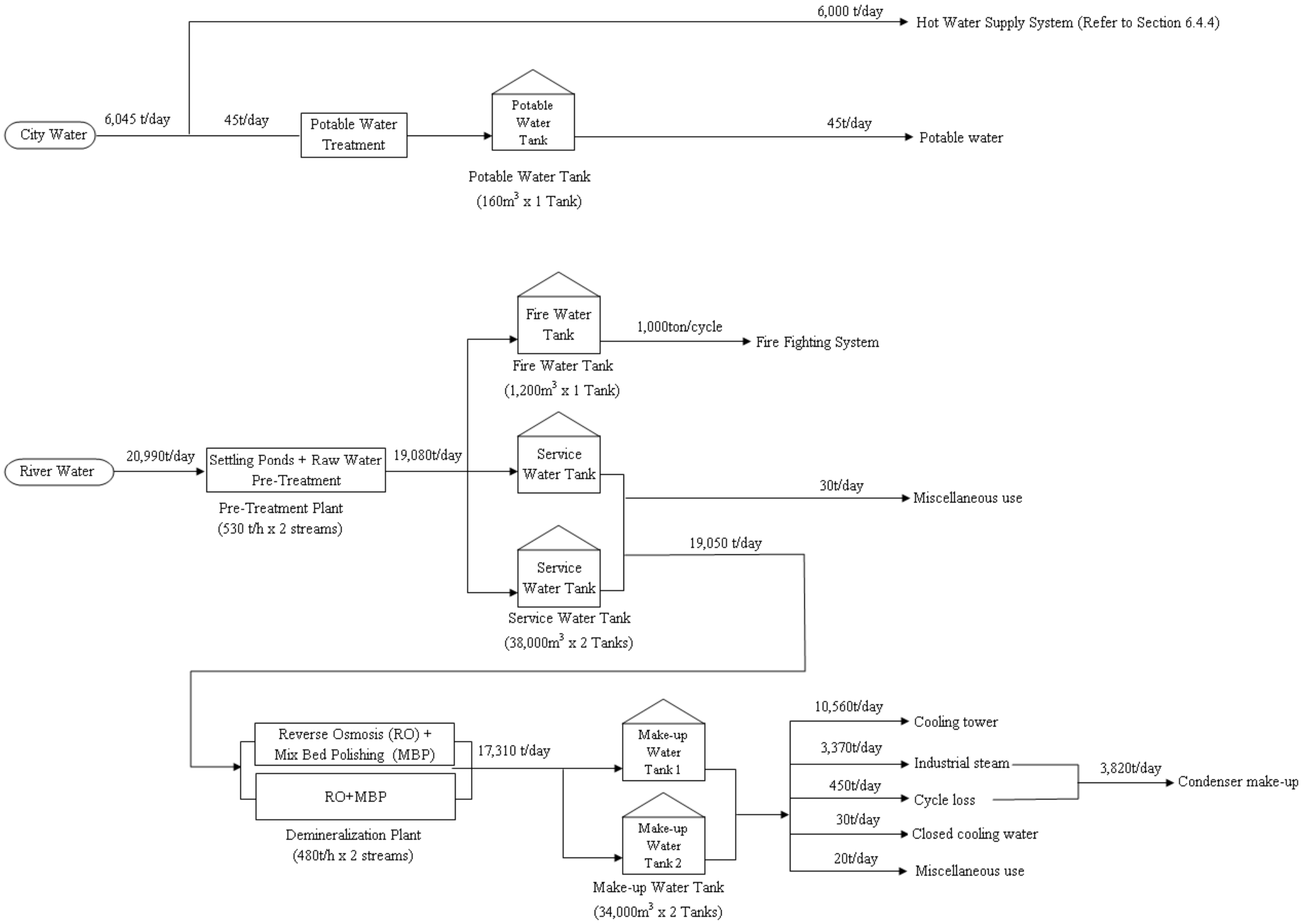


Figure 6.4.5-1 Water Balance of CCCGP No. 2

2) Water Pre-treatment (Filtration) Plant

The water filtration system consists of a rapid filtering device, various pumps, blowers, pipes and valves. This system shall be capable of removing non-reactive (colloidal) silica effectively from the raw water.

Due to the presence of free chlorine in the raw water, the chlorine scavenging chemical dosing equipment shall be provide, which is capable of treating raw-water with a maximum chlorine level less than 0.1 mg/l.

The water pre-treatment plant components shall include provision for the following:

- The clarity of water treated by the filtered water plant shall be below 1 mg/l.
- Two (2) sets of 100% duty each raw water pumps shall be installed. The capacity of each pump shall have a margin to keep the service water production capacity of two (2) streams x 370t/h.
- The type of the filter shall be cylindrical, vertical, mild steel (designed per ASME standard), rubber coating inside, gravity or pressure dual media sand-anthracite filters.
- Two (2) sets of filter air blowers (each 100% duty) shall be equipped for filter air scouring.
- Puddle pipes and fittings for filtered water sump shall be constructed in reinforced concrete.
- Two (2) sets of 100% duty each filter backwash pumps shall be installed.
- Filter water tank with appropriate capacity shall be installed for backwashing of filters.

3) Demineralized Water Plant

The demineralized water stream will consist of reverse osmosis system (RO) and mixed bed polishing system (MBP) (or cation tower, anion tower, mixed bed polisher, vacuum degasifier, regeneration system), pumps, tanks, and pipes.

The demineralized water plant shall have two (2) streams with each production capacity of 480m^3/hr.

The period between regenerations shall not be less than twenty (20) hours, and the regeneration period shall be less than four (4) hours.

The raw water quality shall be taken account of in the design of the Demineralizer plant.

Under all operating conditions the plant shall produce water equal to or better than the specified quality for the boiler feedwater, which shall be as follows:

Table 6.4.5-6 Quality of demineralized water

Item	Unit	Demineralized Water
Conductivity	μs/cm @ 25ºC	Max. 0.2
Total Silica	mg/l	Max 0.02
pH	-	-
Suspended Solids	mg/l	-
Turbidity	Degree	-

Item	Unit	Demineralized Water
Total Fe	mg/l	Max 0.01
Total Cu	mg/l	Max 0.005
CO_2	mg/l	Max 2
Cl^-	mg $CaCO_3$/l	-
SO_4^{-2}	-	-
TDS	mg/l	-
Residual C1	mg/l	-
Sodium and Potassium	mg/l	Max 0.01

The equipment to be supplied for Demineralizer shall have the design features as the following in the case of ion exchange system:

i) Activated carbon filter with 10 micron cartridge filter
    Quantity: Two (2) nos.
ii) Cation Tower (Vessel)
    Quantity: Two (2) towers
    Tank: Fabricated mild steel, rubber lined
    Capacity: 50% duty
    Type: Cation exchanger, cylindrical, vertical, counter flow
    Resin: Strongly acidic cross-lined styrene-divinyl-benzene or macroporous structural type
iii) Anion Tower (Vessel)
    Quantity: Two (2) towers
    Tank: Fabricated mild steel, rubber lined
    Capacity: 50% duty
    Type: Anion exchanger, cylindrical, vertical, counter flow
    Resin: Strong base acrylic based Type 1
iv) Polisher
    Quantity: Two (2) towers
    Tank: Mild steel, rubber lined (design to be the same as for cation and anion vessels)
    Type: Ion exchanger cylindrical, vertical
    Resin: Macroporous structured/strongly basic type 1 cross-linked styrene-divinyl-benzene type

The cation and anion towers (vessels) shall be fabricated from carbon steel and shall be of welded construction designed in accordance with ASME code for unfired pressure vessels. The design pressure shall be 50% in excess of the shut-off head of the demineralizer transfer pump.

The vessel shall be lined internally with a suitable rubber to a minimum thickness of 3 mm to cover all surfaces, nozzles and flange faces.

The vessel shall be complete with all nozzles and fittings necessary for the process and shall include:

i) One (1) manhole located at top of vessel
ii) One (1) manhole located at bottom of vessel
iii) One (1) sight glass located at top of resin level (150mm diameter minimum)
iv) One (1) drain connection

v) One (1) vent connection
vi) Two (2) blind nozzles for resin removal

Sight glasses shall be located such that easy access is available to allow clear visibility of the resin.

The vessel shall be equipped with the distribution and collection systems. The under drain collection system shall be designed to prevent resin from entering the treated effluent.

i) Degasifier
Quantity: Two (2)
Capacity: 100% each
Type: Cylindrical and vertical, fabricated from mild steel, rubber lined

The system shall use a blower with motor driven to degasify carbon dioxide. The exhaust gas shall be led outside of the demineralizer house.

ii) Degassed Water Pit
Quantity: One (1) pit each
Capacity: As required

iii) DM Water Transfer Pump
Quantity: Two (2) pumps
Capacity: 100% duty each
Type: Horizontal, motor driven

iv) Demineralized Water Storage Tank
Quantity: Two (2) tanks
Capacity: 7,000 m^3 (minimum)
Type: Cylindrical, vertical epoxy lined carbon steel

The capacity of the storage tank shall be computed based on the three (3) days supply requirement. However the storage capacity of the tank shall be at least 7,000 m^3.

v) Low Pressure Air System
Quantity: Three (3) sets including low pressure air blowers, separator and controls for resin mixing and compaction.

vi) Instrument Air
Instrument air receiver with necessary distribution of instrument air (tapped off from station instrument air header for valve control). Dedicated compressed air system should be considered alternatively for the DM plant.

vii) Backwash Tower
In case the resins of the cation/anion filters need to be cleaned (backwashed) the same cleaning shall be carried out in the backwash tower using the regeneration pumps. The backwash filter and interconnecting piping shall be included in his scope of work.

4) Chemical Regeneration Plant

A complete chemical regeneration plant shall be provided to regenerate the demineralized water plant. The regeneration waste water shall be stored in the regeneration neutralization pit and discharged to the high salt side of the effluent storage tank by the demineralizer neutralization pumps. The equipment to be supplied shall include the following:

i) HCl/H_2SO_4 (98%) Storage Tank
Quantity: Two (2) tanks
Capacity: For 3 days each
Type: Cylindrical, horizontal, carbon steel

ii) HCl/H_2SO_4 Measuring and Dilution Tank (Demineralizer)
Quantity: Two (2) tanks each
Type: Cylindrical, vertical carbon steel for measuring tank and rubber lined carbon steel for dilution tank

iii) HCl/H_2SO_4 Measuring and Dilution Tanks (Mixed Bed)
Quantity: Two (2) tanks each
Type: Cylindrical, vertical, carbon steel for measuring tank and rubber lined carbon steel for dilution tank.

iv) NaOH (47%) Storage Tank
Quantity: Two (2) tanks
Capacity: For 3 days each
Type: Cylindrical, horizontal, carbon steel

v) NaOH Measuring Tank (Demineralizer)
Quantity: One (1) tank
Type: Cylindrical, vertical, carbon steel

vi) NaOH Measuring Tank (Mixed Bed)
Quantity: One (1) tank
Type: Cylindrical, vertical, carbon steel

vii) Regeneration Pumps (H_2SO_4/HCL)
Quantity: Two (2) pumps each
Capacity: 100% duty each
Type: Horizontal, motor driven

viii) Regeneration Pumps (NaOH)
Quantity: Two (2) pumps
Capacity: 100% duty each
Type: Horizontal, motor driven

ix) Heating Device for NaOH Solution
Quantity: Two (2) for anion tower
Two (2) for polisher

Extreme care shall be taken to ensure the design and layout of the equipment is so arranged that in the event of failure of any fitting or other item of equipment, there is no danger to the operating personnel.

The chemical storage, measuring and dilution tanks shall be installed within bunds. Each bund shall have valved drain lines to the neutralization pit. The drain lines in the foundations and the necessary valves shall be supplied. Since the chemical storage tanks shall be installed outside of the demineralizer house, a sunroof shall be provided.

Each chemical tank shall be supplied with the following fittings:

- i) Access ladders and platforms for storage tanks
- ii) Access manhole
- iii) Filling connection with suitable valves clearly marked
- iv) Drain valve and emergency plug discharge vent
- v) Vent with air dryer and by-pass
- vi) Thermostatically controlled heaters (if required)

(5) Instrumentation and Control

1) Operation Philosophy

Complete water treatment system equipment and auxiliaries shall be primarily operated and monitored from central control room (CCR). Plant shall also be locally operated and supervised from the local control room located in water treatment plant building.

Man-machine interfacing (MMI) of the plant from CCR shall be through CRT/keyboards of the two (2) nos. operator workstations identified for all BOP systems. MMI equipment in local control room shall be CRT/keyboard based operator console.

Operation from CCR and local control room shall cover start-up, shutdown and normal operation of the complete water treatment plant.

2) Control System

Industry standard Programmable Logic Controller (PLC) shall be provided for accomplishing water treatment plant, control system. PLC shall be provided with processor level redundancy PLC shall be interfaced with redundant BOP terminal bus through redundant bi-directional communication link and also to local control room located operator console. BOP terminal bus shall be interfaced to CCR located BOP operator workstations by redundant link through redundant station wide LAN.

Redundant non-interruptible power supply shall be provided for all control system equipment. PLC shall be provided with processor level redundancy. PLC shall have spare processing capacity.

Engineer’s workstation for system modification of PLC shall be provided. Engineer’s workstation shall have the capability to make changes to the system configuration while the plant is on-line. Engineer’s workstation will be common for all BOP control system PLCs.

PLC, Engineer’s workstation, etc. shall be located in the water treatment plant local control room along with operator console and the room shall be air-conditioned.

3) Specific Control System Requirement

The water treatment system shall be fitted with the following control devices.

i) Level control system of each tank

Level control system of each tank is consisting of a level detecting element, level indicator, and their accessories. This system performs operation and control for transfer of material from each tank. The level detecting element must be easy to maintain, stable of action, and free from malfunction due to adhering impurities. It also must be highly anticorrosive.

ii) Demineralizer control system

The plant shall be capable of full automatic operation on manual initiation. Provision for semi automatic control and manual operation of individual motors or valves should be included. Each section of the ion exchange plant shall be capable of automatic sequence control initiated by remote operator command. This control shall include regeneration, filter backwashing and the preparation of regenerants.

The control shall have interlocks such that no mode of operation can be initiated unless the existing mode completes its cycle or is stopped by operator manual override.

The level in the demineralized water storage tank shall determine the control of the plant. In particular, high water level of the demineralized tank and low water level in raw water reservoir shall be annunciated and shall shut down the plant.

The automatic sequence operation during plant start-up shall provide for water recycling to achieve the specified quality of treated water before discharging into the demineralized water storage tanks. In the event that the water quality has not reached the specified quality within a specified time the plant shall not discharge any water and initiate an alarm.

Regeneration of the exhausted resins shall be carried out by automatic sequence operation. Regeneration of each steam will be initiated automatically by the passage of a predetermined volume of water or when the conductivity analyzer show demineralized, water is outside the acceptable quality range. The regeneration of the cation and anion units is simultaneous, in order that the effluents produced are nominally self-neutralizing.

The conductivity analyzer will be located above the bottom of the anion beds. Once the bed starts to become exhausted, the conductivity analyzer indicates a higher conductivity level and will start the regeneration process. The resin volume below the conductivity probe is not exhausted and ensures the water at the outlet is within the required quality range.

Control system shall allow the option to regenerate the ion exchangers individually or in-groups to match system loading. The regeneration rinse/recycle system will be optimized to reduce wastewater production. All necessary initiating devices, instrumentation and control equipment for automatic operation of regeneration cycle shall be provided under this Contract.

The sequence controllers shall permit the length of any filter air scour/backwash and ion exchange regeneration sequence to be varied without the need to reprogram the remainder of the process. Facilities shall be provided for manual overriding of the automatic sequence at any stage.

The cation and anion regeneration sequence controller shall include provision for giving the ion exchange resins a full backwash as part off the regeneration process after a number of normal exhaustion regeneration cycles. Facilities shall be provided to automatically include the full backwash sequence after a variable number of exhaustion and regeneration cycle and also for the operator to manually initiate a backwash at their discretion.

The sequence controllers shall also permit the inclusion of a double and triple regeneration to be given to the resin. This latter facility will be manually initiated at the operator's discretion.

Interlocks shall be provided to prevent any flow of concentrated regenerant solution unless there is a suitable flow of water.

Interlocks shall be provided to prevent initiation of the regeneration cycle unless the effluent sump is at low level.

The control system shall be capable of speed-up 'off-line' test. It shall be possible to manually step through each step in the sequence with the state of the output, appropriate to each step, being indicated whilst isolated from the plant and without reference to the plant input states.

4) Specific Instrumentation Requirement

i) Water analyzing apparatus

Treated water shall undergo a final check by this apparatus. The water analyzing apparatus shall be made up of the sampling system, silica, sodium and conductivity measuring apparatus, flow element, and other hand sampling/analyzing devices. When the stream is off, distilled water shall be supplied to these water analyzers.

ii) Pressure gauge

A pressure gauge shall be fixed at the outlet of each pump. The pressure gauge shall be water-proof as well as aseismatic, so that it is suited for outdoor use. The diaphragm and chamber shall be made of anticorrosive material. A method of installation shall be employed which will render it capable of absorbing vibration.

iii) The raw water discharging flow meter shall be provided.

iv) The minimum required instrumentation is shown in the Table blow.

Table 6.4.5-7 Instrumentation for Pre-treatment DM water plant

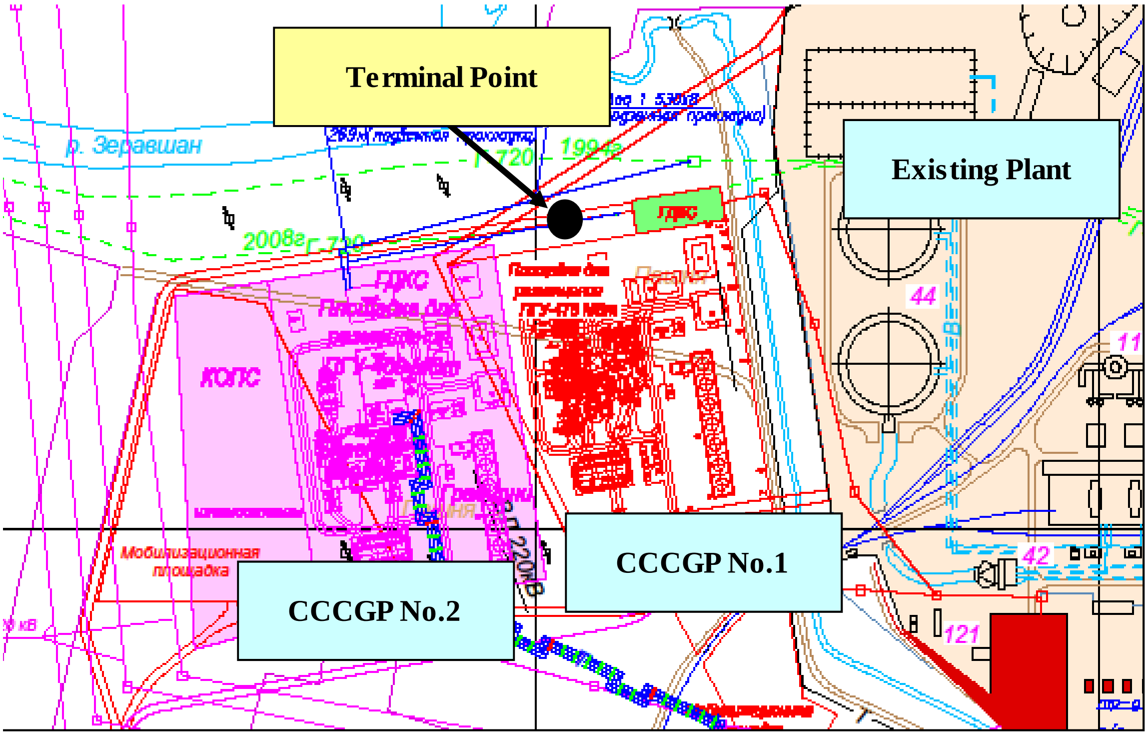
Measuring point	Parameter	Local monitoring	Remote	
			CCR/local control room	Functional usage
Raw water reservoir	Level	X	X	Indication, alarm
Inlet to each filtration vessel	Flow		X	Indication, alarm,

Measuring point	Parameter	Local monitoring	Remote	
			CCR/local control room	Functional usage
				control
Inlet to each filtration vessel	Pressure	X		Indication
Outlet from each filtration vessel	Pressure	X	X	Indication
Outlet from each filtration vessel	Differential pressure		X	Indication, alarm, control
Outlet from each filtration vessel	Clarity	X	X	Indication, alarm
Filtered water storage tank	Level	X	X	Indication, alarm, control
Backwash water	Flow	X	X	Indication
Backwash water	Pressure	X	X	Indication, alarm
Air to filter	Pressure	X	X	Indication, alarm
Inlet to each cation vessel	Pressure	X	X	Indication
Inlet to each cation vessel	Flow	X	X	Indication, alarm, control
Outlet from each cation vessel	Pressure	X	X	Indication
Outlet from each cation vessel	Differential pressure	X	X	Indication, alarm
Outlet from each cation vessel	Sodium		X	Indication, alarm, control
Outlet from each cation vessel	PH		X	Indication, alarm
Inlet to each anion vessel	Pressure	X	X	Indication
Inlet to each anion vessel	Flow	X	X	Indication, alarm, control
Outlet from each anion vessel	Pressure	X	X	Indication
Outlet from each anion vessel	Differential pressure	X	X	Indication, alarm
Outlet from each anion vessel	Conductivity		X	Indication, alarm, control
Outlet from each anion vessel	Silica		X	Indication, alarm, control
Outlet from each anion vessel	Ph		X	Indication, alarm
Inlet to each mixed bed vessel	Pressure	X	X	Indication
Inlet to each mixed bed vessel	Flow	X	X	Indication, alarm, control
Outlet from each mixed bed vessel	Pressure	X	X	Indication
Outlet from each mixed bed vessel	Flow	X	X	Indication, alarm, control
Outlet from each mixed bed vessel	Differential pressure	X	X	Alarm
Outlet from each mixed bed vessel	Silica		X	Indication, alarm, control
Outlet from each mixed bed vessel	Conductivity		X	Indication, alarm, control
Outlet from each mixed bed	Ph		X	Indication, alarm

Measuring point	Parameter	Local monitoring	Remote	
			CCR/local control room	Functional usage
vessel				
Resin traps	Differential pressure		X	Alarm
Dm water storage tank	Level	X	X	Indication, alarm, control
Rinse water to each vessel	Flow	X	X	Indication
Rinse water to each vessel	Pressure	X	X	Alarm
HCl/H_2SO_4 storage tank	Level	X	X	Indication, alarm
NaOH storage tank	Level	X	X	Indication, alarm
HCl/H_2SO_4 dilution & measuring tank	Level	X	X	Alarm
NaOH measuring tank	Level	X	X	Alarm
DM water transfer pump outlet (each)	Pressure	X	X	Indication
Ejector motive water	Pressure		X	Indication, alarm
Ejector motive water	Level		X	alarm

6.4.6 Fuel Gas Supply System

Natural gas is used as the fuel for CCCGP No.2 as well as CCCGP No.1. The natural gas is supplied to the Navoi Thermal Power Plant from the Navoi Gas Distribution Station (hereinafter referred to as "Navoi GDS") through two pipeline systems having a diameter of 720 mm.
The following describes the natural gas terminal point and terminal point supply conditions.



Source: Navoi TPP

Figure 6.4.6-1 Location of the terminal point

Table 6.4.6-1 Supply condition at the terminal point

Item	Unit	Value
Temperature	°C	-5 ~ 22
Pressure	MPa	1.0 ~ 1.2

Source: Navoi TPP

The natural gas is separated at the above-mentioned terminal point and is supplied to CCCGP No.2. After that, the natural gas is led to the pre-treatment system having a filtering function to remove foreign substances.

After the foreign substances have been removed, the natural gas is led to the fuel gas compressor so that the pressure is increased up to the level required at the inlet of the gas turbine. This required pressure level is approximately 3 through 5MPa although this value differs according to each gas turbine manufacturer. Since the operation of the gas turbine depends on the fuel gas compressor, it is recommended to install a total of two fuel gas compressors including one standby, similar to the case of CCCGP No.1.

6.4.7 Electrical Equipment

(1) Electrical System

1) Evacuation of Generating Power

Figure 6.4.7-1 shows the of generator main circuit.

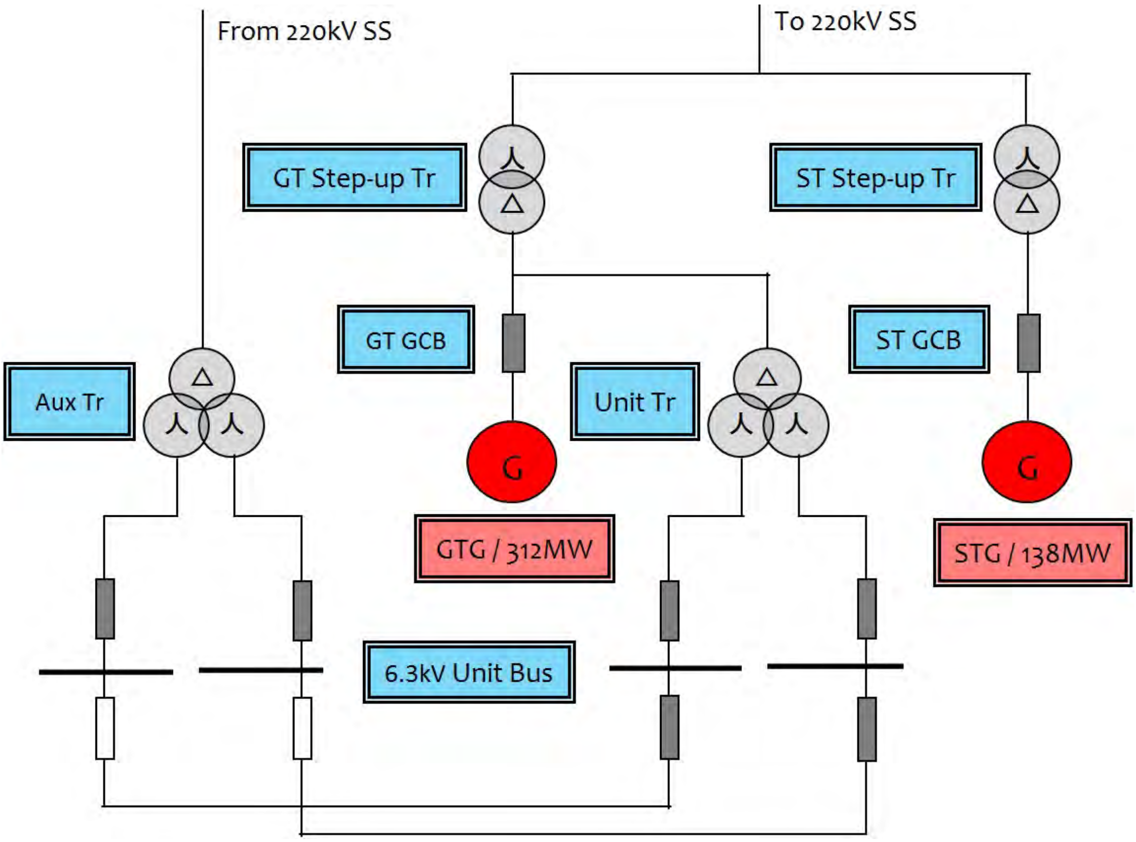


Figure 6.4.7-1 Scheme of generator main circuit

The electrical system will be designed on the basis of the multi shaft configuration having two (2) generators, Gas Turbine Generator (hereinafter called as “GTG”) and Steam Turbine Generator (hereinafter called as “STG”) and two (2) transformers, Gas Turbine step-up Transformer (hereinafter called as “GT transformer”) and Steam Turbine step-up Transformer (hereinafter called as “ST transformer”). The voltage of the power output from the GTG and STG will be stepped up to 220kV via GT transformer and ST transformer. The output from these two transformers is merged and transmitted to the 220kV substation. The bus switching arrangement utilizes double bus and one circuit breaker with transfer bus scheme.

During the unit operations, the power source to the unit auxiliary loads under 6.3kV unit bus will be fed from the GTG via unit transformer and 220kV substation via auxiliary transformer. During the unit shut down and the unit start-up, the power source to the unit auxiliary loads will be fed from 220kV substation via unit transformer and auxiliary transformer. The unit transformers shall be connected to 6.3kV unit bus BA and BB via the circuit breakers. On the other hand, auxiliary transformer shall be connected to the 6.3kV unit bus CA and CB via the circuit breakers. The power will be distributed to the auxiliary loads from the 6.3kV unit buses.

The auxiliary system and associated equipment shall be designed with flexibility and adequate redundancy to provide a reliable source of power for all auxiliaries that will be required for the new plant.

GTG shall be synchronized by GTG circuit breaker when GTG is attained at rated speed and voltage. Next STG shall be synchronized by STG circuit breaker when STG is attained at rated speed and voltage. Also GTG and STG can be synchronized at 220kV power system breaker in the alternative.

(2) Generators

1) GT Generator and ST Generator

The overview specifications of the Generators are shown below.

Table 6.4.7-1 Overview Specifications of the Generators

Generator	GTG	STG
Type	Three Phase Synchronous	Three Phase Synchronous
Number of Poles	2	2
Number of Phases	3	3
Net Power	312MW	138MW
Rated Capacity	368MVA	163MVA
Frequency	50Hz	50Hz
Rated Speed	3,000rpm	3,000rpm
Terminal Voltage	24.0kV	17.5kV
Power Factor	0.85（Lagging）	0.85（Lagging）
Rotor Cooling Method	Hydrogen or Water Cooled	Hydrogen or Water or Air Cooled
Stator Cooling Method	Hydrogen or Water Cooled	Hydrogen or Water or Air Cooled

2) Type of Generator Cooling System

The generators cooling system shall be adopted of hydrogen gas, water or air cooled type.

As a result of recent technological advance of cooling performance and wind age loss reduction, an air-cooled system is adopted in generators of 300MVA class. It is not possible to select air cooled type for GTG because of the capacity shortage (GTG rated capacity: 368MVA > Maximum air cooled generator capacity: 300MVA). Hydrogen supply system for generator cooling is necessary and shall be included in Scope of

Works by the Contractor.

However it is possible to select air cooled type for STG (STG rated capacity: 163MVA < Maximum air cooled generator capacity: 300MVA).Air-cooled system has some advance from hydrogen gas-cooled system such as; simpler system, easy operation and maintenance, allowing for cost savings.

(3) Excitation Method

1) Excitation System

Each generator will be provided with thyristor static excitation system which makes it possible to provide full ceiling voltage, either positive or negative, almost instantaneously under conditions of system disturbances. The system shall include transformer, automatic voltage regulator system (hereinafter called as “AVR”) cubicle, thyristor, convertor cubicle and field circuit breaker. Current transformer for control, regulation, protection and metering of the generator would be either provided in the generator stator terminal bushing both on the lines as well as neutral sides, or would be housed in IPB.

2) Automatic Voltage Regulator System

The generator manufacturer shall have AVR. AVR detects generator voltage and control the reactive power to control the generator voltage.

(4) GT Start-up Method

GT start-up method shall be selected thyristor or motor driven torque converter start-up method.

(5) Transformers

1) GT Transformer

GT Transformer shall step up from GTG voltage (24.0kV) to transmission line voltage (220kV).

GT Transformer shall have tap changing mechanism, oil insulation three (3) phase transformers or four (4) single phase transformer (One for spare). Cooling type shall be Oil Natural Air Forced (hereinafter called as “ONAF”) type. Phase connection shall be Delta-Star (hereinafter called as “Δ-Y”) type.

2) ST Transformer

ST Transformer shall step up from STG voltage (17.5kV) to transmission line voltage (220kV).

ST Transformer shall have tap changing mechanism, oil insulation three (3) phase transformers or four (4) single phase transformer (One for spare). Cooling type shall be ONAF type. Phase connection shall be Δ-Y type.

3) Unit Transformer

Unit Transformer shall step down from GTG voltage (24.0kV) to Unit Bus BA and BB (6.3kV).

Unit Transformer shall have tap changing mechanism, oil insulation three (3) phase transformers or four (4) single phase transformer (One for spare). Cooling type shall be Oil Natural Air Natural (hereinafter called as “ONAN”) type. Phase connection shall be Star-Delta-Delta with Stabilizing Winding (hereinafter called as “Δ-Y-Y”) type.

4) Auxiliary Transformer

Auxiliary transformer shall step down from transmission line voltage (220kV) to Unit

Bus CA and CB (6.3kV).

Auxiliary transformer shall be oil insulation three (3) phase transformers or four (4) single phase transformer (One for spare). Cooling type shall be ONAN. Phase connection shall be Δ-Y-Y type.

The overview specifications of the Transformers are shown below.

Table6.4.7- 2 Specifications for Transformers

Transformer		GT Transformer	ST Transformer	Unit Transformer	Auxiliary Transformer
Rated Voltage	1st	24.0kV	17.5kV	24.0kV	220.0kV
	2nd	220.0kV	220.0kV	6.3kV	6.3kV
Rated Capacity	1st	400MVA	200MVA	25MVA	40MVA
	2nd	400MVA	200MVA	12.5/12.5MVA	20/20MVA
Phase Connection		Δ-Y	Δ-Y	Δ-Y-Y	Δ-Y-Y
Cooling Type		ONAF	ONAF	ONAN	ONAN

(6) Single Phase Transformer and Three Phase Transformer

Comparison of Three Phase Transformer and Single Phase Transformer is shown in the following Table.

Single Phase Transformer has advantage in case of transportation or replacement of one phase transformer by accident. On the other hand, Single Phase Transformer is more expensive because of necessity of the spare transformer, control equipment for each transformer and each basement. Three phase transformer and single phase transformer are equal in performance aspect.

Therefore transformer method shall be three phase transformer or single phase transformer method.

Table 6.4.7-3 Three Phase Transformer and Single Phase Transformer

Type	Three Phase Transformer	Single Phase Transformer
Unit	One (1)	Four (4) : Three (3) + Spare One (1)
Transportation	Base	Easier
Cost	Base	Higher
Space	Base	Larger
Construction	Base	Longer
Management	Base	Same
Reliability	Base	Same

(7) Generator Circuit Breaker and Disconnecting Switch

GT/ST circuit breaker and GT/ST disconnecting switch are set at primary side of GT and ST transformer for synchronization.

GTG is synchronized at 220kV power system via GT circuit breaker when GTG is attained at rated speed and voltage. Next STG is synchronized at 220kV power system via ST circuit breaker when STG is attained at rated speed and voltage. GTG and STG can be synchronized at 220kV power system breaker which is formed by double bus and one circuit breaker with transfer bus scheme.

(8) Isolated Phase Bus

The isolated phase bus (hereinafter referred to as “IPB”) duct shall be forced-air cooled and shall deliver the generator output to the GT/ST step-up transformer with GT/ST circuit breaker, potential transformers, generator surge protection equipment, unit transformer, auxiliary transformer and excitation transformer.

(9) Seal Oil Equipment

Seal oil equipment is necessary when hydrogen cooling method is adopted. The generator seal oil system shall be designed to minimize leakage. The system shall be designed single sided or double sided depending on the manufacture’s standard. It shall consist of AC motor driven seal oil pumps with a 100% capacity emergency backup DC motor driven seal oil pump.

(10) Hydrogen Generation System

Hydrogen generation system is necessary when hydrogen cooling method is adopted. Hydrogen generation system currently provides an economical hydrogen supply solution for generator cooling system.

(11) Unit Electric Supply

The unit electric supply shall be configured from unit transformer and auxiliary transformer.

The equipment used for power plant operation shall be powered from the unit transformer. The equipment used for common equipment (water handling, waste water handling, etc) shall be powered from the auxiliary transformer system.

Moreover, as electric power source for emergencies, 1 set of 3 phase diesel fueled generator is installed for power plant and this enables obtaining safety electricity upon total cessation of the operation of the power plant.

Table 6.4.7-4 shows house load apportion.

Table 6.4.7-4 House Load Apportion

Type	Power supply voltage [V]	Power supply board classification	Usage classification
Three (3) phase AC	6,300	6.3kV Medium Voltage switchgear	Load>200kW
	400	400V Low Voltage switchgear	90kW<Load<200kW
		Motor Control Center	3kW<Load<90kW
	200	Motor Control Center	Load <3kW
	100	Motor Control Center	Valve<1kW
One (1) phase AC	100	AC distribution board	
DC	220	DC Motor Control Center DC distribution board	DC load

1) 6.3kV Unit Bus

6.3kV Unit Bus shall supply necessary auxiliary power for plant operation.

The design of 6.3kV unit bus shall be based on the four (4) configurations of BA, BB, CA and CB.

Unit Transformer shall step down from GTG voltage (24.0kV) to unit bus BA and BB.

Auxiliary transformer shall step down from transmission line voltage (220kV) to unit bus CA and CB.

Unit bus BA/BB and CA/CB shall be connected via bus-tie circuit breaker and disconnecting switch. Basically the bus-tie circuit breaker shall be opened. The bus-tie circuit breaker and disconnecting switch shall be closed in case of unit or auxiliary transformer accident. Unit bus CA/CB evacuates Unit bus BA/BB the electric power in that case. Also Unit Bus CA/CB evacuates Unit Bus BA/BB the electric power when plant accidentally tripped.

6.3kV unit bus shall supply necessary auxiliary power and 400kV Unit Bus.

2) 400kV Unit Bus
400kV unit bus shall supply medium motors and auxiliary power for switching.

3) 220V DC Supply System
220V DC supply system shall have battery equipment and DC load shall be supplied by the power from DC distribution board. Plant can stop safely by DC power from battery under blackout condition.

4) Uninterruptible Power System
Uninterruptible power system (UPS) shall be to supply continuous AC power to the essential AC bus. Uninterruptible power system shall be supplied with AC supply source and 220V DC supply system.

5) Emergency Diesel Generator Equipment
Plant shall have one (1) emergency diesel generator equipment at least.
It shall be capable to supply emergency power from emergency diesel generator equipment. Emergency AC power shall be supplied from emergency diesel generator to 400V emergency unit bus.

6) Site grounding
IEEE-80 recommendations shall be used to determine grounding system requirements for this plant. The entire ground grid system shall exclusively utilize copper conductors with exothermic connections for in-ground connections.

(12) Generator Main Circuit Protection
The typical protections for GTG, STG, GT transformer and ST transformer are shown in the following table.

Table 6.4.7-5 Generator Main Circuit Protection

Name	Factor
GT Generator differential	$87G_{GT}$
GT Transformer differential	$87T_{GT}$
ST Generator differential	$87G_{ST}$
ST Transformer differential	$87T_{ST}$
Current unbalance	46
Loss of excitation	40
Reverse power	67
Stator ground detection	51GN
Generator overexcitation	24
Generator overvoltage	59
Generator undervoltage	27G
Generator over/under frequency	81

Generators and transformers shall be protected by 87G and 87T. As a back-up protection for generator, restricted earth fault relay as well as voltage type ground fault relay is also proposed.

6.4.8 I&C Equipment

(1) Control Philosophy

The control system shall control and monitor the status of equipment and process variables associated with the CCCGP to ensure safe and efficient operation with the applicable specifications and performance requirements.

All control and monitoring functions necessary for startup, normal operation and shutdown of the CCCGP shall be provided in Central Control Room (CCR) The CCR will normally be manned.

(2) System Configuration of the Control and Monitoring System

Figure 6.4.8-1 shows Configuration for CCCGP Control.

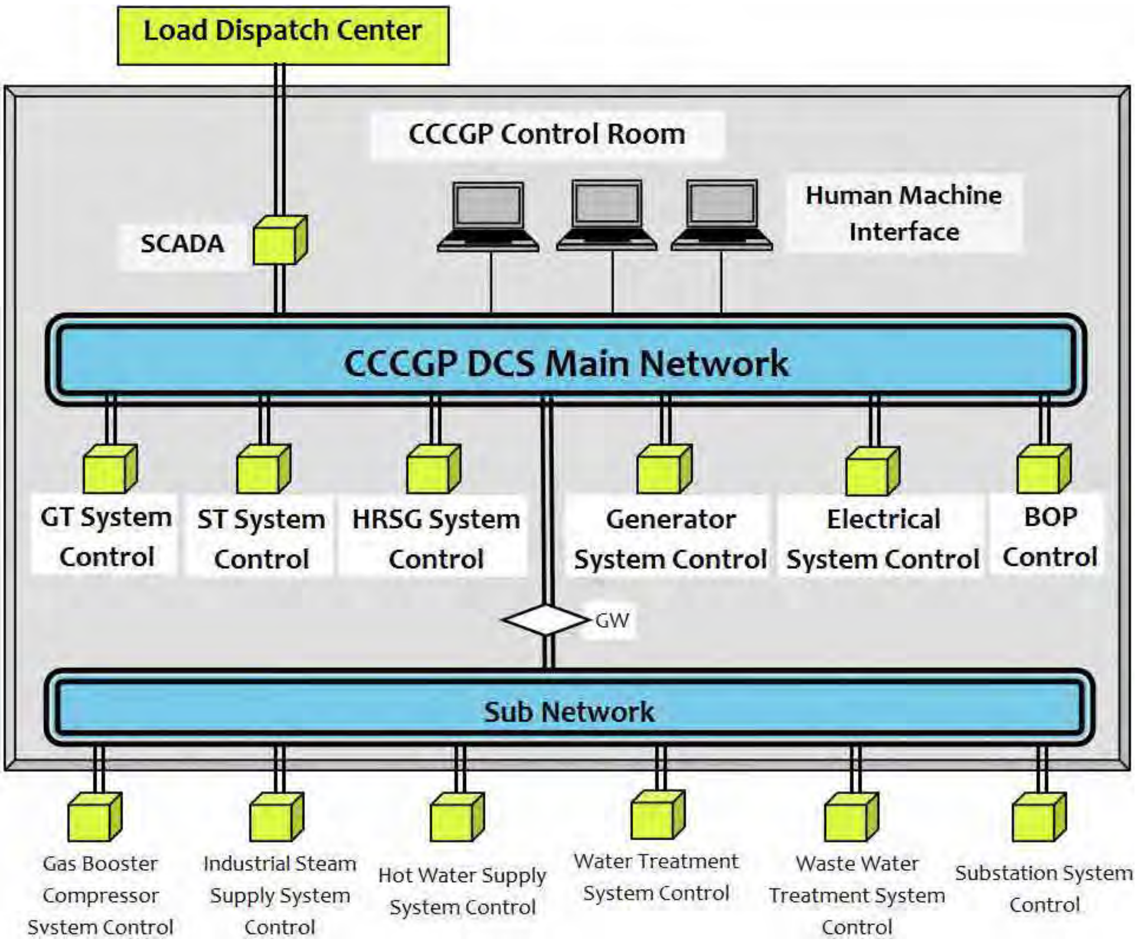


Figure 6.4.8-1 Configuration for CCCGP Control

The design of all instrumentation and control systems shall provide the maximum security for plant personnel and equipment while safely and efficiently operating the new plant under all conditions with the highest possible availability.

Operator Workstation with Human Machine Interface (HMI) and a microprocessor based Distributed Control System (DCS) including redundant controllers using a plant-wide redundant communication highway shall be provided to allow the operators to control CCCGP and to receive monitoring and alarm information.

- The computing and electric power section shall be duplex and the input and output of the DCS will be single.

- Power supply shall be duplex with both AC and DC (butted method)
- Operation during normal times will be through the use of a mouse while confirming the CRT screen.

The operating and monitoring system of the power station are configured by DCS, information management system, maintenance and repair system, network system and related equipment.

The DCS is comprised of the CRT operation system, turbine control system, data assembly system, sequence control system, process I/O system and peripheral equipment. Each independent system is interfaced with DCS.

(3) Control Functions

The design of the control system for the new plant shall utilize the state-of-the-art DCS (Distributed Control System) with data logging system in combination with proprietary controls furnished with the gas turbine / generator, steam turbine / generator, HRSG and BOP (Balance of Plant), gas compressor system and so on.

The operator console of the plant installed in the CCR (Central Control Room) shall be used for the primary operator interface and shall contain LCD (Liquid Crystal Display) with keyboards and mouse. CCR shall equip with shift operator’s room, locker room, WC & shower room etc. in order to create better environment condition for operators.

The gas turbine control system, steam turbine control system, HRSG and BOP control system shall be tied into the DCS with redundant communications networks and hardwired signals for critical control signals.

Those remaining control and monitoring signals for gas compressor control system, heat sources supply control system and so on shall be brought directly or via Remote I/O into the DCS I/O cabinets.

The LCD graphics shall provide the operator with control, monitoring, recording/trending, status, and alarming of equipment and process conditions.

The detector/instrument for protection/control of gas turbine, steam turbine and HRSG shall be redundancy/triple configuration to enhance the reliability of the new plant.

The control system shall be designed to operate and control the new plant with fully automatic, and shall give information of conditions of the new plant and guidance of operation/trouble shootings during start-up, steady state operation and shutdown to the operators.

The configuration of control logic and graphic display of the control system shall be designed for maintenance engineers to be able to easily and correctly modify and change them at site.

DCS shall have the following functions.

1) Turbine automatic operation control system

- Gas turbine operation, control and protection including gas turbine supervisory instruments.
- Steam turbine control and protection including turbine supervisory instruments
- HRSG control and protection
- Generator protection, excitation, voltage regulation and synchronization systems
- Electrical equipment control and protection including supervisory instruments
- Balance of plant control

2) Data collection equipment

- Scan and alert

- Process computation (including performance computation)
- Data log function and data display

3) Common equipment in DCS function

- Gas Booster Compressor System
- Industrial Steam Supply System
- Hot Water Supply System
- Water treatment system
- Waste water treatment system
- Substation System, etc.

4) Maintenance function

Maintenance tools (Engineering Work Station) for the maintenance of DCS are installed and these tools shall have the following functions.

- Control system setting/modification function
- System diagram setting/modification function

These systems have independent monitoring and control. In the event of a defect in the devices, the impact on the power station will be large. For this reason, calculation system, power supply system etc. are multiplexed in order to contribute to the reliable operation of system.
Operator can select each mode to correspond to the plant condition. The typical control modes are shown in the following table.

Table 6.4.8-1 Control Mode by DCS

Control Mode	Event
Full-Automatic	In the “Full-Automatic” mode, the startup or shutdown shall be done by one-push button. Main master sequence is related with each master sequence and operation status on unit side. For example, boiler start preparation to absorber system startup, absorber system startup completed to limestone system startup. As a result, startup is automatically executed from boiler preparation to full load under normal operation via CCCGP startup process.
Semi-Automatic	In the “Semi-Automatic” mode, the startup or shutdown shall be done by step by step. Operator can proceed to step the CCCGP startup and shutdown process to recognize the each breakpoint accomplishment by master sequence.
Manual	In the “Individual” mode, the startup or shutdown shall be manually done.

(4) Field Instrumentation

Field instrumentation for CCCGP such as pressure / level / flow / temperature – transmitters / switches / instruments, flue gas analyzers, vibration detector, etc., will be provided for monitoring the status of equipment and the process variables associated with the CCCGP to ensure safe, efficient operation and performance requirements.
All units are established according to the International System of Units (SI).
Main field instrumentations are as follows:

- Pressure/Differential pressure measurements;
- Level indicating measurements;
- Flow measurements;
- Temperature measurements;
- Density measurements;

- Chemical measurements (pH, conductivity, etc);
- Vibration measurements;
- Position indicators of dampers/valves;
- Continuous Emission Monitoring System (CEMS)

All outdoor mounted instruments shall be designed to withstand the outdoor ambient temperatures. Adequate freeze protection system installations shall be set up in case of the instrument line freezing.

(5) I&C Equipment Power Supply

I&C equipment power supply will be from following switchboards:

- 3x400 / 200 V, 50Hz network supply,
- 200 V, 50Hz Safe AC
- 220 V Battery DC

DC supply system for CCCGP shall not rely on existing Unit and shall be independent.

Other I&C equipment power shall be supplied, as follows:

- 24 VDC redundant
- 48 VDC redundant (if necessary).

(6) Telecommunication System

Telecommunication shall be included in the following system

- CCTV System by IP cameras, Video server and IP Network
- IP telephone system
- Master Clock System
- Uninterruptible power supply (UPS) system

6.4.9 Civil engineering and architectural facilities

The following lists up the planned CCCGP No.2 structures and buildings:

Table 6.4.9-1 List of planned CCCGP No.2 structures and buildings

No.	Names of buildings and structures	Dimensions of building (structure), (width×length×height in meters)	Note
10a	Main building consisting of:		
10a-1	- gas-turbine unit room	45 × 48	
	- steam turbine room	36 × 45	
10a-2	- insertion for GCP (general control panel) and electrical devices	24 × 15	
10a-3	- stack of electrical devices (under CACI (complex air-cleaning installation))	6 × 24	

No.	Names of buildings and structures	Dimensions of building (structure), (width×length×height in meters)	Note
10a-4	- area for steam boiler-utilizer - chimney - tank farm of CWT (chemical water treatment)	1 piece 1 piece	 H=90 m
10a-5	- Gas unit	1 piece	
10a-6	- building of Chemical water treatment (CWT) and Integrated industrial effluent treatment (IIET) - area for tank farm Set of washing equipment - tank farm:	36 × 36 1000 m^3 - 4 pieces 160 m^3 - 1 piece	
10a-7	- deaerator room with feedwater pump and chemicals dosing system	18 × 24	
10a-8a	- boiler room with heating system deaerator	18 × 24	
10a-9a	- engineering and residential building	12 × 36	3 stores
13a	Open installation of transformers with rerolling ways		
	- oil collector (underground based) for collecting accident-related oil from the transformers	180 m^3	
	- capacity of accidental discharge of turbine oil	25 m^3	
	- network of accidental oil runoffs		
19a	ODU-220 kV	1 cell	
19b	Bus-bar assembly	65×60	

No.	Names of buildings and structures	Dimensions of building (structure), (width×length×height in meters)	Note
19d	HV-220 kV AC - 3×300, with length of 0.7 km from bus-bar assembly CCGT-450 with installation for gas switch in cell #10A of existing ODU-220 kV.		At existing ODU-220 the bus-bar bridge L=420 m
25a	Cable tunnels and channels		
26a	Electrical container with backup diesel		
28a	Technological trestles		
	- heating networks		
	- heating network feeding pipelines	2.5 km	Ø325x5
	- hot water (forward and backward) pipelines with armature	0.8 km	Ø630×8
	- steam pipelines with armature	1.5 km	Ø720×9
	- condensate return pipelines with armature	1.5 km	Ø159×5
	- pipeline to GSPU (gas separator pump unit)	59 lm	2 pieces Ø426×6
39a	Gas separator pump unit (GSPU) with armature	30 × 42	
39b	Gas processing facility (GPF)	6 × 18	
39c	System of purge and dump gas pipelines of CCGT and GSPU		
73a	Compressor room for compressed air with receivers	6 × 9	
81a	Electrolysis room with receivers, including nitrogen generating room on sludge disposal site of oily water at flow rate 8-10 m/h, pressure of 20-22 m	12 × 18	
Technical water supply at the site			

No.	Names of buildings and structures	Dimensions of building (structure), (width×length×height in meters)	Note
41a	Circulation pump station - above-ground part - underground part	21×12×13.5 21×12×8.2	
41b	Circulation water lines - 2Ø1420×10 - 2Ø1620×10	200 lm 200 lm	
43b	Water lines of supplementary at the production site 2Ø377×8 L=300 lm	600 lm	2 lines
44a	Ventilator cooling stacks 18 × 18m	1620 m^2	5 pieces
44b	Pumping installation for cooling stack scavenging	22×9.4×9.4	
46a	Pumping installation for drainage of main building - above-ground part - underground part	9.5×6.5×4.5 6×6×10	
46b	Circular drainage of main building	500 lm	
46c	Pressure water passage of drainage of main building - Ø219 × 6	300 lm	
99a	Piezometric network at the CCGT production site		
	- in site roads	7000 m	
	- access road	600 lm	
	- transfer of HV-220 kV	1500×4 pieces	
	- excavation works	15000 m	
	- soil embankment	35000 m	
	- transformer rerolling ways	100 lm	
	- Security fencing of the territory with the check-point	900 lm	

No.	Names of buildings and structures	Dimensions of building (structure), (width×length×height in meters)	Note
	- towers	2 pieces	
	- trenches	2 pieces	
	- security lighting	900 lm	
	- security alarm	900 lm	
	- concrete fence around the site boundary		
	- storage of transformer and turbine oil with regenerative equipment		
	- fixed gas system wiring for gas welding		
	- showers with dressing room		
	- canteen		

6.5 Construction program

6.5.1 Material/equipment procurement program

Equipment required for the construction of the Uzbekistan site is mostly imported from overseas countries. Materials such as cement, aggregate, sand, rebar etc. can be procured in Uzbekistan.

6.5.2 Material/equipment transport program

Since Uzbekistan is an inland country without a coast line, difficulties are found in the transport of large-sized heavy products.
In the 450MW-class CCCGP No.2, the maximum weight of a product will exceed 300 tons even when the heavy product is divided in several parts for transportation.
Several months will be required for transportation when consideration is given to the canal transportation route by the Volga canal from the Black Sea (the Black Sea through the Caspian Sea) and the inland transportation route (through the Republic of Turkmenistan).
Again, when a construction program is to be worked out, a sufficient transportation period must be taken into account with consideration given to the frozen period of the Volga and the distance of transportation.

6.6 Project Implementation Schedule

6.6.1 General

If the project is implemented as a yen loan project, it will require 56 months to complete: 19 months from the agreement of the two governments through the selection of international consultants and the preparation of EPC (engineering, procurement, and construction) contracts plus 37months for the construction of the combined cycle co-generation plant. Figure 6.6.2-1 shows the project implementation schedule from the agreement of the two governments to the

completion of the project in the form of a bar chart. This implementation schedule will be revised as necessary due to changes in related conditions.
The work leading up to the loan agreement on the part of both countries is as shown below. It is difficult to say how much time will be required for this work to be completed, so we are not suggesting a timeframe here.

(1) Uzbekistan

- Prepare a feasibility study report for the project, as required for the yen loan application.
- Prepare an Environmental Impact Assessment report for the implementation of the project.
- Apply for the loan.
- Arrange own funding (15% of the project construction funding)

(2) Japan

- Dispatch study group (from four ministries and agencies)
- Perform a supplemental investigation of the report from Uzbekistan.
- On-site examination of proposal (JICA)
- Provision of funding as per the loan contract.

6.6.2 Project Implementation Schedule

After loan agreement is reached between the two countries, the primary work to be completed before the EPC full turnkey contracts are concluded and the expected time required is as follows.

• Selection of consultant and conclusion of consultant contract	5.5 months
• On-site survey and preparation of EPC tender documents	5 months
• Preparation of bids	3 months
• Evaluation of bids, selection of EPC contactors, conclusion of contracts	5.5 months
• Total	19 months

The followings are assumed to be critical points to be considered in developing the project schedule.

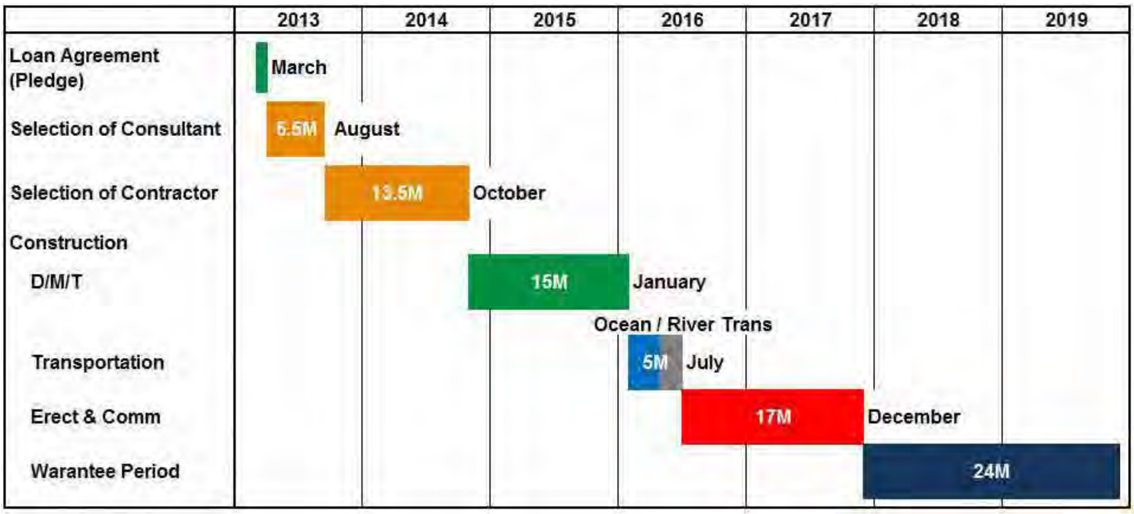
(1) Heavy cargos having a weight of more than 40 tons are transported on channel Don-Volga to Turkmenbashi port. But, channel transportation is limited from March to November because channel is frozen from December to February.

(2) Project schedule is made taking into consideration the above issues and show in Table 6.6.2-1 and Figure 6.6.2-1.
1) Recommended schedule
This schedule is made to shorten each one (1) month of the selection of consultants and manufacturers for arriving gas turbines and other heavy cargos at Turkmenbashi port before July.

Table 6.6.2-1 Required Months from Selection of Consultant to the Completion of CCPP

	Selection of Consultant	Selection of Contractor	Construction Period			
			*1	*2	*3	Total
Recommended	5.5M	13.5M	15M	5 M	17 M	56M

Remarks : *1 Design and Manufacturing、*2 Transportation、*3 Erection and Commissioning



Remarks : D/M/T - Design, Manufacturing and Test

Figure 6.6.2-1 Project Implementation Schedule

6.6.3 Construction Schedule

Figure 6.6.3-1 shows a construction schedule for the CCCGP expected for this project. In the construction work, the existing facilities are demolished first, and the design, fabrication, and transportation of equipment are performed at the same time it performs foundations works after that. This construction period requires 37 months including 2 months of the commissioning period.

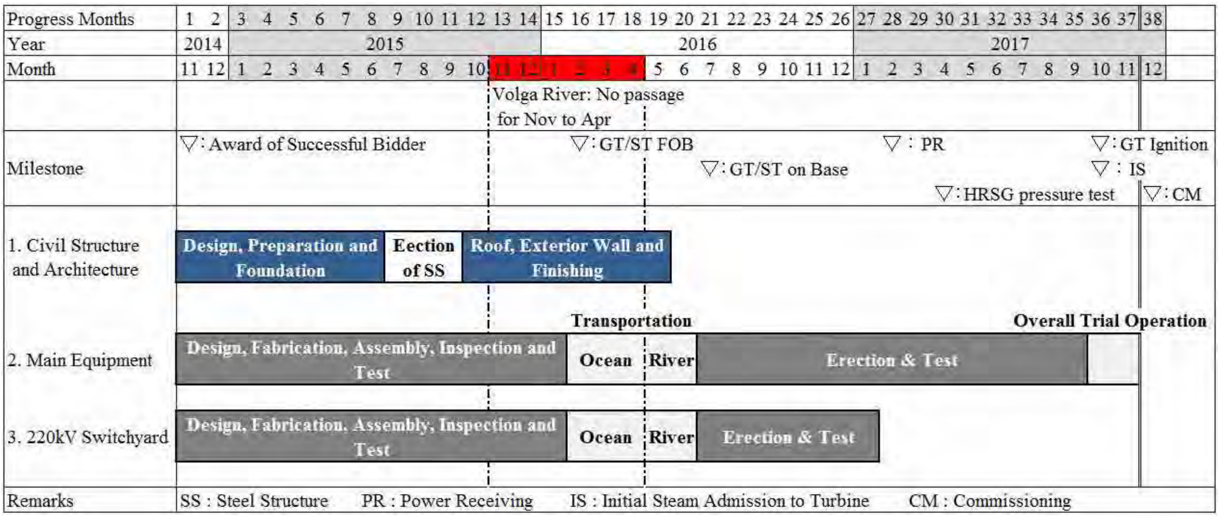


Figure 6.6.3-1 Construction schedule

Chapter 7 System Analysis and Grid Connection Plan

7.1 System analysis

7.1.1 Objective

A 450 MW combined cycle co-generation plant No.2 (hereafter referred to CCCGP No.2), which is scheduled to begin its operation in 2015, is to be added to the Navoi Thermal Power Plant. The objective of the power system analysis is to evaluate the impact of installing this facility under normal condition and emergency condition against the nation's power grid, specifically to the 220-kV network surrounding the power plant. The task of this system analysis is mainly composed of three sub-tasks, namely power flow analysis, fault current analysis, and stability analysis.

7.1.2 Premise

(1) Examined Case

The analysis covers the 220-kV network surrounding Navoi Thermal Power Plant, bordered by three 500 kV substations, namely, Syrdaria Substation, Guzar Subsation, and Karakul Substation. Figure 7.1.2-1 shows the area to be analyzed in this study (220-kV power system network around Navoi Power Plant as of year 2010). The analysis simulates the winter peak of year 2015, as the commission of the generation facility is scheduled in the year. The system analysis is carried out using PSS/E software, while SJSC Uzbekenergo uses another software, "Mustang," which had been developed in former Soviet Union.

Source: SJSC Uzbekenergo

Figure 7.1.2-1 Analyzed network area (Left: Analyzed area, Right: part of the analyzed area)

(2) Input Data/ Data Source

The JICA Study Team cited its key input data such as generated power and load from the preliminary study conducted by SJSC Uzbekenergo, SAESP [*1]. For the line constants and parameters related to generators, the team referred to the figures provided by SJSC Uzbekenergo's National Dispatch Center (NDC). Data which are not available in the above two sources are supplemented from the other sources such as SJSC Uzbekenergo's answer sheet to the team's questionnaire [*2] and the past JICA Study [*3]. Table 7.1.2-1 summarizes the data source.

Table 7.1.2-1 Data reference

Item	Reference
Actual Parameters related to existing transmission facilities	Data provided by National Dispatch Center (NDC)
Typical line constants	Excerpt from Design philosophy provided by SAESP
Generation output (P)	Network diagram provided by SAESP [*1]
Load (P and Q)	Network diagram provided by SAESP [*1]

*1: 3618-10-t1-9.dwg, “Determination of the optimal site location PGU-450MW in the system. Scheme of power: Power flow and voltage levels in networks of 220-500kV area of influence, I Option (Recommended), Navoi thermal power plant in the winter maximum 2015.”
(Originally, “Определение оптимальной площадки размещения ПГУ-450МВт в энергосистеме. Схема выдачи мощности. -- I Вариант (рекомендуемый) -- Потоки мощности и уровни напряжения в сетях 220-500кВ района влияния Навоийской ТЭС в зимний максимум 2015г.”
*2: Answer sheet to the team’s questionnaire [26.09.2012 No. IB-01.21/3371].
*3: “The detailed design study for modernization of Tashkent Thermal Power Plant in the Republic of Uzbekistan final report: main report,” Jan. 2004, Japan International Cooperation Agency (JICA)

7.1.3 Power Flow Analysis

Table 7.1.3-1 shows the average values of the line constants for the existing/ planned transmission facilities.

Table 7.1.3-1 Line Constants (average values)

Voltage [kV]	Rated capacity [MVA]	Positive-phase-sequence Impedance (pu/km)[*]		
		R	X	B
500	1,732 (partly 1,297)	0.0001	0.0011	0.0009
220	262 - 360	0.0015	0.0088	0.0001

* 1,000MVA Base

Source: Developed by JICA Study Team based on the collected data

Table 7.1.3-2 shows the list of major power plants in the analyzed network

Table 7.1.3-2 The list of Power Plants (Year 2015)

Name	Rated capacity [MVA]	Voltage of grid to be connected [kV]
Navoi Thermal Power Plant	25 x 2 units (*1) 150 x 1 unit (*1) 150 x 1 unit 50 x 2 unit 60 x 1 unit (*1) 160 x 1unit (*1) 210 x 2 units 313 (GT) + 163 (ST) 310 (GT) + 140 (ST)	110 110 110 220 220 220 220 220 220
Talimarjan Thermal Power Plant	800 x 1 unit 450 (310 (GT) + 140 (ST)) x 2 unit	500 220
Syrdaria Thermal Power Plant	700 x 1 unit 830 x 1 unit (*2)	500 220
Mubarek Heat Power Plant	60 x 1 unit	220
Buhara Heat Power Plant	70 x 1 unit	220
Kondon Heat Power Plant	30 x 1 unit	220

*1: Normally out of service. Operated under specific condition like inspection of the other units (According to the interview of the staff of Navoi Power Plant, the plant’s Unit 1, 2, 3, 6, and 8 will remain after the commission of the CCCGP No.2).
*2: The unit is set as slack in the system analysis. Because the analysis set the boundary of the analyzed area at

Syrdaria power plant, the unit size of the plant shown in the table does not necessarily represent the actual capacity per unit.

(1) Criteria

For power flow analysis, transmission sections whose loading rate is over 100% of the rated thermal capacity is considered “overloading.” The system is also assumed to satisfy the N-1 standard. For verification of the simulation model, the JICA Study Team referred to the aforementioned result diagram of power flow study targeting the year 2015, which has been provided by SAESP.

The normal operation range of the grid voltage is between -10 % to +5 % of base voltage (500 kV and 220 kV). Table 7.1.3-3 summarizes the criteria.

Table 7.1.3-3 Power Flow Criteria

Item	Criteria
Loading	Rate < 100 %
Voltage	-10% < V < +5%

Source: SJSC Uzbekenergo

(2) Calculation Results

a. Loading

Figure 7.1.3-1 shows the results of the power flow analysis with and without the new CCCGP No.2 to the Navoi Thermal Power Plant. For all the transmission lines, the calculated flow was within the allowable current capacity. For N-1 criteria, the sections shown in Table 7.1.3-4 were evaluated. These cases showed that the analyzed network also satisfies the N-1 standard (Figure 7.1.3-2).

Table 7.1.3-4 Power Flow Analysis Result (N-1 analysis. During Winter Peak)

Section	Calculated power flow amount [MW] and Rated capacity [MVA]		
	Normal case [MW per circuit]	N-1 case [MW per circuit]	Rated capacity [MVA per circuit]
From K-Mozof SS to Navoi TPP	155.2	256.0	360 (planned future)
From Himiya SS to Navoi TPP	158.5	211.4	360

According to SJSC Uzbekenergo’s design standard, the actual rated capacity would be more than 360 MVA for the designated sections, as temperature factor would be considered, up to almost 420 MVA. The standard rated capacity assumes the temperature of 25 degree in Celsius.

b. Voltage

For the purposes of maintaining the proper voltage, the static capacitors with required capacity will be necessary to be inserted into the several substations, because several buses at substations show the voltage below their operation range (-10 % of base voltage). For this purpose, the conducted power flow analysis has put static capacitors at the location shown in Table 7.1.3-5. It is, however, not sure that this attributes to the actual facility configuration or lack of simulation data.

Table 7.1.3-5 Locations where static capacitors are placed in the analysis

Location	Capacity
Koson 220kV Substation	118.50 Mvar
Djizak 220kV Substation	160.80 Mvar
K. Kurgn 220kV Substation	148.40 Mvar
Buhara 220kV Substation	116.30 Mvar

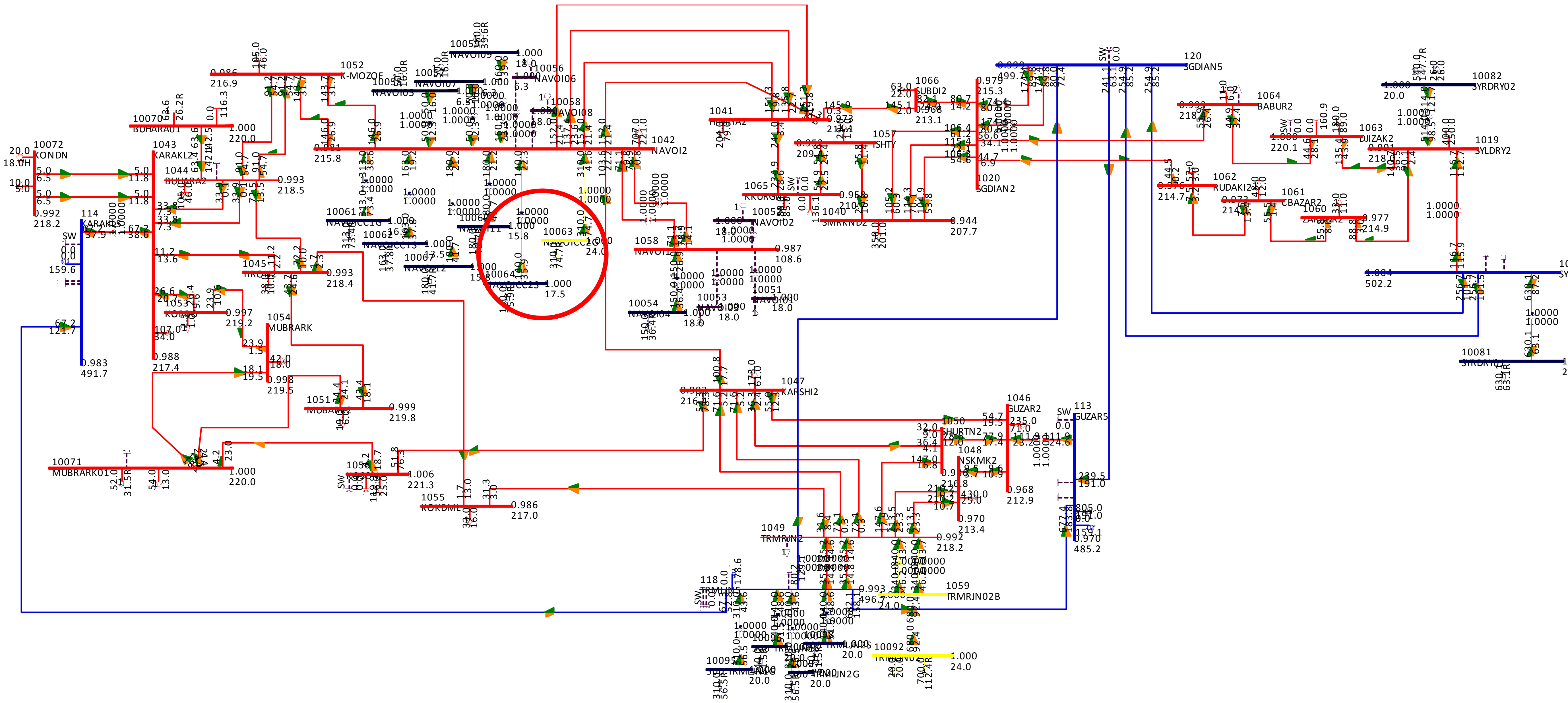


Figure 7.1.3-1a Power Flow Analysis Result (Normal Time. With CCCGP No.2)

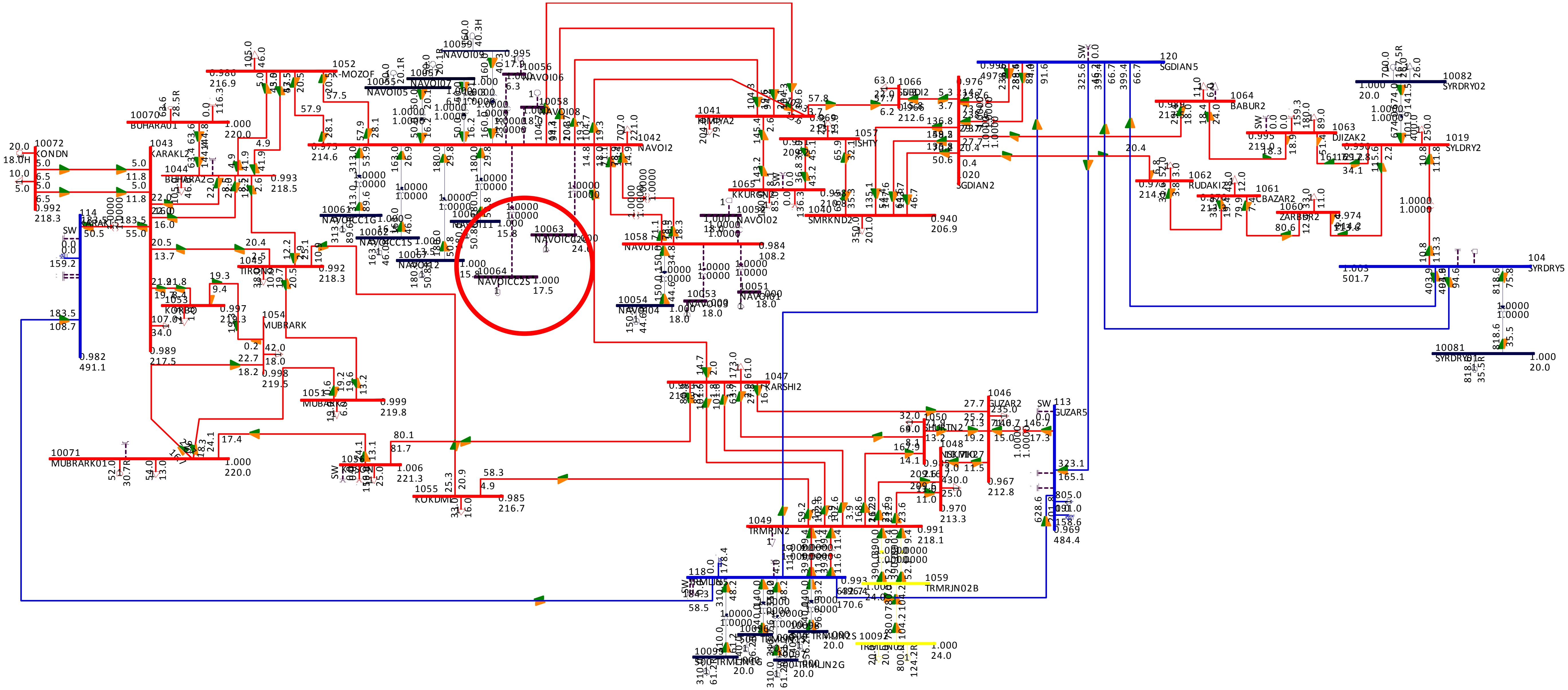


Figure 7.1.3-1b Power Flow Analysis Result (Normal Time. Without CCCGP No.2)

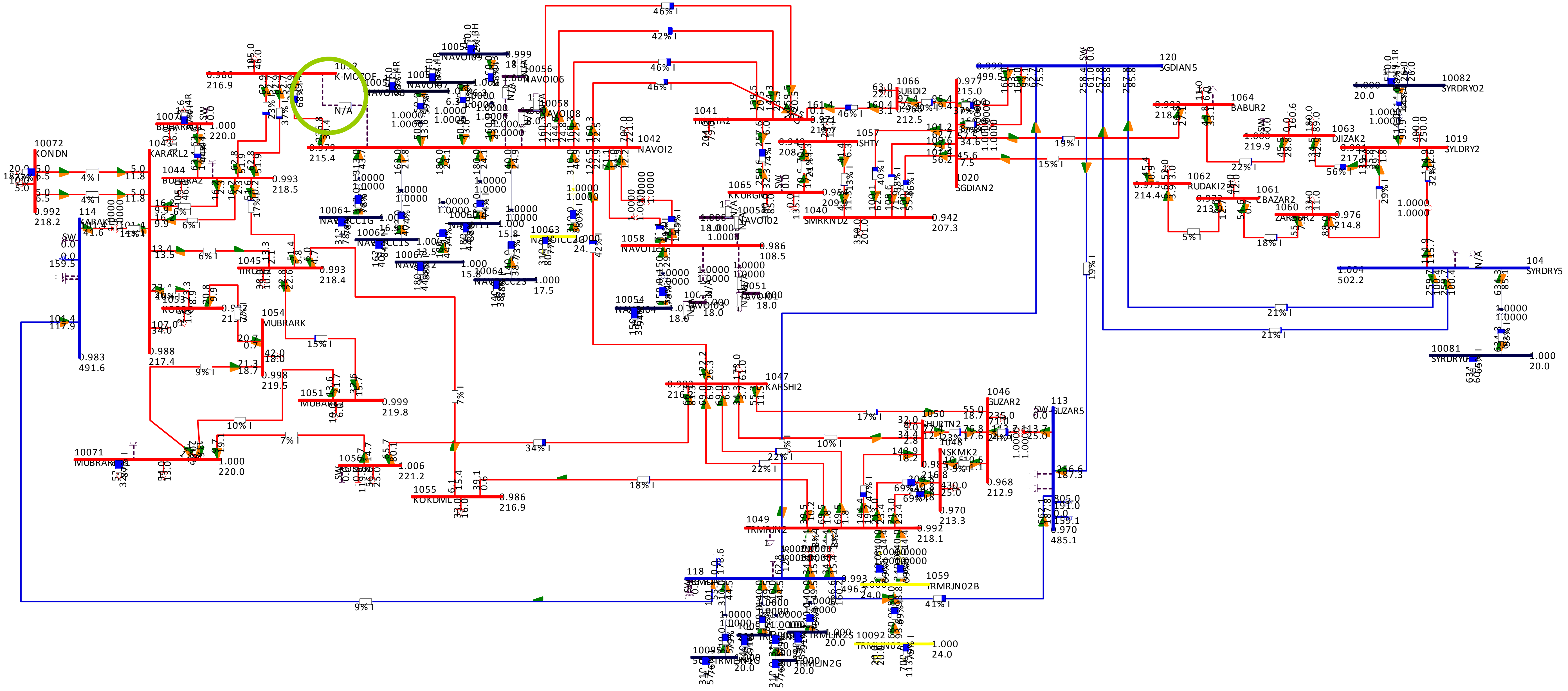


Figure 7.1.3-2 Power Flow Analysis Result (N-1 case at the section between Navoi TPP and K-Mozof SS)

7.1.4 Fault Current Analysis

Because the total installed capacity of Navoi TPP will be increased from 1,250 MW as of now to around 1,800 MW in year 2015, it is anticipated that the fault current around the power plant would be largely increased. This analysis evaluates the impact of adding the new CCCGP No.2.

(1) Approach and Methodology
The 3-phase short-circuit current case is evaluated. Table 7.1.4-1 shows the criteria.

Table 7.1.4-1 Maximum Allowable Fault Currents (representative case)

Nominal Voltage	Total Clearance time (Primary protection)	Maximum Allowable Fault Current
500kV	Max 120 ms	41.8kA
220kV	Max 160 ms (200 ms)	31 kA

Source: SJSC Uzbekenergo

For the actual facilities, the maximum allowable fault current is set individually, e.g., 50 kA for a circuit breaker at Guzar 500 kV Substation. The analysis evaluates the impact of adding new CCCGP No.2 by comparing the value of short-circuit current between the cases with and without the CCCGP No.2.

(2) Result
The 3-phase short-circuit current values for the 500 kV and 220 kV buses for major substations were shown in Table 7.1.4-2 (with and without 450-MW CCCGP No.2). The influence of introduction of 450 MW combined cycle power plant on the network system was +0.5 kA for a 500kV bus and +0.4 kA for a 220kV bus of Navoi Thermal power Plant. In summary, the current was within the rated current/ planned capacity, and therefore, the impact of adding CCCGP No.2 is confirmed to be small.

Table 7.1.4-2 Result of Fault Current Analysis at major buses

Name of facility		Maximum Allowable Fault Current	Without CCCGP No.2	With CCCGP No. 2
Navoi TPP	220 kV Bus 110 kV Bus	60 kA (planned[*])	5.9 kA 8.2 kA	6.4 kA 8.6 kA
Guzar SS	500 kV Bus	31.5 kA	3.0 kA	3.0 kA
Talimarjan TPP	500 kV Bus	40 kA or 56 kA	3.2 kA	3.3 kA
Karakul SS	500 kV circuits	31.5 kA	2.6 kA	2.7 kA
	220 kV circuits	25 kA	5. 8 kA	6.0 kA

*: According to NDC (National Dispatch Center) calculations, the present 3-phase short-circuit current value of Navoi Thermal Power Plant 220kV bus is so large that they plan to upgrade the size of the circuit breakers up to 60kA before the plant’s commission in 2015.

7.1.5 Dynamic Stability Analysis

(1) Approach and Methodology

When all of the synchronous generators in the system are able to maintain synchronized operations even in the event of an equipment fault occurring, which constitutes the system, the system can be considered stable. The calculations were executed under the criteria that “when the oscillations of the phase angles among the rotors of synchronous generators which constitute the system tends to converge even in the case of the severest single contingency, the system is stable.”

Fault sections were selected taking into consideration typical heavy-loaded sections near Navoi TPP (Table 7.1.5-1).

Table 7.1.5-1 Stability Analysis Cases

Case	Fault Section (1cct)
Case 1	220 kV Navoi TPP – K-Mozof SS Transmission line
Case 2	220 kV Navoi TPP – Himiya SS Transmission line
Case 3	500kV Talimarjan TPP – Guzar SS

Table 7.1.5-2 Fault Sequence

Time	Event
0 ms	Single Circuit Three-phase Short Circuit Fault at the selected section
160 ms	Fault Clearance (1cct Open)
10 s	End of Calculation

(2) Analysis Conditions

The stability analysis was conducted under the following conditions:

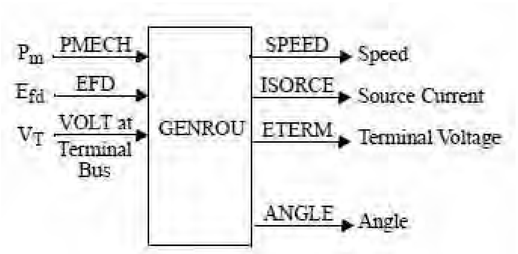
- Generator models were developed based on the data provided by SJSC Uzbekenergo as shown in Table 7.1.5-3. For items without data provided, typical figures were set. Because all the generators are for thermal power plant, the round rotor generator model was assumed for all the generators.

Table 7.1.5-3 Generator Model: GENROU (Round Rotor Generator Model)

	T’do	T’’do	T’qo	T’’qo	H	D	Xd	Xq	X’d	X’q	X’’d=X’’q	Xl	S(1.0)	S(1.2)
CCCGP No.1 and No. 2														
Gas Turbine	8.9	0.044	0.99	0.07	2.0	0	2.48	2.3	0.232	0.53	0.22	0.187	0.12	0.37
Steam Turbine	9.0	0.046	1.25	0.08	3.2	0.11	2.02	1.95	0.285	0.39	0.148	0.123	0.12	0.37
Other generators														
Navoi #12	6.45	0.03	0.5	0.03	3.2	0	1.38	1.2	0.23	0.5	0.16	0.15	0.12	0.37
Talimarjan 500 kV	9.0	0.03	1.5	0.02	3.22	0	2.22	2.1	0.29	0.49	0.22	0.17	0.12	0.37

Source: SJSC Uzbekenergo

Note: The study cited the parameters for CCCGP No.2 from those for the existing CCCGP No.1, as the technical specification of CCCGP No.2 is expected to be similar to that of the CCCGP No.1



Source: PSS/E manual

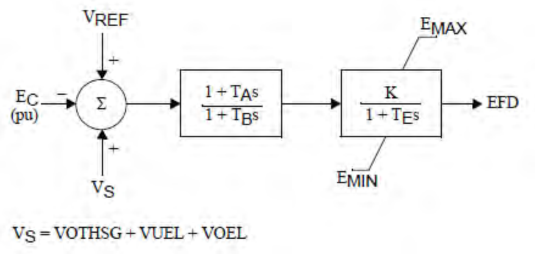
Figure 7.1.5-1 Block Diagram of GENROU

- The simple exciter model (SEXS), shown in Table 7.1.5-4, was applied as the exciter models for all the generators due to the limited data availability. This assumption also applied to the designated CCCGP No.2.

Table 7.1.5-4 Exciter Model for the other generators: SEXS (Simplified Excitation System)

TA/TB	TB	K	TE	EMIN	EMAX
0.1	10	100	0.05	0	5

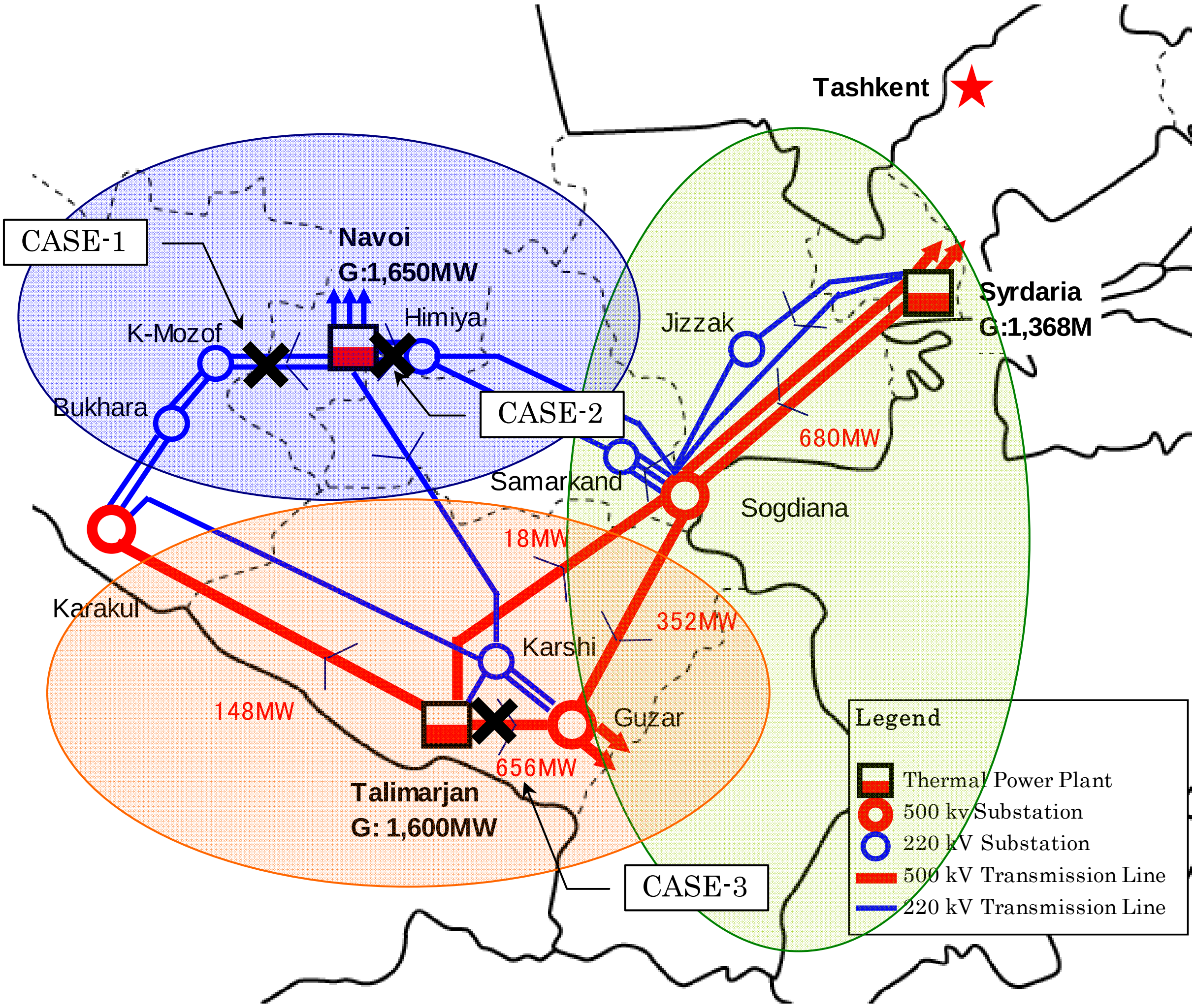
Source: SJSC Uzbekenergo



Source: PSS/E manual

Figure 7.1.5-2 Block Diagram of SEXS

- To set the severest calculation condition, the power plants with relatively-smaller capacity, namely Mubarak, Buhara, and Kondon Heat Power Plants, are set as out of service for the stability analysis. Instead, the other larger-size power plants’ output are set as almost maximum.



Source: Developed by JICA Study Team

Note: The demand area covered by green circle is mainly supplied by Syrdaria TPP. Likewise, the area covered by red circle is supplied by Talimarjan TPP, while the area covered by blue circle is supplied by Navoi TPP.

Figure 7.1.5-3 Power Flow Diagram for the Stability Analysis (During Winter Peak in 2015).

(3) Result

Table 7.1.5-5 shows the stability analysis results for each case in Table 7.1.5-1. Behaviors of phase angle oscillation for the cases were shown in Figure 7.1.5-4 to -6.

Table 7.1.5-5 Stability Analysis Results

Case	Fault Section (1cct)	Result
Case 1	220 kV Navoi TPP – K-Mozof SS Transmission line	Stable
Case 2	220 kV Navoi TPP – Himiya SS Transmission line	Stable
Case 3	500kV Talimarjan TPP – Guzar SS	Stable

For the planned system in the year 2015, the oscillation waveforms of phase angle differences were found converged in the case of a single circuit fault of the primary heavy-loaded sections near Navoi TPP. Therefore, it was confirmed that the planned system was stably operated under such severe conditions.

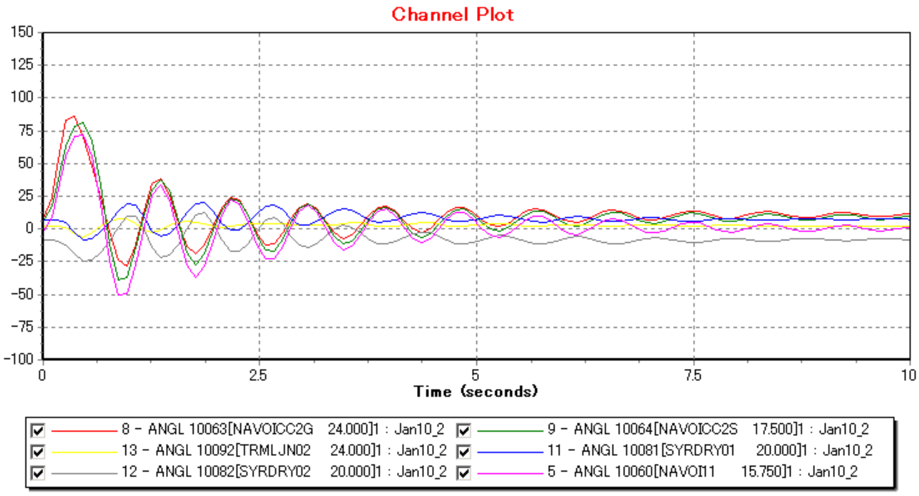


Figure 7.1.5-4 Case-1 Line Fault: 220 kV Navoi TPP – K-Mozof SS Transmission Line

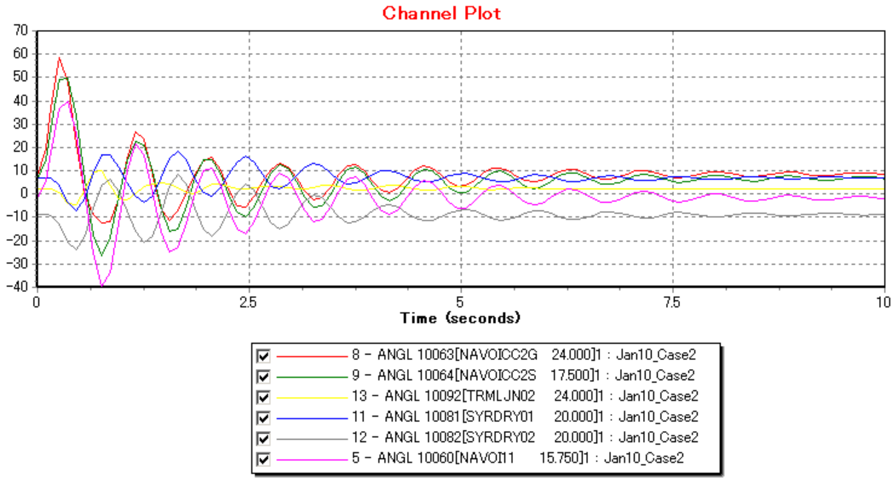


Figure 7.1.5-5 Case-2 Line Fault: 220 kV Navoi TPP – Himiya SS Transmission Line

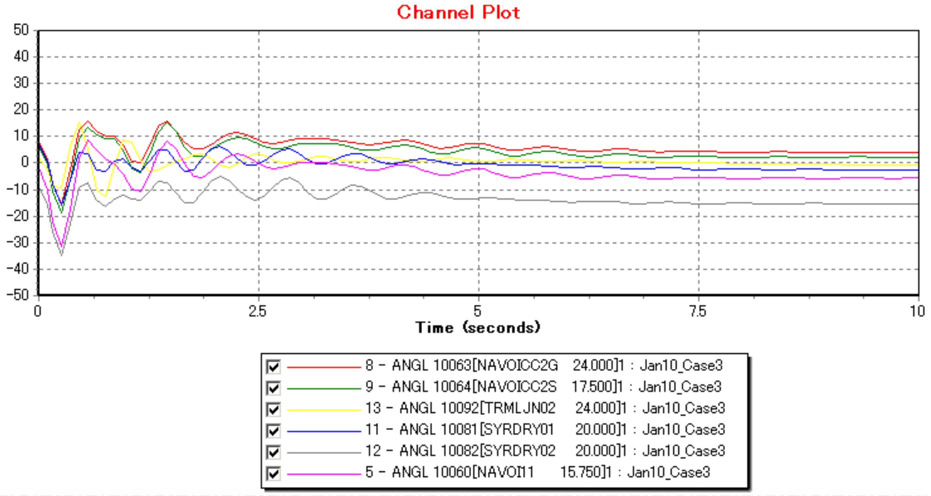


Figure 7.1.5-6 Case-3 Line Fault: 500 kV Talimarjan TPP – Guzar SS Transmission Line

7.1.6 Conclusion

The analysis revealed that there will be no significant problem of power flow, voltage, short-circuit current, and dynamic stability caused by connecting the new 450 MW CCCGP No.2 of the Navoi Thermal Power Plant to the currently-planned power system of year 2015. Therefore it is confirmed that the installation of CCCGP No.2 would not require to modify or strengthen the currently-planned power system.

7.2 Grid Connection Plan

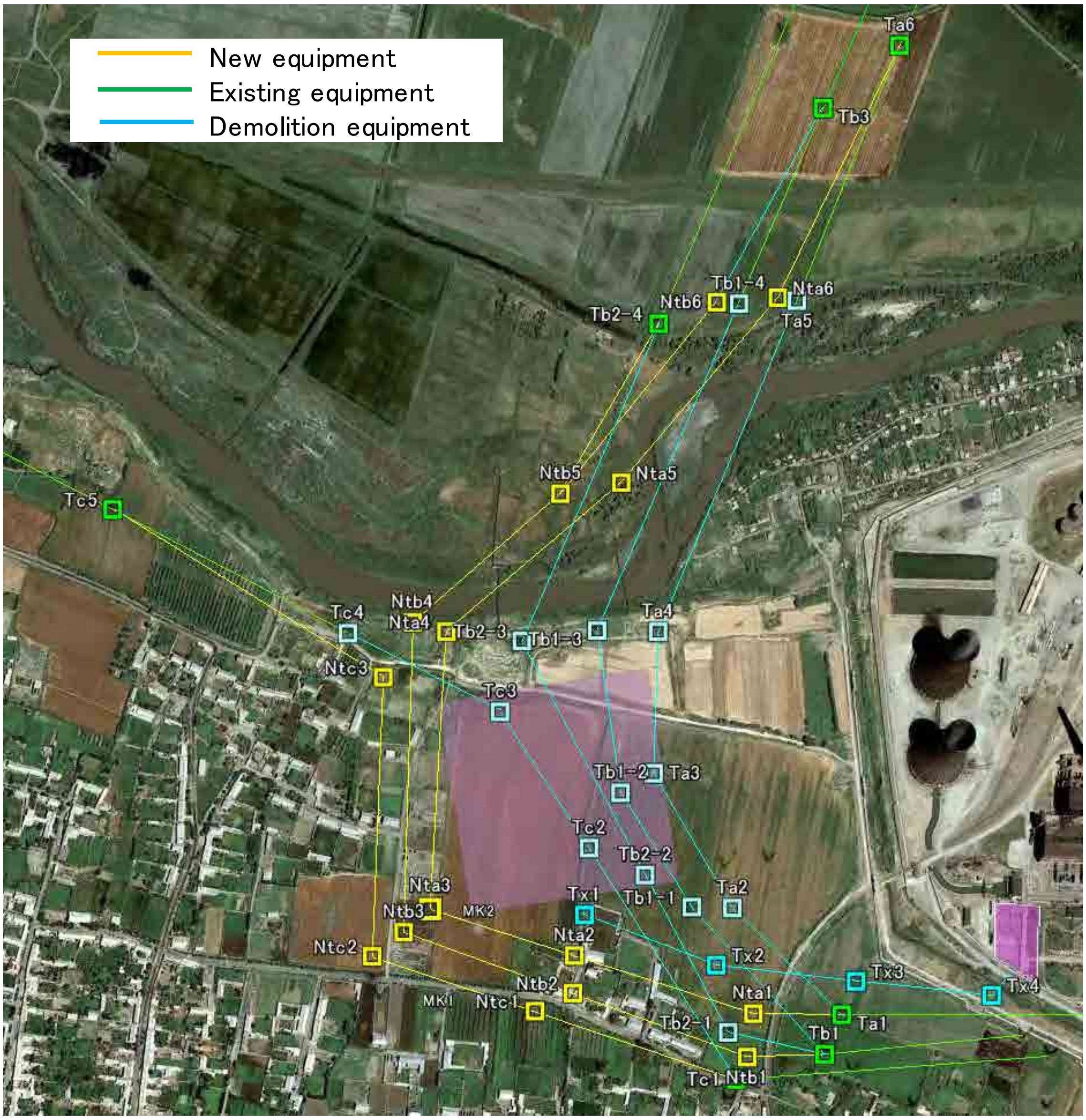
For the transmission line and substation design of this project, the materials and information provided by the counterpart and JICA Report "Republic of Uzbekistan Supplemental Study to enhance the collaboration with NEDO on Tashkent Heat Supply Power Plant Modernization Project" were referred to.

7.2.1 Layout of Transmission Line

Estimated layout of transmission line is shown in Figure 7.2.1-1.

Concept of transmission line route selection

- The locations of towers are set to be a good distance from west settlement and close to new thermal power stations as far as possible.
- The clearance of transmission lines is set to be secured as 40m in light of the length of tower arms, Right of Way (ROW: 25m)
- Some boundary towers between new towers and existing towers are considered for reconstruction. It is possible that reconstruction and reinforcement of other towers or tower members will be required, arising from unclear present conditions and the design conditions of existing towers.



Source: Study Team

Figure 7.2.1-1 Layout of Transmission Line

7.2.2 Basic design conditions of Transmission lines

For the design of the branch span of this project, both the Regulations on Electrical Devices (PUE) and Uzbek-Standard (GOST) were referred to.

(1) Voltage
220kV

(2) Ambient Temperature
Ambient Temperature is shown in Table 7.2.2-1.

Table 7.2.2-1 Ambient Temperature

Item	Temperature[^{o}C]
Maximum air temperature	45 ^{o}C
Minimum temperature	-30 ^{o}C
Annual mean air temperature	15 ^{o}C
Temperature in case of glazed frost	-5 ^{o}C

Source: JICA Report" Republic of Uzbekistan Supplemental Study to enhance the collaboration with NEDO on Tashkent Heat Supply Power Plant Modernization Project"

(3) Wind Velocity
Maximum normative wind velocity: 28m/s
Conductor installation condition: 10m/s

(4) Wind Pressure
Maximum normative wind velocity pressure: 490Pa
Conductor installation condition: 60Pa

(5) Grazed frost condition
Thickness: 10mm
Density: 0.9g/cm^3

(6) Load Condition

8 conditions which consist of normal operation, conductor installation, and maximum temperature conditions were considered.

1) Maximum air temperature, no wind, no glazed frost
2) Minimum air temperature, no wind, no glazed frost
3) Annual mean temperature, no wind, no glazed frost
4) Conductors are covered with grazed frost (thickness: 10mm, density: 0.9g/cm^3), temperature -5℃, no wind
5) Maximum normative wind velocity pressure q_{max}, temperature –5 ^{o}C, no glazed frost
6) Conductors are covered with glazed frost (thickness: 10mm, density: 0.9g/cm^3), temperature –5oC, wind velocity pressure 0.25 q_{max}
7) During conductor installation (temperature -15 ^{o}C, wind pressure 6.25kgf/m2, no glazed frost
8) Maximum conductor temperature (assumed 100 ^{o}C), no wind, no glazed frost)

7.2.3 Allowable Tension

(1) Allowable Tension of Conductor and Ground wire

In PUE "Allowable tension of conductors and cables for overhead line (more than 1kV)", the allowable tensions in the case of conductor installation were provided as shown in Table 7.2.3-1. Therefore, the tension in the severest condition was assumed 45% of the ultimate tensile strength of the conductor and ground wire.

Table 7.2.3-1 Allowable Tension

Temperature	Allowable Tension in case of installation (% of Ultimate Tensile Strength)
Maximum load at the minimum air temperature (-30 °C)	45
Maximum load at the annual mean temperature (15 °C)	30.

Source: JICA Report" Republic of Uzbekistan Supplemental Study to enhance the collaboration with NEDO on Tashkent Heat Supply Power Plant Modernization Project"

(2) Allowable Tension of insulator

Based on Table7.2.3-1, the allowable tension in the severest condition was assumed 45% of Rated Ultimate Strength (RUS) of insulator.

7.2.4 Design of Conductor and Ground wire

(1) Conductor and Ground wire

The Conductor and Ground wire which were assumed in this consideration were shown in Table7.2.4-1.

Table 7.2.4-1 Properties of Conductor and Ground wire

Type	Conductor	Ground wire	
	ACSR300mm^2	AC70mm^2	OPGW70 mm^2
Component of stranded wires	Al:24/4.0mm St:7/2.65mm	AC: 7/3.5	AC:8/3.2mm OP unit 1/5.0
Total area of aluminum wires	300mm^2	67.35mm^2	77.89mm2
Overall diameter	23.95mm	10.5mm	11.4mm
Weight	1,138kg/km	426.5kg/m	470.1kg/km
Ultimate tensile strength	90.6kN	77.3kN	80.2kN
Modulus of elasticity	78,300N/mm^2	149,000N/mm^2	142,000N/mm^2
Coefficient of linear expansion	19.5*10^{-6}/°C	12.9*10^{-6}/°C	13.8*10^{-6}/°C
DC resistance at 20 °C	0.0958 Ω/km	1.12 Ω/km	0.834 Ω/km

Source: Study Team

(2) Maximum working tension of conductor

As a maximum span length is measured to be approximately 440m at point between Ntc3 and Tc5, the maximum design span length is assumed to be 450m in consideration of elevation difference. Therefore, the maximum tension of conductor and ground wire for this project will be occur in 450m span. The values of maximum working tensions of conductor and ground wires satisfy the determined allowance tension as shown in Table7.2.4-2. The applied stringent condition was "Conductors are covered with grazed frost (thickness: 10mm, density: 0.9g/cm^3), temperature -5 oC, no wind" in clause 2. (6).

Table 7.2.4-2 Working Tension and Allowable Tension of Conductor

Type	UTS	Tension		Allowable Tension
ACSR300mm^2	90.6kN	Maximum Tension	40kN	0.45>0.42

Source: Study Team

(3) Maximum working tension of ground wire

The working tension of ground wire is determined so that it's sag becomes less than 80% of the conductors' sag under the condition which is "Annual mean temperature, no wind, no glazed frost", (usually called EDS: Every Day Stress) at the standard span length (450m) for avoiding reverse flashover from ground wire to the conductors and direct lightning strokes to conductors.

Table 7.2.4-3 Working tension and Allowable Tension of Ground wire

Type	UTS	Tension		Allowable Tension
AC70mm^2	77.3kN	Maximum Tension	21kN	0.45>0.27
OPGW70 mm^2	80.2kN	Maximum Tension	23kN	0.45>0.28

Source: Study Team

(4) Standard Span Length
450m

7.2.5 Insulator Design

(1) Insulator Type and Size

1) Type

The standard disc type porcelain insulator with socket complying with the IEC 60305 is applied to the transmission lines for this project.

2) Size

The selected insulator size and its strength, respectively are shown in Table 7.2.5-1.

Table 7.2.5-1 Insulator Size

Size	Height	Diameter	RUS
250mm disc	146mm	255mm	120kN

RUS: Rated Ultimate Strength
Source: IEC 60305

(2) Number of Insulator Unit

1) Pollution level

Pollution level assumed “Light” classified in the IEC 60071-2 (Table I). The required creepage distance /phase to earth voltage for “Light” level is 16mm/kV.

2) Standard lightning impulse withstand voltage

Standard lightning impulse withstand voltage for 220kV equipment is 1,050kV and minimum clearance at 1,050kV is 2,100mm as classified in IEC60071-2.

3) Number of insulator units per string: 15units

From the necessary creepage distance of insulator, the number of insulator units per string of the standard string is 12 units. While from the standard lightning impulse withstand voltage, the number of insulator units per string was determined as 15 units Standard insulator sets applied to the existing have 16 units per string.

(3) Tension insulator assembly

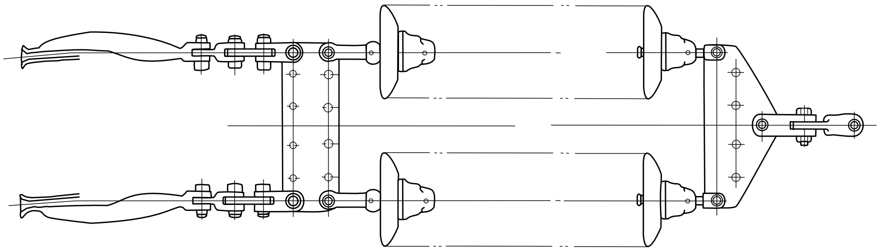
Working tension of insulator assemblies and allowance strength were shown in Table 7.2.5-2. Example of insulator assemblies (Tension type) is shown in Figure 7.2.5-1.

Table 7.2.5-2 Working Tension of Insulator Assemblies

Conductor	Maximum Tension (Span length :450m)	Suspension and Tension insulator assembles	Allowance Strength*
ACSR300mm^2	80 (40kN×2 bundles) kN	Double strings of 240kN (120kN×2)	0.45>0.33

*Allowance Strength is applied as 45% of RUS which is as same as the value of conductor

Source: Design by JICA study team



Source: Study Team

Figure 7.2.5-1 Example of insulator assembly (Tension type)

7.2.6 Ground Clearance

The most severe state for the ground clearance of conductors will occur when the assumed conductor’s temperature rises to 100°C under still air conditions. As for this project, the minimum height of conductor above ground provide by counterpart is shown in Table 7.2.6-1. As the area for this project is purchased by counterpart, so it is assumed the public do not enter this area. Therefore, Ground Clearance Value of plain as the minimum ground clearance was applied to this project.

Table 7.2.6-1 Minimum Height of Conductor above Ground

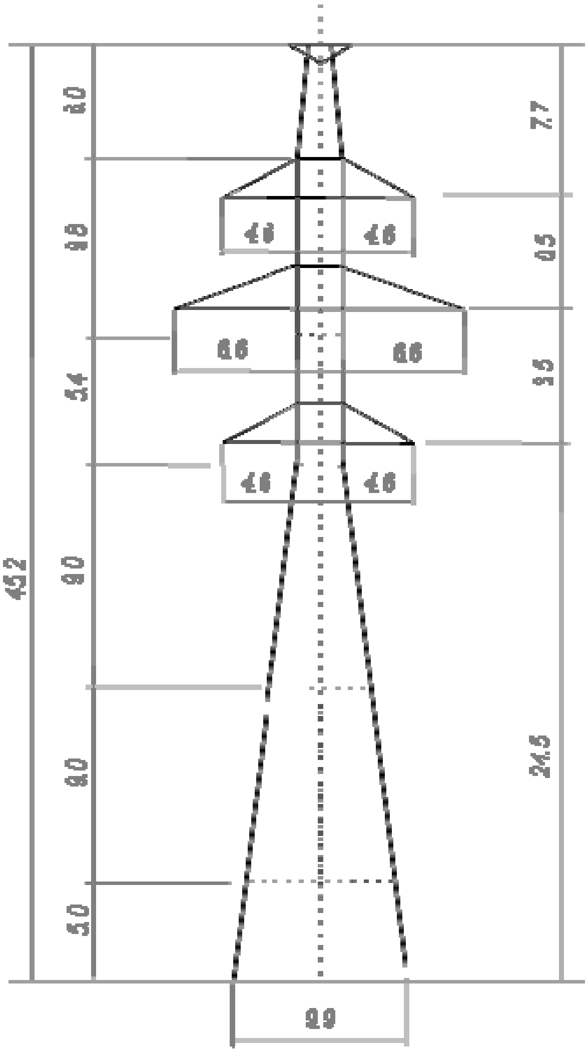
Classification	Height
Plain	8m
Crossing point of roads	15m
Crossing point of railway	16.5m

Source: SAESP

7.2.7 Tower Design

Based on the consideration of minimum ground clearance and the materials provide by counterpart, Tower type “y220-2T+14” was applied to this project as shown in Figure 7.2.7-1.

Final tower type at each tower including such as heavy angle tower, tower near the river and boundary tower between new construction tower and existing tower shall be examined by the results of detail design.

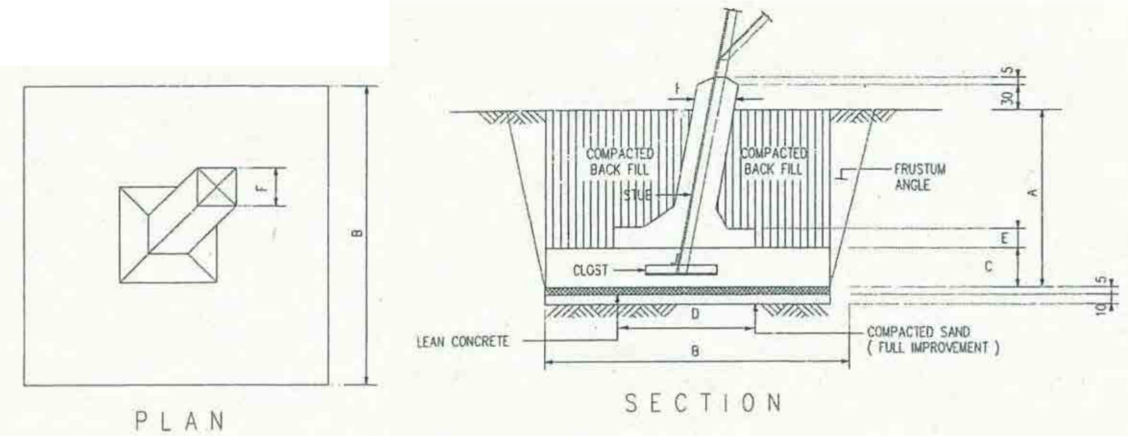


Source: SAESP

Figure 7.2.7-1 Tower Skelton Type"y220-2T+14"

7.2.8 Foundation Design

As it is considered that the nature of soil in the area is good, it can therefore be assumed that normal pad and chimney type foundation are applicable to all towers in this project as shown in Figure 7.2.8-1. Final Foundation type at each tower including such as heavy angle tower, tower near the river and boundary tower between new construction tower and existing tower shall be examined by the results of detail design.



Source: Study Team

Figure 7.2.8-1 Foundation Type and Chimney

7.2.9 Designs on a bay and bus bar into an existing substation

(1) Standard of Bay design

Counterpart personnel has not submitted any standards, design criteria and actual construction costs in relation to a 220kV bay connected into an existing substation and a 220kV bus bar in the substation.

Then, the study team has made assumptions in the basic design of such facilities based on our experiences of overseas design works.

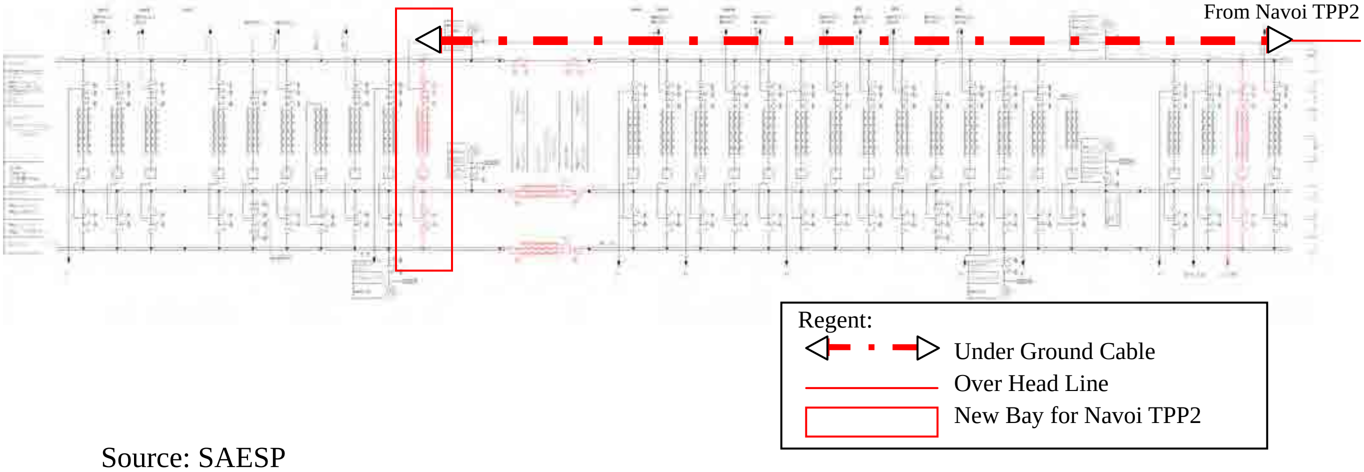
The 220kV equipment of switchgear is subject to a following standard.

- IEC 60056 High Voltage equipment
- IEC 60076-1 Power transformers, General.
- IEC 60076-2 Power transformers, Temperature rise.
- IEC 60076-3 Power transformers, Insulation levels, dielectric tests and external clearances in air.
- IEC 60076-5 Power transformers, Ability to withstand short circuit.
- IEC 60076-10 Power transformers, Determination of sound levels.
- IEC 60137 Insulating bushing for alternating voltages above 1kV
- IEC 60156 Transformer Insulating liquids-determination of the breakdown voltage at power frequency – test methods
- IEC 60214 On-load tap-changers.
- IEC 60255 Protection relays
- IEC 60296 Specification for unused minerals insulating oils for transformers and switch-gear
- IEC 60354 Loading guide for oil-immersed transformers
- IEC 60420 High voltage alternating current switch-fuse combinations.
- IEC 60427 High Voltage Switchgear
- IEC 60439 Low voltage switchgear
- IEC 60551 Determination of transformer and reactor sound levels
- IEC 60616 Terminal and tapping markings for Power Transformers
- IEC 60694 Common specifications for high-voltage switchgear and controlgear standards.
- IEC 60722 Guide to the lightning impulse and switching impulse testing of power transformers and reactors.
- IEC 60815 Guide for the selection of transformer insulators in respect of polluted conditions

- IEC 61330 high voltage/low voltage prefabricated substations

(2) Design of Bus & bay in the existing substation

220kV cable system has been applied to utilize a bus extension in this study due to safety and maintenance reasons. The route of bus bar extension is planned to be located under eight (8) existing transmission lines. The study team recommends that the underground cable system should be utilized in the bus bar extension from bay of the CCCGP No.2 due to secure availability to prevent interruptions by maintenance and turbulence from other transmission lines. Shown in Figure 7.2.9-1 the design of the bus and bay from CCCGP No.2.



Source: SAESP

Figure 7.2.9-1 Single Line Diagram of 220kV Navoi SS on the Bus & Bay from CCCGP No.2

7.2.10 Construction cost

(1) Total construction cost

Total construction cost including transmission line and substation is 9.3millon USD.

(2) Cost estimation of transmission line

Based on the materials related to Navoi No.2 Power station provided by counterpart, the construction cost of transmission line for this project was estimated as 6 million USD as shown in Table 7.2.10-1.

[Cost estimation of Demolition line]

Based on the experience of construction in Japan, Unit cost of demolition working is 30% of that of construction cost

[Premium rate]

This project involves complicated construction, such as shifting conductors from existing transmission lines to new construction transmission lines, in consideration of N- 1 criterion during the construction of replacement boundary tower between existing tower and newly constructed tower. In this case based on the experience of construction in Japan, a premium rate to all construction costs raising assumed at 50%.

Table 7.2.10-1 Construction cost of transmission line

Item	Construction Length [km]	Unit cost [M USD/km]	FC [MUSD]	LC [MUSD]	Total cost [M USD]
New construction line	1.0	0.50	0.3	0.2	0.5
Reconstruction line	5.0	0.50	1.5	1.0	2.5
Demolition line	5.0	0.15			0.75
Premium rate*					1.88
Total					5.63

Source: Study Team

(3) Cost estimation of a bay and bus bar into an existing substation

The costs of a bay and bus bar into an existing substation have been estimated based on our overseas and Japanese experiences. The estimated costs are described in Table 7.2.10-2. Equipment cost based on the aforementioned standards is described in Table 7.2.10-3.

Table 7.2.10-2 Substation Construction Cost

Items	FC (M USD)	LC (M USD)	Total (M USD)
Equipment	2.402		2.402
Transportation fee		0.120	0.120
Civil and erection	0.672	0.168	0.840
Miscellaneous cost	0.324		0.298
Total	**3.398**	**0.288**	**3.686**

Source: Study Team

Table 7.2.10-3 Substation Equipment cost

Unit of cost：M USD

No.	Items	Unit	CIF	Q'ty	Total prices
1	**220kV switchyard**				**1.708**
1.1	Circuit Breaker (3-phase)	set	0.182	1	0.182
1.2	Disconnection switch with 1 earthing switch (3-phase)	set	0.060	3	0.180
1.3	Disconnection switch with 2 earthing switches (3-phase)	set	0.067	1	0.067
1.4	Current transformer (3-phase)	set	0.050	1	0.050
1.5	Busbar structure conductor, fitting	set	0.038	1	0.038
1.6	Set of Structures for Switch Bay etc.	set	0.086	1	0.086
1.7	Set of Overhead Connections for switch Bay	set	0.068	1	0.068
1.8	XLPE cable (420m), 2 terminals etc.	set	0.315	3	0.945
1.9	Grounding	set	0.092	1	0.092
2	**Control and Relay**				**0.520**
2.1	For 1 feeder	set	0.360	1	0.360
2.2	AC / DC and LV Cables	set	0.160	1	0.160
3	**Communication and SCADA**				**0.060**
	Extension of function	set	0.060	1	0.060
4	**Spare parts**				**0.114**
	5% of Total above	set			0.114
	Total				**2.402**

Source: Study Team

Chapter 8 Environmental Social Consideration

8.1 Environmental status

The general outline of the environmental status of the project area based on the existing EIA report and the result of the field survey is described below.

8.1.1 Air quality

Table 8.1.1-1 describes the result of annual continuous atmospheric survey in 2010 at three measurement points (residential, industrial and roadside area Figure 8.1.1-1) in Navoi City by Uzbek Hydro meteorological Institution“Uzgidromet”.
The nitrogen dioxide (NO_2) concentration is 0.015～0.11 mg/m^3, higher than the maximum permissible concentration (MPC) at the maximum level, with annual average of 0.04 mg/m^3.

The pollutant concentration is diluted with change of atmospheric condition such as wind direction, so that the concentration value with a long period of time such as average annual value is lower than the value with shorter period of time like 24-hour value, 30-minute value and 10-minute value, Likewise, the ambient air quality standard is also lower for the concentration value with longer period of time.
Comparing with the 1-hour value regulated by IFC/WB EHS Guidelines shown in the table below, the 30-minute value of the nitrogen dioxide (NO_2) concentration in Navoi City described in the table is considered to satisfy the IFC/WB EHS Guideline, since the 1-hour value is even lower the 30-minute value.
In addition, annual average of NO_2 concentration satisfies the annual average value of IFC/WB EHS Guidelines.

The sulfur dioxide (SO_2) concentration is 0.001～0.009 mg/$m^{3,}$ which is well below MPC at the maximum level. This value is also considered to satisfy the standard value of IFC/WB EHS General Guideline, since the 24-hour value is even lower than the 30-minute value.

It is also predicted that nitrogen dioxide (NO_2) concentration around power plant site will become much lower, since the number of vehicles and industry plants, which is the generation source of NO_2, around the power plant site is more lower than that in Navoi City.
Therefore, the NO_2 concentration value around the power plant site is predicted to be about the same or lower as the value of residential area in Navoi City at most with conservative point of view.

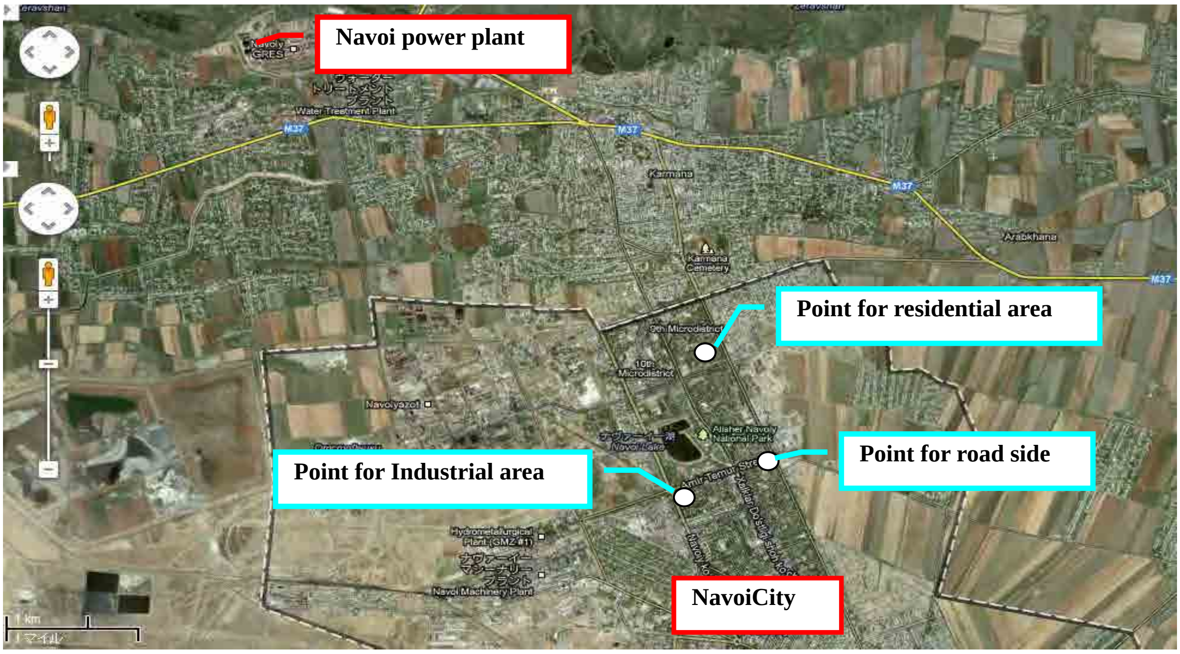


Figure 8.1.1-1 Measuring location of Air Quality in Navoi City

Table 8.1.1-1 Comparison of Air quality in Navoi city with the environmental standard

Pollutant	Area	Current value in Navoi City (mg/m^3)		Uzbekistan Maximum permissible concentration (MPC) (30 min) (mg/m^3)	IFC/WB EHS General Guidelines(2007) (mg/m^3)
		minimum ~maximum (30 min)	Annual average (1year)		
nitrogen dioxide （NO$_2$）	Residential	0.015～0.09	0.04	0.085	0.2(1hour) 0.04(1year)
	Industrial	0.016～0.11	0.04		
	Roadside	0.016～0.10	0.04		
nitrogen oxide （NO）	Residential	0.014～0.09	0.03	0.6	―
	Industrial	0.009～0.014	0.03		
sulfur dioxide （SO$_2$）	Residential	0.001～0.008	0.002	0.5	0.5(10min) 0.125(24hours)
	Industrial	0.002～0.008	0.002		
	Roadside	0.002～0.009	0.003		
carbon oxide （CO）	Residential	0.7～3.0	1.0	5.0	―
	Industrial	0.6～2.0	1.0		
Suspended particles（dust）	Residential	0.062～0.5	0.1	0.15	0.15（24hours） 0.07（1year）

Reference: the document by Uzbek Hydro meteorological Institution“Uzgidromet”obtained at the survey.
Sanitary norms, rules and hygiene normative documents of the Republic of Uzbekistan. San Pin No. 0015-94.

8.1.2 Water quality

1) Zerefshan River

Table 8.1.2-1 describes the result of water quality survey Zerefshan River conducted at 1 km upstream of Navoi City, 0.5km downstream of Navoi, and the water inlet of the power plant.

It should be noted that water quality of Zerefshan River in Navoi, upstream of the power plant, exceeds the MPC in SS, oil content, sulfate, heavy metals, and other items.

The inlets of the power plant are located upstream of the outlets, thus intake water is not impacted by the discharge; however, water quality of SS, oil content and sulfate exceeds the

MPC.

This water quality also exceeds the standard for a body of water for fishing activity. It is said that industrial activities in Navoi City and agriculture surrounding area are the main reason of the insufficient water quality.

Moreover, though it is not described in Table 8.1.2-1, water temperature and salinity downstream around the power plant is increasing every year, for which the existing power plant is said to be one of the pollution sources.

Table 8.1.2-1 Comparison of water quality in Zerafshan River with the environmental standard

Item	Unit	1km upstream of Navoi	0.5km downstream of Navoi	Water inlet of the power plant	Environmental standard in Uzbekistan
pH	—	7.032	6.967	8.3	6.5- 8.5
DO	mg/ℓ	10.065	9.386	—	Summer: 4.0 or higher Winter: 6.0 or higher
BOD	mgO2/ℓ	1.561	1.433	—	3.0
COD	mgO2/ℓ	11.342	16.900	—	—
SS	mg/ℓ	**349.025**	**455.364**	**487.0**	30
Oil	mg/ℓ	0.034	**0.104**	**0.212**	0.05
Ammonia	mg/ℓ	0.072	**0.165**	—	0.08
Nitrite	mg/ℓ	0.039	0.08	**0.164**	0.08
Nitrate	mg/ℓ	5.746	9.026	10.4	40
Sulfate	mg/ℓ	**516.250**	**582.455**	**453.0**	100
Phenol	mg/ℓ	0.001	**0.002**	—	0.001
Chloride	mg/ℓ	96.167	142.091	71.5	300
Calcium	mg/ℓ	97.267	105.0	107.0	180
Sodium	mg/ℓ	106.75	**127.0**	—	120
Potassium	mg/ℓ	1.667	1.845	—	50
Phosphate	mg/ℓ	**0.018**	**0.023**	—	0.01
Fe	mg/ℓ	0.054	0.084	0.33	0.5
Cu	mg/ℓ	**1.600**	**2.345**	—	0.001
Zn	mg/ℓ	**3.350**	**4.209**	—	0.01
Cr	mg/ℓ	**4.367**	**5.864**	—	0.5
Pb	mg/ℓ	**0.125**	0.00	—	0.03

Reference: EIAp23, 34-35 and the document obtained at the survey.
Rules for protection of surface water from contamination by discharge water.（San Pin No.0056-98）

2) Water quality of the effluent from the existing power plant

There are 5 water outlets usually used at the existing Navoi power plant and the measurement result of the pollutant concentration of water discharge from each water outlet is shown in Table 8.1.2-2.

The condenser cooling system in Unit 1~4 and Unit 7~9 of the existing power station adopts once-through system. Any pollutant will not be predicted to be generated in this system, though large amount of thermal effluent will be discharged. However, as described above, the high concentration of oil, sulfate and SS are observed in not only wastewater, but also in thermal effluent which reflects the water quality of Zerafshan River.

The condenser cooling system in Unit 11 and 12 of the existing power station adopts natural-draft system, and water is usually supplied from Zerafshan River and treated with simple precipitation system before use. As a result, concentration of pollutant in the

blow-down from the cooling tower exceeds the effluent standard in many items.
Also, water from Zerafshan river is used for the purpose of feeding the existing boiler after simple treatment; therefore, water quality of the effluent exceeds the wastewater standard.

Table 8.1.2-2 Pollutant concentration in the effluent of the existing power plant compared with the effluent standard

Items	Water outlet（mg/ℓ）					Effluent standard for Navoi power plant
	No. 1	No. 2	No. 3	No.4	No. 5	
pH	8.29		**8.7**		8.2	6.5－8.5
SS	478.0	55.4	217.4	86.6	244.5	487
Oil	**0.204**	**0.435**		**1.03**		0.112
Dissolved inorganics	1,089	1,116.2	**2,518**	-	**1,740**	1,500
Nitrite	0.156					3.3
Nitrate	9.99					45
Sulfate	438	414	**1,300**		**978**	500
Chloride	71	71	256		102	350
Calcium	102	100.8	154		202.8	487
Magnesium	83.64	76.8	**225.7**		61.24	170.1
Fe	4.58					4.62
The Maximum Discharge Volume(m^3/h)	88,000	35	97.5	5	344	—
Remark	Thermal effluent from Unit 1-10 one-through system	Rain water from Unit 8-12 after oil-treatment	Blow-down from the cooling tower of Unit 11-12	Rain water from Unit 1-7 after oil-treatment	Effluent from water demineralization facility	—

Reference: EIA p.24 and the document obtained at the survey.
Rules for protection of surface water from contamination by discharge water.(San Pin No.0056-98)

8.1.3 Noise and vibration

1) Noise

The noise level at 1km from existing power plant by brief prediction is described in Table 8.1.3-1(EIA p. 65)..

Noise level in the residential area located 1km fro the site is 54dB, which satisfies the Uzbekistan environmental standard (55dB) and IFC/WB EHS General Guidelines.

The noise measurement conducted in 2003 in the existing power plant shows that noise level which is 2-15 dB higher than the work noise standard (80dB) was observed at water-cooling tower, steam turbine, compressor, power generator, draft fans and deaerator of the power generation facility (EIA p.64-65).

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Table 8.1.3-1 Noise level at 1km from Existing power plant compared with the Uzbekistan and other environmental standards

Place	Predicted value	Standard in Uzbekistan (residential area)		IFC /WBEHS General Guidelines(2007)	
		Daytime	Nighttime	Daytime	Nighttime
1km from Existing power plant	54dB	55dB(A)	45dB(A)	55dB(A)	45dB(A)

Reference: EIA p.65

Protection from noise” (State committee of Uzbekistan for architecture and construction. Tashkent. 1996) (Norms for household construction)（KMK 2001.08-96）

2) Vibration

The survey of vibration around the power plant site has not been conducted.

8.1.4 Natural environment

1) Geography and geology

Navoi power plant site is situated in the western side of Zerafshan lowland which is a plain within the submontane district, surrounded by a flat district extending 10km.

Zerafshan lowland is gently inclined toward the east in the direction of Zerafshan River (EIA p.5, 6).

2) Geology and earthquake

The layer of the project area consists of quaternary deposit of alluvial clayey loam and sandy loam, 5m to 10m thick. A gravel layer of 20 to 25m thick lies underneath. (EIA p.36).

According to the hearing survey from the power plant official, the existing power plant has never experienced any large scale earthquakes or damages caused by earthquakes before.

According to the database of United States Geological Survey, 7 earthquakes have occurred within the 100km radius of the Navoi power plant since 1973. All of these earthquakes were below the magnitude of 5. Therefore, earthquakes that have potential to give significant impact to the power plant are not expected to occur.

Date	focal depth (km)	Magnitude	Distance from power plant (km)
8th, May, 1977	33	4.5	34
7th, Jun, 1979	33	4.3	37
29th, Mar, 1980	37	4.2	85
26th, Apr, 1980	33	4.2	88
3rd, Apr, 1984	33	4.7	68
18th, Jan, 1998	33	3.8	84
3rd, Jun, 2007	10	4.0	71

3) Meteorology

Mountainous area extends in the area 10km north, south, and east from the Navoi power plant site, and a flat land largely extends in the west side of the site. This topology influences largely the atmospheric aspect of the project site, including air current and meteorology, wind direction and speed（EIA p.6）.

a. Air temperature

The annual average temperature in Navoi is 15.87 ºC, with the lowest of 2.77 ºC in January and the highest of 28.78 ºC in July. The highest temperature ever observed is 43.8 ºC which occurred in 2007 between May and August, and the lowest temperature is -17.4 ºC (EIA p.8).

b. Precipitation

The maximum precipitation rate is observed between winter and spring, and the minimum occurs in summer. The monthly maximum precipitation is recorded in March and April, and the minimum precipitation in September （EIA p.8）

The yearly average precipitation is 205.68mm. Dense fog occasionally appears, mainly in winter, and the yearly average time of occurrence of dense fog is 41.4 hours (EIA p.8).

c. Wind direction/wind speed

As shown in Figure 8.1.4-1, the wind around the project site is mainly easterly wind (38%), or 51% including northeast wind, and the exhaust gas from Navoi power plant is blown westward, in the direction of agricultural area, which is opposite to Navoi City located in the southeast.

Pollutants in the exhaust gas may reach Navoi City in the southeast of the project site with northwest wind, but the annual average occurrence rate of northeast wind is below 8%, 14% in summer and 4% in winter (EIA p7, 8).

The average wind speed in the project area is 1.9~3.5m/s throughout the year, highest in March and lowest in September. The yearly average wind speed is 2.4m/s (EIA p7).

As frequency of wind speed, 0~1m/s is about 40%, 2~3m/s is about 40%, 4~5m/s is about 12%, and exceeding 8m/s is rare (EIA p7).

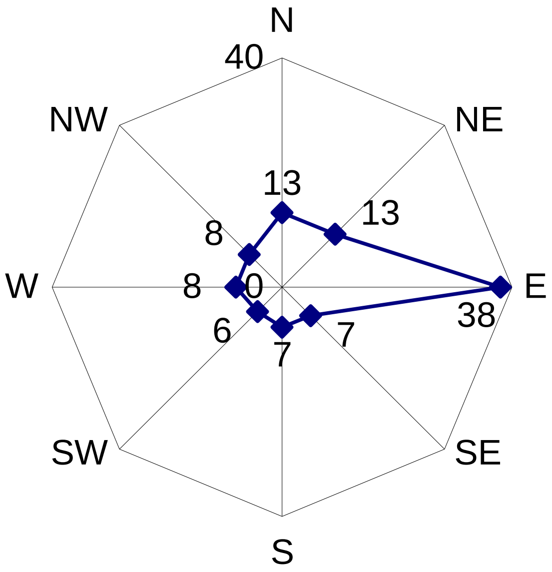

Figure 8.1.4-1 Wind rose

Reference: EIA Figure 1. p.5

4) Hydrology

a. Characteristics of Zerafshan River

Zerafshan River is 750km long, flowing from east to west. River water is taken at the maximum rate of 20m3/hour between Zaatdin Village and Navoi City to be used at 4 irrigation canals. Remaining river water flows beside Navoi power plant site into Kuyumazar water reservoir located 23km east of Bukhara (Figure 8.1.4-2) (EIA p.32).

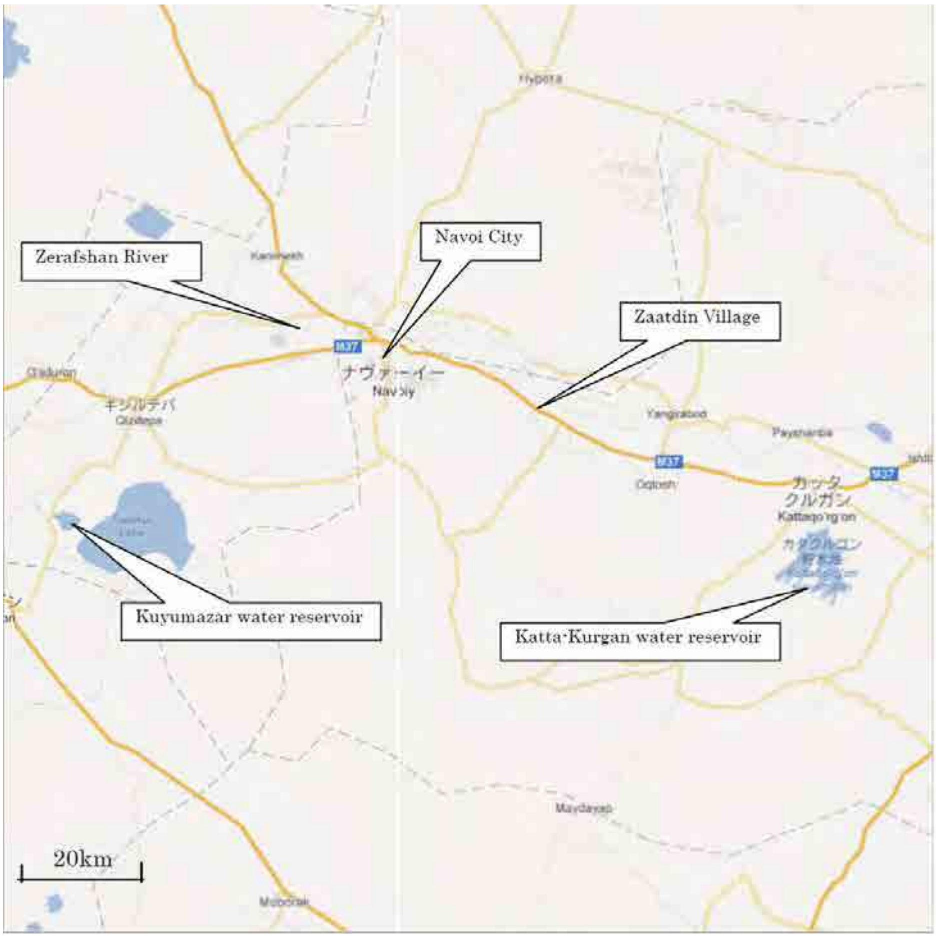

Figure 8.1.4-2 The route of Zerafshan River

b. River water temperature

The maximum water temperature of Zerafshan River in Navoi City is 24 ºC recorded in June and July. The water temperature of the effluent from the Navoi power plant at the time of discharge is 18~26 ºC, and temperature rise from the timing of water intake is 7~9 ºC (EIA p.57).

c. Flow rate

Flow rate of Zerafshan River is controlled through Katta-Kurgan water reservoir with capacity of 500 million m3constructed in 1947 (EIA p.32).

Flow rate of Zerafshan River reaches a maximum in July and August, increases between June and September, and decreases from October to May (EIA p.33).

5) Biology

a. Vegetation

The project site is adjacent to the residential area and the power plant already under influence of human activity.

According to the existing documents, in the surrounding area of the existing Navoi power plant site, Glasswort, Mulberry, Populous, Platanus, Siberian elm, Russian olive are observed. Grape and rose are grown as horticultural crop（EIA p.44）.

Precious species designated by IUCN (International Union for Conservation of Nature and Natural Resources) and by the Uzbekistan Red Data Book are not observed.

b. Terrestrial animals

According to the existing documents, in the surrounding area of the existing power plant site, reptiles including Desert Lidless Skink, Racerunner, water snake, Middle Asian tortoise, birds including Tree Sparrow, Laughing Dove, Common Starling, Common Swallow, Red-rumped Swallow, Black Swift, My-lady's-belt, Magpie, amphibians including ground toads and frogs, and mammals including mouse, mole lemming, Common Pipistrelle, Tamarisk Gerbil, Long-eared hedgehog, White-toothed Shrew are observed（EIA p.45）.

Precious species designated by IUCN (International Union for Conservation of Nature and Natural Resources) and by the Uzbekistan Red Data Book are not observed.

c.Aquatic organisms

Table 8.1.4-1 shows the list of aquatic organisms observed in Zerafshan River and the water reservoir in the basin.

30 species from 7 families of aquatic organisms are observed in Zerafshan River, of which Cyprinidae family is the largest with 19 species (EIA p.45). Most of the aquatic organisms in Zerafshan River are local species. There are several non-native species, such as *Rhinogobius* sp., Balkhash perch (*Perca schrenki*), Spotty gubach, Korean and common sawbelly (*Hemicuter leucisculus*) (EIA p.45~46).

Comparing fish species observed in Zerafshan River with IUCN List (February, 2012), 4 species are categorized as Least Concern (LC): *Leuciscus leuciscus*, *Aspius aspius*, *Silurus glanis*, and *Stizostedion lucioperca*.

Table 8.1.4-1 List of aquatic organisms in Zerafshan River and reservoir or other water body in the river shed

Species	Zarafshan r.	Water reservoirs						Lakes			Amu-Bukharskij Channel
		Akdarinskoe	Karaultepnnskoe	Kattakurganskoe	Kuyumazarskoe	Tudakulskoe	Shorkulskoe	Tuzgan (Solenoe)	Dengizkul	Karakyl	
Acipenseridae											
Spine	-	-	-	-	+	+	-	+	+	-	+
Pseudoscaphirhynchus kaufinanii	-	-	-	-	+	+	+	+	+	+	+
Cyprinidae											
Rutilus rutilus aralensis	+	-	-	-	+	+	+	+	+	+	+
Zarafshan dace (*Leuciscus leuciscus*)	+	+	-	-	-	-	-	-	-	-	-
Ctenopharyngodon idella	+	-	-	+	+	+	+	+	+	-	+
Aspius aspius taenatus nidiliodes	+	-	-	-	+	+	+	+	+	-	+
Ston morocos (Pseudorasbora)	+	+	+	+	+	+	+	+	+	-	-
Pseudogobio rivularis	+	+	-	+	-	-	-	-	-	-	-
Gudgeon	+	-	-	-	-	-	-	-	-	-	-
Khramulya (Varicorhinus)	+	+	+	-	-	-	-	-	-	+	-
Barbus capito conocephalus	+	+	-	+	+	+	+	+	+	+	+

Species	Zarafshan r.	Water reservoirs						Lakes			Amu-Bukharskij Channel
		Akdarinskoe	Karaultepnnskoe	Kattakurganskoe	Kuyumazarskoe	Tudakulskoe	Shorkulskoe	Tuzgan (Solenoe)	Dengizkul	Karakyl	
Barbus brachycephalus	-	-	-	-	+	+	-	+	+	-	+
Schizothorax intermedius	+	+	+	-	-	-	-	-	-	-	-
Chaicalburnus chalcoides aralensis	-	-	-	+	+	+	+	+	+	+	-
Alburnoides bipunctatus	+	+	+	-	-	-	-	-	-	+	-
Alburnoides taeniatus	+	+	+	-	-	-	-	-	-	+	-
Abramus brama orientalis	+	-	-	-	+	+	+	+	+	+	-
Abramis sapa	+	-	-	-	+	+	-	+	-	-	-
Capoetobrama kuschakewitschi	+	-	-	-	-	-	-	-	-	-	+
Hemicuter leucisculus	+	-	+	+	+	+	+	+	+	-	-
Iculter lucidus	+	-	+	+	+	+	+	+	+	-	-
Pelecus cultratus	-	-	-	-	+	+	-	+	+	-	+
Carassius auratus gibelio	+	+	+	+	+	+	+	+	+	+	-
Carpio	+	+	+	+	+	+	+	+	+	+	-
Hypophthalmichthys molitrix	-	+	-	+	+	+	+	+	+	-	+
Hypophthalmichthys nodilis	-	-	-	+	+	+	+	+	+	-	+
Cobitidae											
Noemacheilus strauch	+	+	-	-	-	-	-	-	-	-	-
Noemacheilus pardalis	+	-	-	-	-	-	-	-	-	-	-
Noemacheilus oxianus	+	-	-	-	+	+	-	+	+	-	+
Noemacheilus amudarjensis	+	-	-	-	-	-	-	-	-	-	+
Noemacheilus sp.	+	-	-	-	-	-	-	-	-	-	-
Barbus brachycephalus	+	-	-	-	+	-	-	-	-	-	+
Siluridae											
Silurus glanis	+	+	-	+	+	+	+	+	+	+	+
Poecelidae											
Gambusia affinis holbrockii	+	+	-	+	+	+	+	+	+	+	+
Channidae											
Channa argus warpa chowskii	+	+	-	-	-	+	+	+	+	+	+
Percidea											
Stizostedion lucioperca	+	-	-	-	+	+	+	+	+	-	-
Perca schrenki	-	-	-	+	-	-	-	-	-	-	-
Gobiidae											
Rhinogobius sp.	+	-	-	-	+	+	-	+	+	-	-
Total - Presence	30	15	9	14	24	24	17	24	23	12	15

Note: + presence
- absence

Reference；The document obtained at the survey

8.1.5 Social environment

1) Land use

The existing Navoi power plant site is located 6km northwest of Navoi City, at an altitude of 334.2m, with the area of approximately 100ha (EIA p.5).

The land facing the north side of the site is farmland and residential area, and the south side is the residential area of Uyrot Village and the road connecting Tashkent and Bukhar. In the east side, the residential area of Michurin Village, Zerafshan River, and the road connecting Navoi and Uchkuduk are located.

The west side is a mixture of residential area and farmland of Yangiobod Village; the residential area is located up to about 2.5km from the power plant, and only farmland exists beyond that point.

The near residential area from the existing power plant site is located 650m west and 400m south west of the site (Figure 8.1.5-1).

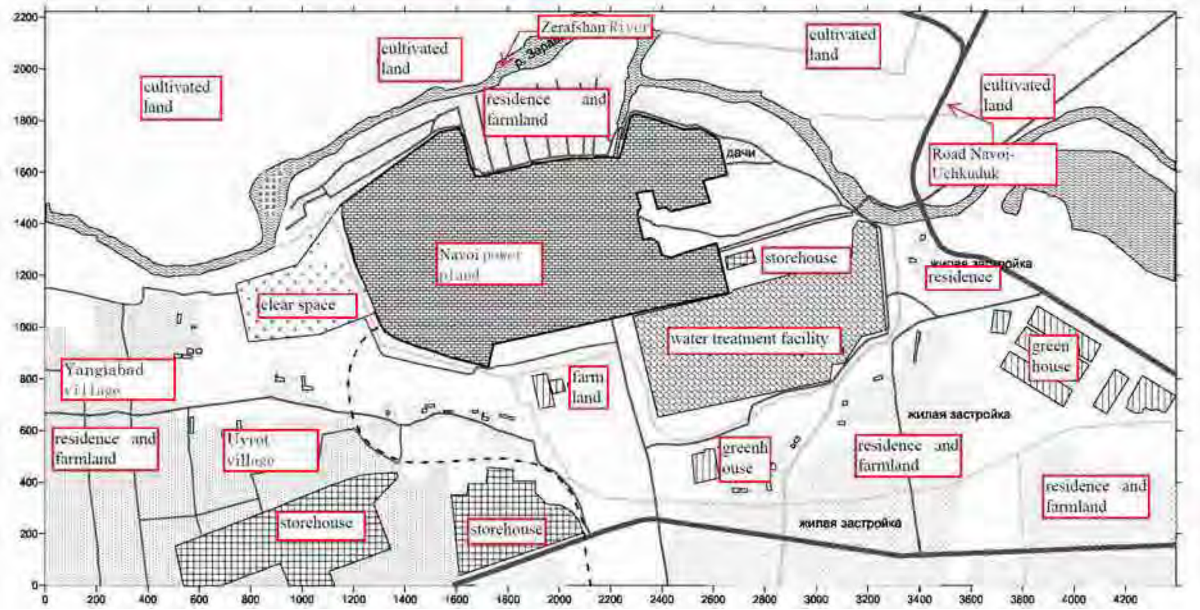

Figure 8.1.5-1(1) Land use around Navoi thermal power plant (EIA Appendix 1）

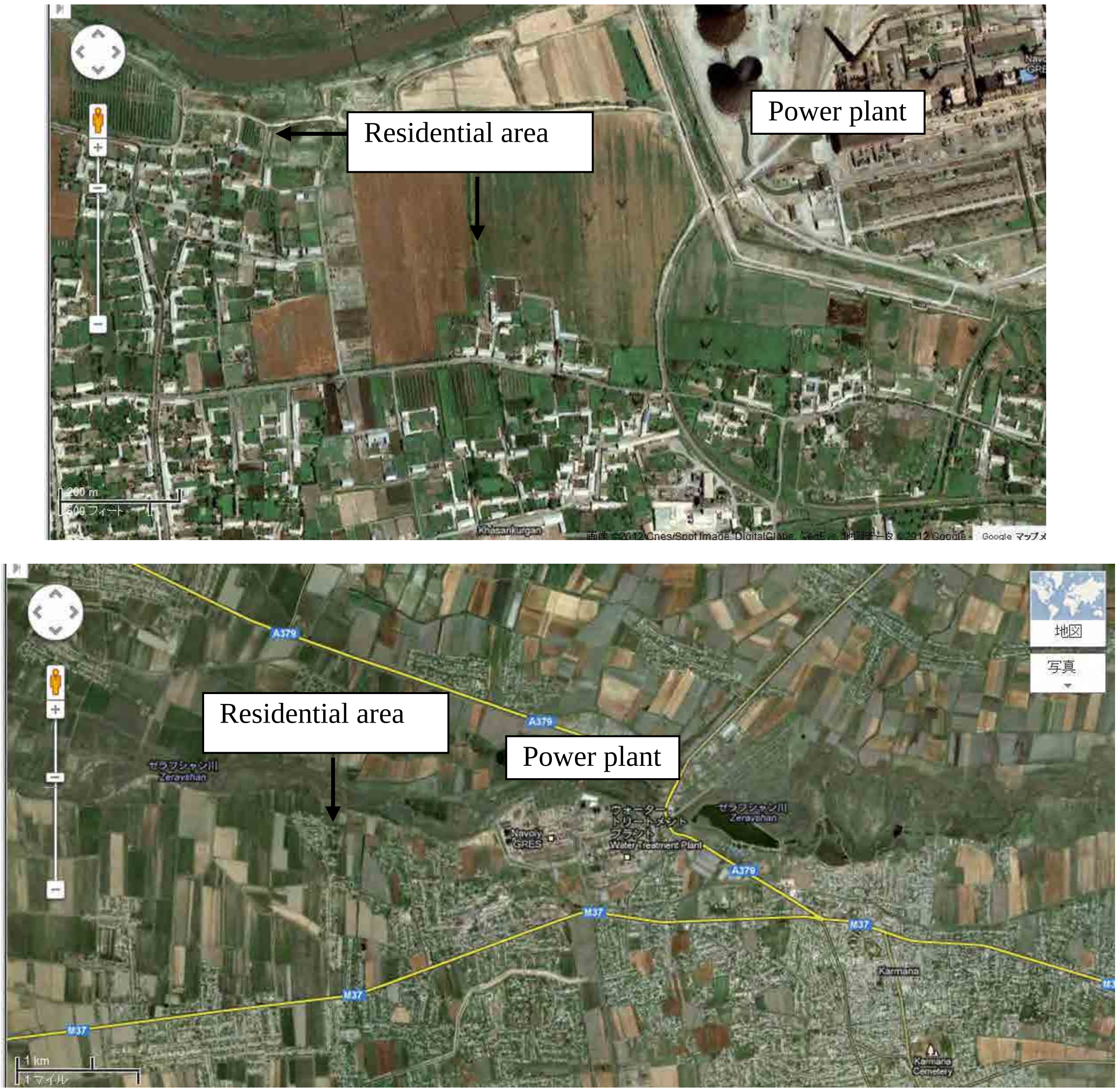

Figure 8.1.5-1(2) Land use around Navoi thermal power plant

8.2 Environmental Impact Assessment and other legal system

8.2.1 Environmental Administration and related legal system[1]

1) Environmental Administration

a. Administrative boundary

The following governmental agencies play primary roles regarding the Environmental Administration in the Republic of Uzbekistan.

- The President: Act as a decision maker on major environmental issues and also a leader to promote international cooperation on environmental conservation.
- The Diet: Clarifying the environmental conservation policies, making decision in the Diet, acting as liaison with the State Nature Conservancy council, establishing sanctuary and disaster area, developing legal systems.
- The Cabinet: Implementing environmental conservation policy, making decision and supervising operation on environmental conservation plan, and allocating natural resources.

b. Implementing Agencies

Based on the above role-sharing, the actual implementing body mainly managing the environment issue is the State Committee for Nature Protection “Goskompriroda” which was established in 1989 in the Cabinet office and is reporting to the Diet. Also as local organization of the State Committee for Nature Protection, the local Committee for Nature Protection exists in each province and major cities. State and local Committee for Nature Protection implements and manages environmental conservation.

The primary responsibilities held by the State Committee for Nature Protection are as follows.

- Legal surveillance regarding environmental conservation
- Promotion on environmental conservation plan
- Guidance on environmental tests implemented by the state
- Approval of environmental standards
- Issue and nullification of license for emission/storage of pollutant and industrial waste
- Implementation of environmental measurement
- System for international cooperation on environmental issues

Other than the State Committee for Nature Protection environmental management is conducted by Ministry of Health, Ministry of Agricultural Water Utilization under the scope of each jurisdiction respectively. Also, Sate Land Use Committee, State Forestry Committee, Uzbek Hydro meteorological Institution “Uzgidromet” are obliged to conduct environmental conservation. Monitoring on air /water quality in the general environment is actually measured by Uzbek Hydro meteorological Institution “Uzgidromet” under State Nature Conservatory Committee.

2) System of legal restriction on the environment

Laws regarding nature conservation, utilization of natural resources, environmental

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[1] Republic of Uzbekistan Preparatory Survey on Tashkent Heat Supply Power Plant Modernization Project Final Report,2009

conservation are composed of act, presidential decree, legislative decree, and enactment. The legal system regarding environmental conservation is composed not only from the aspect of environmental conservation, but also from the aspects of laws regarding ecological conservation of land, water, wildlife and plant.
Followings are the Basic Laws and the established years.

- The Law of the Republic of Uzbekistan “On Nature Protection” (9 December 1992 ref, 754-XII)
- The Law of the Republic of Uzbekistan “On Water and Water Use” (6 May 1993, ref. 837-XII)
- The Law of the Republic of Uzbekistan “On Ambient Air Protection” (27 December 1996, ref. 353-I)
- The Law of the Republic of Uzbekistan “On Fauna Use and Protection” (26 December 1997, ref. 545-I)
- The Law of the Republic of Uzbekistan “On Flora Use and Protection” (26 December 1997, ref. 543-I)
- Land Code of the Republic of Uzbekistan (30 April 1998, ref. 599-I)
- The Law of the Republic of Uzbekistan “On Forest” (15 April 1999, ref. 770-I)
- The Law of the Republic of Uzbekistan “On Protection of Population and Areas from Emergency Conditions of Natural and Technogenic Character” (20 August 1999, ref. 824-I)
- The Law of the Republic of Uzbekistan “On Environmental Audit” (25 May 2000, ref. 73-II)
- The Law of the Republic of Uzbekistan “On Radiation Safety” (31 August 2000, ref. 120-II)
- he Law of the Republic of Uzbekistan “On Protection of Agricultural Plants from Pests, Diseases and Agrestals” (31 August 2000, ref. 116-II)
- The Law of the Republic of Uzbekistan “On Solid Waste Disposal” (5 April 2002, ref. 362-II)
- The Law of the Republic of Uzbekistan “On Subsoil” (new edition), (13 December 2002, ref. 444-II)
- The Law of the Republic of Uzbekistan “On Preserved Natural Territories” (3 December 2004, ref. 710-II)

The above are primary Basic Laws and there are numbers of decrees and regulations which deal with specific restrictions.

8.2.2 The EIA in Uzbekistan

1) The procedure for EIA
In Uzbekistan, in the implementation of business activities having potential environmental and human impact such as a power station project, the Environmental impact assessment (EIA) should be implemented according to the Law on Nature Preservation (enacted in December 9, 1992).
Regarding the specific procedure, according to the Resolution of the Cabinet of Ministers no. 491 on Adoption of the Environment Impact Assessment Regulations in the Republic of Uzbekistan (enacted December 31, 2001, hereinafter referred to as “Regulations No.491) .
The activity is classified into four categories (category I to IV) according to the degree of potential impact.
A thermal power plant with generation capacity of 300MW or higher is classified to category I, 100MW to 300MW into category II, and smaller than 100MW as category III, according to

“Regulations No.491)

For business activities in category I to III submission of a detailed environmental impact assessment (EIA) is required according to “Regulations No.491”, the Environmental Impact Assessment should be submitted to the State Committee for Nature Protection for approval prior to the business activity having potential environmental and human impact.

a. Implementation of EIA
As determined in Section 10 of the Regulations No.491, 3 steps of EIA procedure as described below: the preliminary assessment in the planning phase; the review of the assessment; and the establishment of the final environmental standard prior to the start of the facility operation.

【Planning phase】

i. Preparation of the draft EIA
The draft EIA report should be prepared in the planning phase of the project and submitted to the State Committee for Nature Protection.

ii. Reflection of the EIA review
Following the review of the draft EIA, additional survey, in-situ investigation, special analysis, or model simulation is conducted as necessary to determine the appropriate environmental protection measures before being reviewed by the State Committee for Nature Protection for approval.
The draft environmental impact assessment report shall be reviewed within 30 days from the day of submission.

【Pre-operation phase】

Statement of Environmental Consequences should be prepared and submitted prior to the commercial operation of the project facility. This procedure is almost equivalent to the procedure of approval application in pre-operation phase in Japan.

The draft EIA for CCCGP No.2 in this project was submitted to the State Committee for Nature Protection for approval, and was turned down for amendment as a result of the review in November 11, 2011.
The main reason for rejection was that the potential environmental impact of pollutant and risk of gas explosion in view of the installation of CCCGP No.2 and shutdown of the existing Unit 1,2 and Unit 3,8 is not discussed.
The revised EIA was established and the Environmental Impact Statement was approved in February 12, 2012 after a review by the State Committee for Nature Protection.

2) Public consultation
In Uzbekistan, public meeting within the scope of the EIA procedure is not specifically regulated in the Regulations No.491
The Regulations No.491 Chapter 11 specifies that the result of the public consultation shall be described as necessary in the EIA report.
In consequence, in the power generation project in Uzbekistan, public meeting is generally held by the power generation company as part of the environmental impact assessment in case of the project in urban area such as Tashkent.
The meeting is planned and conducted by the project operator. The procedure consists of five steps:
Step 1, the notification of the meeting to the relevant people;

Step 2, the preparation of the abstract of the EIA, distribution to the relevant people, and the EIA report being made available to public inspection;
Step 3, opening the meeting with local residents;
Step 4, collection and analysis of the opinions of local residents through questionnaire; and
Step 5, report of the result of the meeting to the relevant organization.

Table 8.2.2-1 describes the basic scheme of implementation of EIA public explanation meeting.

Table 8.2.2-1 The basic scheme of implementation of EIA public meeting

Step	Contents
1	Conduct the meeting with the local administration, local residents, local community
2	Preparation of the abstract of the EIA, distribution to the relevant people, and the EIA report is made available within the power plant and the local community
3	Opening the EIA explanation meeting with local residents;
4	Collection and analysis of the opinions of local residents through questionnaire
5	Report of the result of the meeting to the relevant organization.

The meeting schedule should be widely notified using newspaper and other mass media and the relevant website.

The EIA abstract is made in Uzbek and Russian and distributed to the relevant people. It is made available to the public within the power plant and the local community. The EIA explanation meeting is an opportunity of direct session with local residents, and should be open to as many local people as possible.

The meeting should consist of the explanation of the overview of the project, including the advantage of the new facility and potential environmental impact, from the project operator, as well as Q&A sessions. After that, the questionnaire is distributed to collect the view of the local people and ensure their understanding of the project concept.

The result of the meetings is reported to the relevant organization through the summary report of the meetings published by the project operator, and publicized through the mass media.

The opinion from the local residents will be reflected in the final Statement of Environmental Consequences as described above.

8.2.3 The gap with JICA Environmental Guidelines (April 2010)

The content of the Statement of Environmental Consequences is stipulated in Chapter 11 of the Environmental Impact Assessment Regulations No.491 (the Resolution of the Cabinet of Ministers no. 491 (enacted December 31, 2001)).

The regulation by the Environmental Impact Assessment Regulations on the content of the EIA in Uzbekistan is very simple. In this regard, the comparison was made between the content of the EIA in this project (including the actual description) with the requirement of World Bank OP 4.01 Annex B and JICA Guideline on Environmental and Social Consideration (Table 8.2.3-1).

Hereby, it is necessary to prepare for abbreviated RAP, environmental management plan and monitoring plan for both construction and operation phase.

Table 8.2.3-1 Comparison among JICA Guideline, World Bank (OP 4.01) and the EIA content in this project

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	The Environmental Impact Assessment Regulations (the Resolution of the Cabinet of Ministers no. 491 (enacted December 31, 2001))	Contents of the EIA in this project	Gap between JICA Guideline and the EIA	Correspondence of this Survey Mission
Executive Summary	This concisely discusses significant findings and recommended actions.	Concisely discusses significant findings and recommended actions.	No regulations.	The important result and the outline of the activities are described as a conclusion.	There is no gap.	
Policy, legal, and administrative framework	This is the framework within which the EIA report is to be carried out.	Discusses the policy, legal, and administrative framework within which the EA is carried out. Explains the environmental requirements of any co-financiers. Identifies relevant international environmental agreements to which the country is a party.	No regulations.	Legal description as introduction.	There is no gap.	
Project Description	This describes the proposed project and its geographic, ecological, social and temporal context, including any off-site investments that may be required (e.g. dedicated pipelines, access roads, power plants, water supply, housing, or raw material and product storage facilities). It also indicates the need for any resettlement or social development plan. It normally includes a map showing the project site and the area affected by the project.	Concisely describes the proposed project and its geographic, ecological, social, and temporal context, including any offsite investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, and raw material and product storage facilities). Indicates the need for any resettlement plan or indigenous peoples development plan. Normally includes a map showing the project site and the project's area of influence.	-Equipment, materials and resources, technology used. Analysis of the fuel for environmental assessment. -The current status of the residential area, farmland, transmission line, life infrastructure.	Partial description. No description on the resettlement plan.	There is a gap.	Developing abbreviated RAP

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	The Environmental Impact Assessment Regulations (the Resolution of the Cabinet of Ministers no. 491 (enacted December 31, 2001))	Contents of the EIA in this project	Gap between JICA Guideline and the EIA	Correspondence of this Survey Mission
Baseline Data	This assesses the dimensions of the study area and describes relevant physical, biological, and socio-economic conditions, including all changes anticipated to occur before the project commences. Additionally, it takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project site, design, operation, or mitigation measures, and it is necessary to indicate the accuracy, reliability, and sources of the data.	Assesses the dimensions of the study area and describes relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Also takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigatory measures. The section indicates the accuracy, reliability, and sources of the data.	-Environmental analysis of the environmental status, population, land development before the project installation.	Description.	There is no gap.	
Environmental Impacts	This predicts and assesses the project's likely positive and negative impacts in quantitative terms, to the extent possible. It identifies mitigation measures and any negative environmental impacts that cannot be mitigated, and explores opportunities for environmental enhancement. It identifies and estimates the	Predicts and assesses the project's likely positive and negative impacts, in quantitative terms to the extent possible. Identifies mitigation measures and any residual negative impacts that cannot be mitigated. Explores opportunities for environmental enhancement. Identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specifies topics that do not require further attention.	-Technical countermeasures to mitigate and prevent negative environmental impact. -Situation analysis of negative impact in the emergency case, assessment of preventive measures. -Prediction of	No description of mitigation measures during construction. Little description on mitigation measure during operation.	There is a gap.	Developing environmental management plan and monitoring plan for construction and operation phase.

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	The Environmental Impact Assessment Regulations (the Resolution of the Cabinet of Ministers no. 491 (enacted December 31, 2001))	Contents of the EIA in this project	Gap between JICA Guideline and the EIA	Correspondence of this Survey Mission
	extent and quality of available data, essential data gaps and uncertainties associated with predictions, and it specifies topics that do not require further attention.		environmental change after project installation.			
Analysis of Alternatives	This systematically compares feasible alternatives to the proposed project site, technology, design, and operation including the “without project” situation in terms of the following: the potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, it quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. It also states the basis for selecting the particular proposed project design, and offers justification for recommended emission levels and approaches to	Systematically compares feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.	The analysis of the alternatives for the project plan and technical decisions regarding natural protection, in view of the latest technologies.	Description of alternative site selection.	There is no gap.	

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	The Environmental Impact Assessment Regulations (the Resolution of the Cabinet of Ministers no. 491 (enacted December 31, 2001))	Contents of the EIA in this project	Gap between JICA Guideline and the EIA	Correspondence of this Survey Mission
	pollution prevention and abatement.					
(Environmental Management Plan	This describes mitigation, monitoring, and institutional measures to be taken during construction and operation in order to eliminate adverse impacts, offset them, or reduce them to acceptable levels.	Covers mitigation measures, monitoring, and institutional strengthening; see outline in OP 4.01, Annex C.	The construction plan including the environmental impact of the equipments, technologies, materials used in construction and mitigation measures.	-Little description on mitigation measure during operation phase. -No description on the environmental management plan and monitoring plan during construction and operation.	There is a gap	Developing environmental management plan and monitoring plan for construction and operation phase.
Public Consultation	This includes a record of consultation meetings (date, venue, participants, procedures, opinions of major local stakeholders and responses to them, and other items), including consultations for obtaining the informed views of the affected people, local NGOs, and regulatory agencies.	N/A (It is stated in Appendix)	No regulations. (as necessary).	Implementation of the public consultation is described in the Annex.	There is no gap.	
Appendixes	N/A	(i) List of EA report preparers --individuals and organizations. (ii) References --written materials both published and unpublished, used in study preparation. (iii) Record of interagency and	No regulations.	-Implementation of the public consultation is described in the Annex. -Description of reference document	No requirement in JICA Guidelines.	

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	The Environmental Impact Assessment Regulations (the Resolution of the Cabinet of Ministers no. 491 (enacted December 31, 2001))	Contents of the EIA in this project	Gap between JICA Guideline and the EIA	Correspondence of this Survey Mission
		consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs. (iv) Tables presenting the relevant data referred to or summarized in the main text. (v) List of associated reports (e.g., resettlement plan or indigenous peoples development plan).		and data for simulation/.		

8.2.4 Standards related to this project

As a major environmental regulation in `Uzbekistan, standard value / regulation air, water and noise at thermal power plant shall be described.

1) Atmosphere

a. Environmental standard

In the Republic of Uzbekistan, maximum permissible concentration (MPC) for protecting human health is established for the general/ working area.

Table 8.2.4-1 indicates MPC and classes of danger of main pollutants generated by power station emissions.

30min MPC value for NO_2 in Uzbekistan is very strict, lower than half of the 1 hour average value of IFC/WB General EHS Guidelines and EU environmental standard.

30min MPC value for SO_2 is similar to 10min value of IFC/WB EHS Guideline.

Table 8.2.4-1 Standard and Danger Class of Main Pollutants Formed by Power Stations

Pollutant	Maximum Permissible Concentration (MPC) (mg/m^3)			Danger Class＊	IFC/WB EHS General Guidelines (2007) (mg/m^3)	EU environmental standard (mg/m^3)
	30min	Daily average	working area			
Nitrogen dioxide (NO_2)	0.085	0.06	5.0	2	0.2(1hour average) 0.04(yearly average)	0.2(1hour average) 0.04(yearly average)
Nitrogen oxide (NO)	0.6	0.25	-	3	—	—
Sulfur dioxide (SO_2)	0.5	0.2	10.0	3	0.5(10min) 0.125(daily average)	0.35(1hour average) 0.125(daily average) 0.02(yearly average)
Carbon oxide (CO)	5.0	4.0	20.0	4	—	—
Suspended particles （dust）	0.15	0.1	-	3	0.15（daily average)） 0.07 (yearly average)	0.05（daily average） 0.04（yearly average）

Note: ＊Class of danger is categorized as follows according to the Russian standard

1- Pollutant of extreme danger
2- Pollutant of high danger
3- pollutant of medium danger
4- pollutant of low danger

Reference: Sanitary norms, rules and hygiene normative documents of the Republic of Uzbekistan. San Pin No. 0015-94.

b. Emission standard

In the Republic of Uzbekistan, the pollutant in the exhaust gas emitted from the thermal power plant is not regulated by concentration standard of pollutant in the exhaust gas established by fuel type and generation scale, like in the IFC/WB EHS Guidelines.

Instead, ground concentration of air pollutant discharged from each stack is estimated by a designated method, and it should not exceed concentration standard value calculated from each area / danger factor shown in the Table 8.2.4-2, against the MAC shown in the Table 8.2.4-2.

Precisely, MAC for each pollutant emitted from each stack is regulated by this concentration standard. This makes it possible to increase permissible emission by lowering ground concentration, by designing higher stack, for example, for the same scale and type of emission source.

Monitoring activity on the emission amount from each stack has been conducted at the existing power plant. It is often observed that emission amount of NO_2 from Unit 1~12 exceeds the permitted maximum emission amount, and penalty has been paid for that.

This policy of emission control by diffusion is similar to emission control policy for SOx in Japan (K value regulation).

Table 8.2.4-2 Territorial Rates for Assessment on Pollutants, Being Discharged into Atmosphere

Territorial location	Limits in MPC depending on the class of hazard of discharged pollutant			
	1	2	3	4
Provinces: Tashkent, Fergana, Andizhan, Namangan Cities: Navoi, Samarkand, Bukhara	0.17	0.20	0.25	0.33
Provinces: Bukhara, Djizak, Kashkadaria, Navoi, Samarkand, Syrdaria	0.20	0.25	0.33	0.50
The Republic of Karakalpakstan, the Khorezm province	0.25	0.33	0.50	1.00

Reference: “Instruction on Inventory of Pollution Sources and Rating the Pollutant Emission into Ambient Air for Enterprises of the Republic of Uzbekistan”（the Ministry of Justice ref. 1533.3 January 2006）

The project area corresponds to Navoi Province (out of town of Navoi City).
Standard value for maximum ground concentration of emission from each stack of Navoi power plant calculated by territorial rate of Navoi Province are shown in Table 8.2.4-3.

Table 8.2.4-3 Standard value of main pollutants maximum ground concentration (Navoi Plant)

Pollutant	MPC （mg/m^3）	Territorial rate	Standard value of maximum ground concentration （mg/m^3）	Danger Class
Nitrogen dioxide	0.085	0.25	0.021	2
Nitrogen oxide	0.6	0.33	0.20	3
Sulfur dioxide	0.5	0.33	0.063	3
Carbon oxide	5.0	0.50	2.50	4
Soot	0.15	0.33	0.050	3

Reference: “Instruction on Inventory of Pollution Sources and Rating the Pollutant Emission into Ambient Air for Enterprises of the Republic of Uzbekistan”（the Ministry of Justice ref. 1533.3 January 2006）

According to EIA（p31,46）, the maximum ground concentration of NO_2 emitted from CCCGP No.2 is 14.455$\mu g/m^3$ (0.17MPC), and it is about 70% of the standard described above.

There is no regulation concerning pollutant concentration in exhaust gas in Uzbekistan. In this project, NOx concentration will be compliant to the Russian standard （GOST 29328-92） cited below. This standard value is equivalent to the guideline value for thermal power plant stipulated in IFC/WB EHS Guideline.
The result of the in-situ survey also indicates that NOx concentration in the exhaust gas from CCCGP No.1 under test-operation satisfies the Russian standard.

Table 8.2.4-4 Emission standard for exhaust gas

Pollutant	GOST 29328-92	IFC/WB EHS Guidelines for Thermal power plant (2008)
Nitrogen oxides（NOx）	51mg/Nm^3 (25ppm)	51mg/Nm^3 (25ppm)

Reference: The document obtained at the survey.

2) Water quality

a. Environmental standard

There is a water quality standard for drinking water and other water usage facilities at water withdrawal station as an environmental standard in Republic of Uzbekistan shown in Table 8.2.4-5.

Table 8.2.4-5 Environmental Standard for drinking water and water usage

Pollutant and such	**Drinking water supply**	**Non-drinking water (recreation)**
Suspended matters	Suspended matters content shall not increase on:	
	0.25 mg/ℓ	0.75 mg/ℓ
	For ponds that contain more than 30 mg/ℓ of mineral substances during low water an increase of the content of suspended matters is allowed within 5%	
	Clouds with rate of sedimentation more than 0.4 mm/s for flowing pond and more than 0.2 mm/s for reservoirs are prohibited for discharge	
Floatable impurities (substances)	Floating films, spots of mineral oils and accumulations of other impurities shall not be detected on the surface of a pond	
Smell	Water shall not obtain alien smells with intensity of not more than 1 mark (point) detected:	
	Immediately or at further chlorination (other treatment)	Immediately
coloration	Shall not be detected in the column:	
	20cm	10cm
Temperature	Summer temperature of water as a consequence of discharge of wastewater shall not increase more than 3°C comparing to the average temperature of the hottest month of a year for the last 10 years.	
Hydrogen ion index (pH)	Shall not exceed 6.5-8.5	
Mineral content	Shall not exceed 1,000 mg/ℓ of dry residue, including:Chlorides – 350 mg/l ;Sulfates – 500 mg/l	
Dissolved oxygen	Shall not be less than 4 mg/ℓ at any period of the year in a sample taken before 12:00 a.m.	
Biochemical oxygen demand	Should not exceed at 20°C:	
	3.0 mgO_2/ℓ	6.0 mgO_2/ℓ
Chemical oxygen demand	Should not exceed at 20°C:	
	15.0 mgO_2/ℓ	30.0 mgO_2/ℓ
Substances liable to cause infection	Shall not contain any	
Bacillus coli	Not more than 10,000 in ℓ (not distributed for decentralized water source)	Not more than 5,000 in ℓ
Colyfag (in plaque forming units)	Not more than 100 in ℓ (not distributed for decentralized water source)	Not more than 100 in ℓ
Teleorganic eggs of worms, cysts of Bacillus coli	Shall not contain in 1 ℓ	
Chemical substances	Shall not contain in concentrations exceeding MAC	

Reference: Rules for protection of surface water from contamination by discharge water.（San Pin No.0056-98）

Zerafshan River water is not used for portable water and recreation, and the MPC shown in Table 8.2.4-6 is established.

Table 8.2.4-6 Water quality standard for Zerafshan River water (MPC)

Items	Unit	MPC
pH		6.5- 8.5
DO	mg/ℓ	Summer：4.0.Winter：6.0
BOD	mgO2/ℓ	3.0
Ammonia	mg/ℓ	0.08
Nitrate	mg/l	40
Nitrite	mg/l	0.08
Phenol	mg/l	0.001
Oil	mg/l	0.05
Suspended solids (SS)	mg/l	30
Calcium	mg/l	180
Sodium	mg/l	120
Potassium	mg/l	50
Chloride	mg/l	300
Sulfate	mg/l	100
Phosphate	mg/l	0.01
Fe	mg/l	0.5
Cu	mg/l	0.001
Zn	mg/l	0.01
Cr	mg/l	0.5
Pb	mg/l	0.03

Reference: The document obtained at the survey.
Rules for protection of surface water from contamination by discharge water.（San Pin No.0056-98）

b. Effluent standard

Effluent from the power plant must be treated in a way so as to meet the water quality standard for water usage shown in the table above, considering the environmental impact.
The effluent standard applied to the five water outlets of the existing Navoi power plant is shown in Table 8.2.4-7.

Monitoring activity on the water quality at water outlets has been conducted at the existing power plant. It is often observed that water quality falls short of the standard, and penalty has been paid for that.

Also, the temperature rise at 500m downstream of the water outlet is regulated to be 3 ºC or lower as the Navoi power station.

Table 8.2.4-7 The effluent standard for the existing outlets of Navoi Power Plant

Items	Unit	Effluent standard for Navoi power plant	IFC/WB EHS Guidelines for Thermal power plant (2008)
pH	—	6.5－8.5	6.5－9.0
SS	mg/ℓ	487	50
Oil	mg/ℓ	0.112	10
Dissolved inorganics	mg/ℓ	1,500	—
Nitrite	mg/ℓ	3.3	—
Nitrate	mg/ℓ	45	—
Sulfate	mg/ℓ	500	—

Items	Unit	Effluent standard for Navoi power plant	IFC/WB EHS Guidelines for Thermal power plant (2008)
Chloride	mg/ℓ	350	—
Calcium	mg/ℓ	487	—
Magnesium	mg/ℓ	170.1	—
Residual chlorine	mg/ℓ	—	0.2
Total chromium	mg/ℓ	—	0.5
Copper	mg/ℓ	—	0.5
Iron	mg/ℓ	4.62	1.0
Zinc	mg/ℓ	—	1.0
Lead	mg/ℓ	—	0.5
Cadmium	mg/ℓ	—	0.1
Mercury	mg/ℓ	—	0.005
Arsenic	mg/ℓ	—	0.5

Reference:EIA p.21,p23） and the document obtained at the field survey.
Rules for protection of surface water from contamination by discharge water.（San Pin No.0056-98）

3) Noise and vibration

Noise standard established by the environmental standard for residential area is shown in Table 8.2.4-8. It shall not exceed 45dB during night and 55dB during daytime, which is similar to IFC/WB EHS Guidelines.

Table 8.2.4-8 Environmental standard for noise (residential area)

Category	standard in Uzbekistan		IFC EHS General Guidelines(2007)	
	daytime	Nighttime	daytime	Nighttime
Residential area	55dB(A)	45dB(A)	55dB(A)	45dB(A)

Reference: Protection from noise” (State committee of Uzbekistan for architecture and construction. Tashkent. 1996) (Norms for household construction)（KMK 2001.08-96）

In accordance with this standard, sound pressure level in the housing area for each vibration shown in Table 8.2.4-9 is established.

There is also noise standard San Pin No.0120-01 as working environment within industrial area and shall not exceed 80dB.

There is no environmental standard for vibration level.

Table 8.2.4-9 Environmental standard for noise (residential area)

Octave band (Hz)	31.5	63	125	250	500	1,000	2,000	4,000	8,000
Sound pressure level (dB)	84	67	57	49	44	40	37	35	33

Reference: Protection from noise” (State committee of Uzbekistan for architecture and construction. Tashkent. 1996) (Norms for household construction)（KMK 2001.08-96）

4) Waste

Standard for treatment of waste shall be established for all economical activities regardless of the types of industry in Republic of Uzbekistan.

Reference: RD 118,0027714.60-97 Nature protection. Treatment of waste from production and consumption.

Terms and definitions. Goskompriroda of Uzbekistan. Tashkent. 1997.

Hazardous waste is categorized into classes I to class IV: I Extreme danger, II High danger, III Medium danger, IV Low danger.
Waste generated in Navoi power plant is usually Class III and IV.

Standard value for maximum allowable amount of waste is calculated through the consumption amount of materials used from the production to the final process at the current production facilities through the most appropriate manufacturing method. Every waste material must have the following displayed; how the name of the waste material, generation source, physical /chemical characterization, danger level and production standard.
Maximum allowable storage amount is established for every waste material for standards such as on disposal amount, manufacture plan of the product, treatment of waste material and usage schedule.

Transportation of waste to disposal site or reuse is delegated to the licensed company. Final disposal is conducted at the licensed disposal facility.
The status of waste during transportation and treatment is assessed through a manifest system.
In the existing power plant, scrap metal and oil are reused by a special company, and sludge is disposed of at a designated disposal site.
Domestic waste is disposed of at a disposal site in Navoi.

Table 8.2.4-10 describes the types of waste, amount of generation and disposal situation in the existing power plant.

Table 8.2.4-10 Types, amount of generation and disposal situation of waste in the existing power plant

Description of waste	products t/y	composition of waste	Placements
Ferrous scrap	620.0	metal	Temporary storage in the territory of entity, repair workshops. The bulk of it accumulates in centralized maintenance workshop. Always supply to scrap recycling entity “Vtorchermet” in Navoi
Nonferrous scrap	10.0	Copper, aluminum	Temporary storage in the territory of electric workshop. Always supply to scrap recycling entity “Vtorchermet” in Navoi
Borings of ferrous metal	18.6	Ferrous metal	Temporary storage in special container. Always supply to scrap recycling entity “Vtorchermet” in Navoi
Waste electrodes (stubs)	1.12	Stub	Temporary storage in centralized maintenance workshop and other departments in containers. Always supply to scrap recycling entity “Vtorchermet” in Navoi
Waste transformer oil	45.0	Oil	Used oil is pouring out into oil box Part of it is used again and part of which is supplied to petroleum storage depot for recovery.
Waste engine oil	1.1	Oil	Used oil is pouring out into oil box. Part of it is used again and part of which is supplied to petroleum storage depot for recovery.
Used car tires	2.52	Rubber	Temporary storage in the territory of Vehicle Workshop. Always supply to recycling entity “Vtorsyryo”
Used accumulators	1.043	Cell jar Lead plates Electrolyte	Temporary storage in the territory of Vehicle Workshop. Always supply to recycling entity “Vtorsyryo”. Stored in tight glass tare, after sedimentation light-colored part is used for refilling of accumulators, contaminated part after neutralization is supplied to landfill for construction waste materials. Private company “Barno” in Navoi
Rags	0.5	Fabric + petroleum products (oil)	Temporary is storage in container to be burned out in boiler #3 model TGM-94.

Description of waste	products t/y	composition of waste	Placements
Oily sand	2.0	Sand contaminated by oil products	Temporary is storage in container. Is always supplied to coating plant DAEWOO “Magistral” for mixing with inert materials during asphalt production.
Oily crushed stone	6.0	Crushed stone contaminated by oil products	Temporarily is stored near transformers in concrete area. Is always is supplied to coating plant DAEWOO “Magistral” for mixing with inert materials.
Oily sludge	50.0	Sludge contaminated by oil products	Taking out for use in coating plant DAEWOO “Magistral” in asphalt production.
Slime from cleaning of turbine oil	2.5	Contaminated oil TO-22C	Send to treating facilities of industrial wastewater. Always burn out in boiler #3 model TGM-94.
Sludge from wastewater of water treatment unit	5000.0	Sludge	Temporary storage in sedimentation tanks 1 and 2 and after cleaning of sedimentation tanks is taken out to special designated place in landfill for construction waste materials – private company “Barno”
Sludge from pretreated raw water	2546.0	Sludge	After cleaning of sedimentation tanks is taken out to special designated place in landfill for construction waste materials – private company “Barno”
Mud from river water clarification	4334.5	Sand, clay	Temporary storage in sedimentation tanks and bowls of cooling tower. Then taken out to landfill for construction waste materials – private company “Barno” in Navoi
Sediment form chemical cleaning of condensers and pipes of screening system	18.0	Solid substances	Is sent to sludge remover units 1,2 (pond of vaporizer) at treating facilities of industrial wastewater where water evaporates and sediment settles and stores until filling of pond.
Waste lime	320.0	Lime, small stones	Upon accumulation is taken out in special tight vehicle to to landfill for construction waste materials – private company “Barno” in Navoi.
Wastes of process salt	68.5	Insoluble salt	Temporary storage in the territory of chemical workshop and upon accumulation is taking out to landfill for construction waste materials – private company “Barno” in Navoi
Wastes of boiler clothing	495.0	Asbestos, pasteboard, brick, cement, clay	60% of generated wastes are sent to recycling plant “Electroizolit” for recycling and the remaining parts unusable for recycling, are sent in special tight vehicle to landfill for construction waste materials – private company “Barno” in Navoi
Wastes of thermo-insulating materials	250.0	Asbestos, products of silicate cotton, diatomite	
Debris	25.0	Plaster, waste bricks and etc.	Temporary storage in the territory of repair works and sent in special tight vehicle to landfill for construction waste materials – private company “Barno” in Navoi
Waste paper	1.0	Paper	Temporary storage in special room, always take out to waste paper receiving centers.
Worn-out working cloth	3.88	Fabrics, rubber	Temporary storage in generating places, part of which is used as cleaning rags and unusable part (worn boots and shoes) sent to landfill for domestic wastes “Kizilkumkommunal-servis” PLC – Navoi
Solid domestic waste	70.6	Solid domestic waste	Temporary storage in container. Always send to landfill for domestic wastes “Kizilkumkommunal-servis” PLC – Navoi
	300.0		Temporary storage in container. Always send to landfill for domestic wastes “Kizilkumkommunal-servis” PLC – Navoi
	4.0		
Food waste	1.92	Remains of foodstuff and peel	Store in special vessel and taken out everyday for cattle feed

Reference: The document obtained at the survey.

8.3 Scoping and TOR of the survey

8.3.1 Result of the review of the EIA

1) Environmental impact assessment

a. Air quality

The project involves construction of CCCGP No.2 of 450MW and decommission of Unit 3 (150MW) and Unit 8 (160MW), which result in 140MW of increased power generation.

The EIA describes that emission of NO_2 and NO before the project implementation was 3,543 t/ y and 575 t/y respectively, and will both decrease to 3,454 t/y and 561 t/ y after the project is in operation(Table 8.3.1-1) （EIA p.60-61）

Table 8.3.1-1 Emissions of pollutants Generated from Navoi power plant

Item	Before the project（t/y）	After the project（t/y）
Nitrogen dioxide（NO_2）	3,543	3,454
Nitrogen oxide（NO）	575	561
Sulfur dioxide（SO_2）	510	911
Dust	＜1	＜1
Others	＜1	＜1
Total	5,108,797	5,302,625
Note	Unit 1and 2 decommissioned; CCCGP No.1 in operation.	Unit 3and 8 decommissioned; CCCGP No.2 in operation.

The estimated maximum ground concentration of NO_2 in the exhaust gas from the existing Navoi power plant (Unit 1~12) is 135.15μg/m^3 within 3km radius of the site, which is 1.59 times higher than MPC.

The estimated NO_2 concentration from Unit 3 and 8 which are to be decommissioned in this project is 0.79MPC (67.15μg/m^3), whereas the estimated concentration from CCCGP No.2 is 0.17MPC (14.455μg/m^3).

Consequently, this project will largely contribute to the decrease of NO_2 concentration. (EIA p.62)

b. Water quality

In this project, adoption of forced-draft cooling tower system was planned in the EIA, but forced draft air cooling system will also be considered. The amount of thermal water discharge into Zerafshan River will decrease after decommission of Unit 3 and 8 (EIA p.80).

According to the regulation in Uzbekistan, water temperature rise at 500m downstream of the water outlet shall be 3ºC or less. The estimated maximum water temperature rise by blow-down from a forced-draft system at 100m downstream of the outlet is 0.5 ºC (EIA p.57）.

Washing wastewater is generated from the water treatment system for CCCGP No.2 at the rate of 92.5m^3/h and is discharged into Zerafshan River after treatment (EIA p.55).

c. Noise and vibration

・Noise

The estimated noise level in the residential area near other project site, taking into consideration of the attenuation effect of the buildings and the green zone, will be below the environmental standard value (EIA p.65).

・Vibration

The estimated vibration level from the power plant is less than 50dB (EIA p.65).

d. Resettlement

According to the EIA, 30 households (11 households in Uyrot village and 19 households in Yangiobod Village) will be resettled as a result of land acquisition for transmission line and road. Resettlement and decommissioning of the houses will be conducted before 15 May, 2012 (EIA p.5, Pre-Feasibility Study Appendix 7).

Total area of land needed for construction of the transmission line and road (22ha) is much larger than the plant site for CCCGP NO.2 (9ha), and the adequacy of the area for construction shall be verified promptly.

2) Environmental management plan (mitigation measures, monitoring plan)

In the EIA of this project, the following mitigation measures will be conducted during operation phase.

-Exhaust gas: the existing Unit 3 and 8 will stop operation with the operation of the power plant of this project.

-Effluent: forced-draft cooling tower system or draft air cooling system are adopted and will not generate large thermal water. Decommission of the existing Unit 3 and 8 will decrease the generation of thermal water.

There is no description of the mitigation measures during construction phase. There is no description of the monitoring plan during construction or operation phase of this project.

8.3.2 Scoping

The predicted environmental impact items and the aspect of the environmental impact is summarized in Table 8.3.2-1, according to the items cited in JICA Guidelines and based on the existing EIA review.

Table 8.3.2-1 Draft Scoping

No.	Items	Assessment				Reason for assessment (blue figure: construction period only)
		Construction phase		Operation phase		
		Positive	Negative	Positive	Negative	
【Pollution】						
1	Air pollution	N	A	B	A	- Temporary emission of air pollutants (Sox, NOx, etc) from heavy machines and vehicles and flying dust may occur, and a residential area is nearby. - In case gas is used for fuel, very little SO_2 and soot is generated. Although significant amount of NO_2 is emitted, stopping of the old power plants is also decided.
2	Water pollution	N	A	B	A	- Muddy water after rain, domestic wastewater generated by workers is temporarily generated. - Either forced draft cooling tower cooling system or forced draft air cooling system will be adopted, and large amount of thermal waste water discharge is not predicted. Stopping of Unit 3 and 8 will also diminish the thermal waste water. - Forced draft cooling tower will generate cooling tower blow-down. - Plant waste water and oily waste water is generated but stopping of the existing facilities is also decided. - Domestic waste water will be generated by project workers.
3	Waste	N	B	B	B	- Domestic waste, waste oil, waste material will be generated. - Waste oil from the equipment and oil-separating system of the waste-water treatment system and sludge from the precipitation system of the waste-water treatment system will be generated, but may be diminished after stopping of the existing facilities. - Domestic waste is generated from the project establishment.
4	Noise/vibration	N	A	N	A	- Temporary noise from the construction machines and vehicles will be generated. There is a residential area nearby. - Noise from cooling tower fan is predicted. Turbines and pumps may also be potential noise source. Residential area is nearby.
5	Subsidence	N	N	N	N	- No pumping of ground water.
6	Odor	N	N	N	N	- Materials generating bad smell will not be used during construction and operation phase.
【Natural environment】						
1	River water	N	N	B	N	- No pumping of river water. - Either forced draft cooling tower cooling system or forced draft air cooling system will be adopted, and intake of cooling water from the river is not necessary. - Less amount of river water will be taken compared to the old Unit 3 and 8 which used river water for cooling system.

No.	Items	Assessment				Reason for assessment (blue figure: construction period only)
		Construction phase		Operation phase		
		Positive	Negative	Positive	Negative	
2	ground water	N	N	N	N	- No pumping of ground water.
3	Protected area	N	N	N	N	- The project site does not include protected area.
4	Terretrial ecosystem	N	B	N	B	- Air pollution and noise during construction may have temporary impact on terrestrial organisms. ・The project site is adjacent to the residential area and the power plant already under influence of human activity.
5	River ecosystem	N	B	B	B	- Water turbidity caused by construction work may have temporary impact on river organisms. - Either forced draft cooling tower cooling system or forced draft air cooling system will be adopted, and large amount of thermal waste water discharge is not predicted. Stopping of Unit 3 and 8 will also diminish the thermal waste water. - Forced draft cooling tower will generate cooling tower blow-down. - Plant waste water and oily waste water is generated but stopping of the existing facilities is also decided. - Domestic waste water will be generated by project workers.
6	Precious species	N	B	N	B	- The project site is adjacent to the residential area and the power plant already under influence of human activity. No precious species are observed.
【Social environment】						
1	resettlement	A	A	A	A	- Land acquisition of 22ha for construction of transmission line and road will result in resettlement of 33 households.
2	Employment and livelihood	B	B	B	B	- The new employment and new business in the local area may increase the income of the local people in the surrounding area. - Income gap between the project workers and the local people may occur.
3	Local society	B	B	B	B	-Increased employment and new business will enhance the development of the local economy. - Influx of workers may generate infectious disease, HIV, conflict with local people, income gap. - Influx of workers and their family may require establishment of social infrastructure such as medical facility, schools, road, sewage line, etc. - Construction work will cause increased traffic in the road in the surrounding area, which may cause increased risk of traffic accident. - Increased traffic may damage the road in the surrounding area.
4	Cultural heritage	N	N	N	N	- No archeological, historical, cultural, and religious heritage site exists within the site.
5	Landscape	N	N	N	N	- The project site is adjacent to the residential area and the power plant with much human activity and is not a significant landscape area.
6	Minorities	N	N	N	N	- The project site is adjacent to the residential area and the power plant with much human activity and not an area for minorities to live in groups.

No.	Items	Assessment				Reason for assessment (blue figure: construction period only)
		Construction phase		Operation phase		
		Positive	Negative	Positive	Negative	
7	Labor environment	B	B	B	B	- There is a risk of labor accident of workers. - There is a risk that security agents threat the security of the local people.
【Others】						
1	Global warming	N	B	B	N	- Temporary emission of CO_2 rom heavy machines and vehicles. - The reduction of CO_2 emission concerning this project is more than 684,150 tons per year.

Notes: The categorization criteria is as follows.
A: causes serious impact.
B: causes certain degree of impact.

The result of the scoping described above and the items that need additional survey are listed in Table 8.3.2-2.

Table 8.3.2-2 The result of the scoping described above and the items that need additional survey

category	item	Construction phase	Operation phase	Additional survey item
Items that will potentially receive negative impact	Items that will potentially receive serious impact	【pollution mitigation】 - Air pollution - Water pollution - Noise and vibration 【social environment】 - resettlement	【pollution mitigation】 - Air pollution - Water pollution - Noise and vibration	- Simulation of air quality and noise during construction and operation phase shall be conducted as necessary. - Environmental management plan for air pollution, water pollution, noise and vibration and others during construction and operation phase shall be established. - Resettlement plan shall be developed based on the survey.
	Items that will potentially receive certain degree of impact	【pollution mitigation】 - Waste 【natural environment】 - Terrestrial ecosystem - River ecosystem - Precious species 【social environment】 -Employment and livelihood - Working environment	pollution mitigation】 - waste 【natural environment】 - Terrestrial ecosystem - River ecosystem - Precious species 【social environment】 -Employment and livelihood - Working environment	- Environmental management plan for waste during construction and operation phase shall be established. - Environmental management plan for ecosystem, employment and livelihood, local community, working environment during construction and operation phase shall be established.

category	item	Construction phase	Operation phase	Additional survey item
Items that will potentially receive little impact		【pollution mitigation】 - Land sinking - Odor 【natural environment】 - River water - Ground water - Protected area 【social environment】 - Cultural site - Minorities	【pollution mitigation】 - Land sinking - Odor 【natural environment】 - River water - Ground water - Protected area 【social environment】 - Cultural site - Minorities	—

8.3.3 TOR of the survey

1) Review of the existing documents

The environmental management plan (mitigation measure, monitoring) of air pollution, water turbidity, waste, noise and other pollution during construction and operation phase shall be confirmed based on the IFC/WB EHS General Guidelines.

Air pollution and noise have direct impact on the households in the surrounding area and the estimation shall be carefully considered. In this regard, in addition to the review of the prediction of air pollution and noise, simulation shall be conducted as necessary regarding construction and operation phase.

Impact assessment of air and water pollution shall be comprehensively evaluated, considering positive impact by decommissioning the existing Unit 3 and 8, and negative impact by newly constructing CCCGP No.2.

2) Major check points to the project owner

- Predicted data of air pollutants emitted from the power plant (including the existing facility) shall be confirmed and its adequacy shall be considered.
- Prediction data of noise source concerning the power plant shall be confirmed and its adequacy shall be considered.
- The flow balance of water intake of the power plant (including the existing facility) shall be confirmed.
- Measurement data of air quality, water quality, noise, ecosystem cited in the EIA shall be obtained.
- Laws and regulations currently not available shall be obtained (revised laws of labor safety, EIA-related regulations).

3) Development of the environmental management plan/monitoring plan and determination of cost, funding, and implementation system

There is almost no description about “the environmental management plan” and “the monitoring plan “in the EIA.

Consequently, appropriate plans shall be established respectively and the contents, implementation structure and budget shall be discussed with the project operator.

4) Point to be confirmed by the relevant regulating authorities

The EIA contents shall be compared with the laws and regulations of Uzbekistan concerning environmental assessment, JICA Environmental Guidelines and WB Safeguard Policy OP4.01, Annex B to determine the deviation. The supplementary EIA shall be compiled based on the result. The project owner and the related authorities shall check the contents and discuss the information disclosure and the implementation of the stakeholder’s meeting.

5) Confirmation of the resettlement status of the residents

Support for the preparation of a brief resettlement action plan shall be conducted fundamentally based on JICA Guidelines.

a. Analysis of the legal framework concerning land acquisition and resettlement
b. Necessity of land acquisition and resettlement
c. Implementation of socioeconomic survey (population census survey, property/estate survey, household finance/life survey) concerning land acquisition
    - Population census survey
        (subject): all the occupants in the proposed project site
        (content): confirmation of number of the local people entitled to compensation or livelihood restoration measure (including land owner, tenant, merchant, shop worker, illegal occupant). Their intension for the resettling site shall also be investigated.
        (note): in order to minimize the issue of the residents moved into the site after the cut-off date, the cut-off date shall be announced in principle on the starting day of the survey, and the people moved in after that shall not be granted for compensation or livelihood restoration measure.
    - survey of land and asset
        (subject): assets of all the occupants within the proposed project site
        (content): confirmation of the items and quantity of the assets physically or economically affected by the project.

    - Household finance/life survey
        (subject): at least 20% of the occupants within the proposed project site
        (content): the typical characteristics of the households entitled to compensation. Basic data regarding their livelihood and living standard. The survey should cover and confirm the living status of social minorities, the people below the poverty level, people possessing no land, indigenous or minority people, and the people not protected under Uzbekistan legal system.

d. Requirement of compensation for lost assets and livelihood restoration
    - Compensation of lost assets
    - Livelihood restoration
e. Consideration of grievance system
f. Consideration of implementation system
g. Consideration of implementation schedule
h. Consideration of Cost and funding
i. Consideration of the monitoring system/monitoring form
j. Confirmation of consultation with the affected people

However, as there is a description in the EIA that 30 households will be resettled as a result of land acquisition for constructing transmission line and road, and there is also information that resettlement and decommissioning of houses will be carried out by 15 May 2012, the status of procedure in Uzbekistan concerning land acquisition and resettlement should be confirmed. If public meeting for explaining compensation has already been held and resettlement and compensation has already started, the current status should be checked, including the implementation status of public consultation, comments from local people, details of compensation and livelihood restoration method, current status of resettlement and compensation.

6) Data collection concerning climate change countermeasure

- Collection of data necessary for quantitative understanding of greenhouse gas suppression effect (data characteristics and data collection based on CDM methodology etc).
- Estimation of greenhouse gas reduction effect (based on CDM methodology).

8.4 The result of survey

8.4.1 Re-assessment of the prediction

In order to predict the impact of the project on air quality during operation phase, the accumulative impact of the total power plant was predicted and assessed, taking into account the estimation of emission and the shutting down of the existing facilities.

A quantitative prediction and re-assessment was conducted to estimate the impact of noise and vibration during construction and operation phase.

The prediction and assessment of water pollution during operation phase was conducted taking into account decommission of the existing facility and the reduction of effluent.

1) Air pollution

a. Operation phase

Emission data of exhaust gas from the power plant described in the EIA does not appropriately take into account the heat supply of CCCGP No.2, however, it does consider the existing Unit 6 and 10 as “not operating”, in addition to Unit 1,2 and Unit 3,8.

In this regard, review of pollutant emission was conducted under the condition that Unit 6 and Unit 10 are in operation and heat supply of CCCGP No.2 is included.

Also, used gas fuel in CCCGP No.2 contained almost no sulfur in result of review, whereas gas fuel containing 0.03% sulfur was used in the EIA.

Moreover, in the EIA, exhaust gas temperature was set as high as 126 ºC to minimize corrosion by sulfer. In the result of the review, as the gas turbine containing little sulfur is used, gas temperature is set to 100 ºC.

Table 8.4.1-1 describes emission data from each stack of power plant specified in EIA report as well as the result of this review.

Emission amount of NO_2 from CCCGP No.2 increases about 1.7 times, from 18.3g/s to 32.5g/s; therefore, the maximum ground concentration of NO_2 will also be expected to become higher than the value specified in EIA report for CCCGP No.2, which is 14.455μg/m^3 (0.17MPC) by the method used in Uzbekistan.

The maximum ground concentration standard from CCCGP No.2 stipulated by regulation in Uzbekistan is 21μg/m^3 (0.25MPC).

The permitted maximum emission volume from CCCGP No.2 becomes 26.6g/s, calculating with the standard of ground-level concentration. The emission volume, according to the result of this survey mission, however becomes 32.5g/s, which exceeds the permitted emission volume.

Therefore, prediction on the impact caused by NO_2 emission was conducted using emission gas data. The prediction was conducted using gaussian plume model. This model is used in the US and Japan, but is different from the method used in Uzbekistan, and the final check by the Uzbekistan side shall be conducted until future operation.

Table 8.4.1-1(1) Emission data from stack of power plant (EIA)

Items	Unit	Existing units				Gas-combined	
		Stack2	Stack 3	Stack4	Stack 5	CCCGP No.1	CCCGP No.2 (this project)
		Unit 3, 4	Unit 5, 6, 7	Unit 8,9,10	Unit 11, 12		
Emission volume (wet)	m^3/s	501.0	397.1	646.8	700.9	691.2	736.1
Exhaust gas temperature	°C	142	136	141	150	126	126
Exhaust gas speed	m/s	7.6	6	9.8	24.8	12.2	13.0
Stack height	m	56	56	56	180	60	60
NO_2. emission	g/s	29.1	28.4	47.2	94.1	17.2	18.3
NO. emission	g/s	4.7	4.6	7.7	15.3	2.8	2.9
SO_2. emission	g/s	2.4	3.1	7.2	1.0	15.6	16.6
NO_2.concentration	mg/m^3	58.1	71.4	73.0	134.3	24.8	24.8
NO. concentration	mg/m^3	9.4	11.6	11.9	21.8	4.0	4.0
SO_2. concentration	mg/m^3	4.8	7.8	11.1	1.4	22.5	22.5

Note: concentration of pollutants is actual base in the exhaust gas.

Table 8.4.1-1(2) Emission data from stack of power plant (Result of Review)

Item	Unit	Existing units				Gas-combined	
		Stack2	Stack 3	Stack4	Stack 5	CCCGP No.1	CCCGP No.2. (this project)
		Unit 3, 4	Unit 5, 6, 7	Unit 8,9,10	Unit 11, 12		
Emission volume (wet)	m^3/s	**500.2**	**596.1**	**863.2**	700.9	**847.6**	**783.4**
Exhaust gas temperature	℃	142	136	141	150	126	**100**
Exhaust gas speed	m/s	**9.5**	**9**	**8.1**	24.8	**14.9**	13.8
Stack height	m	56	56	56	180	60	60
NO_2. emission	g/s	29.1	**42.6**	**81.4**	94.1	**28.9**	**32.5**
NO. emission	g/s	4.7	**6.9**	**13.2**	15.3	**4.7**	**5.3**
SO_2. emission	g/s	2.4	**4.6**	**12.4**	1.0	**36.5**	**0.9**
NO_2.concentration	mg/m^3	58.1	71.4	**94.3**	134.3	**34.1**	**41.5**
NO. concentration	mg/m^3	9.4	11.6	**15.3**	21.8	**5.5**	**6.7**
SO_2. concentration	mg/m^3	4.8	7.8	**14.4**	1.4	**43.0**	**1.2**

Note: bold letter: changed value from EIA report (Appendix 3).

【Atmospheric diffusion estimation model】

Using the following Gaussian diffusion model, 30-min value estimation was conducted according to the time scale in conformity to the ambient air quality standards of Uzbekistan.

$$C = \frac{Q_p}{2\pi\ \sigma_y \sigma_z u} \cdot \exp(-2\frac{y^2}{2\sigma_y{}^2})\exp\left\{-\frac{(z-He)^2}{2\,\sigma_z{}^2}\right\} + \exp\left\{-\frac{(z+He)^2}{2\,\sigma_z{}^2}\right\}$$

[Symbol]

C: Above-ground concentration at a leeward distance R (m)
Q_p: Emission volume
σ_y: Parameter in the horizontal direction (m)
σ_z: Parameter in the vertical direction (m)
Converting 3-min value to 30-min value using the formula below
$\sigma_y = \sigma_{y1} \times (30/3)^{0.2}$ （σ_{y1} ;Pasquill-Gifford）
σ_z: Parameter in the vertical direction (m) （Pasquill-Gifford）
u: Wind speed (m/s)
Calculating the wind speed at the stack outlet level, using the measurement ground-level wind speed (10m) and the elements described below.
$U2 = U1\ (Z2/Z1)^P$
U1: wind speed at measurement height level (m/s), Z1: measurement height level（10m）
U2: wind speed at the stack outlet level (m/s), Z2: Stack height (m)
P: Coefficient of stability
R: Horizontal distance between smoke source and calculated point (m)
z: Above-ground height
He: Effective stack height (m)
$He = H + \Delta H$
H: Actual stack height (m)
ΔH: Elevation height (m)

【Meteorological conditions】

The concentration of NO_2 discharged from the stack having reached the ground by dispersion heavily depends on the diffusion parameter for each of the wind speed and atmospheric stability, as shown in the aforementioned calculation formula.

Calculation is simulated under the conditions shown below, based on the stability and wind speed indicated in the atmospheric stability classification of Pasquill.

Outlet of the stack is located at high elevation, so that atmospheric stability at the stack outlet becomes “Neutral” compared to the instability of atmosphere at ground level. For instance, stability B at ground level is set to be stability C at stack outlet level, and wind speed condition at outlet level is set to be between 1.0m/s and 4.0m/s, accounting for wind speed condition of Stability B with conservative point of view.

Setting conditions for stability and wind speed

Stability		**Wind speed conditions at ground level (m/s)**
Unstable	B	1.0, 2.0, 3.0, 4.0
Neutral	C	1.0, 2.0, 3.0, 4.0
	D	1.0, 2.0, 3.0, 4.0, 6.0, 8.0,10.0,15.0

(Reference) Pasquill stability categories

Wind speed at ground level U (m/s)	**Daytime**				**Nighttime (rate of solar radiation = 0)**
	Rate of solar radiation Q (unit 0.01 kWm^{-2})				
	60 < Q	**30 – 59**	**15 – 29**	**1 - 14**	
U < 2.0	A	A-B	B	D	F
2.0 - 2.9	A-B	B	C	D	E
3.0 - 3.9	B	B-C	C	D	D
4.0 - 5.9	C	C-D	D	D	D
6.0 < U	C	D	D	D	D

Note: This category shows the stability of the atmosphere proposed by Pasquill, English. Category A means the most unstable atmospheric condition; category B being the most stable atmospheric condition; and category D being the intermediate condition.

【Consideration of stack height and Compliance to the standard】

The stack height is set to 60m in the EIA, but actually no specific discussion has been had in setting the stack height.

Emission amount of NO_2 from CCCGP No.2 increases about 1.7 times, from 18.3g/s to 32.5g/s; therefore, the maximum ground concentration of NO_2 will also be expected to become higher than the value specified in EIA report.

As cited above, exhaust gas temperature, which had been set to 126 ºC in the EIA, was set to 100 ºC in the latest consideration, resulting in lower temperature rise caused by calorific value of exhaust gas.
In this regard, the stack height shall be set to achieve the maximum ground concentration lower than that of the EIA conditions (NO_2 emission, stack height of 60m, exhaust gas temperature 126 ºC).

Here, the maximum ground concentration under the condition that exhaust gas temperature of 100 ºC, stack height of every 20m between 80m and180m is predicted and compared with the maximum ground concentration of the initial plan, in order to determine the favorable stack height.

The prediction was conducted for all the cases of stability and wind speed described above.
The prediction result is shown in Table 8.4.1-2. The maximum ground concentration becomes similar to the one of the initial plan, if stack height is set to 160m; thus complying with the regulatory standard of Uzbekistan.

As a result of the consideration by Uzbekenergo through a method used in Uzbekistan, the stack height was set to 90m, on the ground that the maximum ground concentration standard from CCCGP No.2 in Uzbekistan is satisfied by the stack height of 90m.

Table 8.4.1-2 Maximum ground concentration of NO_2 (μg/m^3) for different stack height in CCCGP No.2

Items		Stack height 60m, exhaust gas temperature:126ºC NO_2 emission 18.3 g/s:（EIA）	Exhaust gas temperature: 100 ºC, NO_2 emission 32.5 g/s					
			Stack height 80m	Stack height 100m	Stack height 120m	Stack height 140m	Stack height 160m	Stack height 180m
Maximum ground concentration (μg/m^3)	Stability B	4.6－5.6	8.7 －9.6	8.2 －8.7	7.4 －7.9	6.5 －7.4	5.8 －6.9	5.2 －6.6
	Stability C	3.1－4.3	5.9 －7.3	5.5 －6.3	5.3 －5.6	4.7 －5.1	4.1 －4.6	3.6 －4.3
	Stability D	0.7－2.1	1.4 －3.1	1.3 －2.4	1.2 －1.9	1.1 －1.6	0.9 －1.3	0.7 －1.1

It should be noted that NO_2 contained in the emission gas during plant operation needs to be continuously monitored and confirmed if it meets the regulatory standard of Russia (GOST 29328-92) and Environmental, Health and Safety Guideline for Thermal Power Plant of IFC/WB.

The maximum ground concentration of NO_2 in all the cases with stack height of 90m is shown in Table 8.4.1-3.
The maximum ground concentration (30 min value) with CCCGP No.2 is 9.1μg/m^3 and occurs under the condition that air stability is B, wind speed is 3.0 m/s. This is about 10 % of Uzbekistan environmental standard, and about 5 % of IFC/WB guideline 1hour value.
NO_2 concentration value in residential area of Navoi City is 90μg/m^3 at the maximum, which exceeds environmental standard of Uzbekistan (85μg/m^3), but it is below 1-hour value of IFC/WB EHS General guideline (200μg/m^3).
In consequence, it satisfies the guideline value, even source contribution of CCCGP No.2 is taken into account.

Table 8.4.1-3 Prediction of the maximum ground concentration of NO_2 by CCCGP No.2 (30 min value)

Items	Atmospheric conditions (stability)	Wind speed	Maximum ground-level concentration a (μg/m^3)	Maximum ground-level concentration distance (km)	Current ※ concentration b(μg/m^3)	Environmental standard (MPC) of Uzbekistan (μg/m^3)	IFC/WB EHS General Guidelines (2007)
NO_2	B	1.0 m/s	8.4	3.7	15～90（average 40）	85	200 (1-hour value)
		2.0 m/s	9.0	2.5			
		3.0 m/s	9.1	2.1			
		4.0 m/s	8.9	1.8			
	C	1.0 m/s	5.7	8.1			
		2.0 m/s	6.5	6.5			
		3.0 m/s	6.8	6.7			
		4.0 m/s	6.8	6.8			
	D	1.0 m/s	1.3	52.1			
		2.0 m/s	2.0	24.6			
		3.0 m/s	2.3	16.6			
		4.0 m/s	2.5	12.8			
		6.0 m/s	2.7	9.9			
		8.0 m/s	2.7	8.3			

		10.0 m/s	2.6	7.2			
		15.0 m/s	2.4	5.8			

※The value, b refers to the measurement result in residential area of Navoi City.

【Prediction result of the total cumulative impact of the power plant】

Assessing impact of the pollutants at the whole power plant, it is necessary to consider the operation condition and gas emission amount of the existing power plant along with the operation of CCCGP No.2.

With CCCGP No.2 in operation, decommission of Unit 3 and 8 has already been determined. Shutdown of Unit 6 and 10 will not cause insufficient heat supply; however, Unit 6 and 10 will start their operation in case that heat supply increases by any chance.

Table 8.4.1-4 describes emissions of pollutants generated from Navoi power plant in case of the shutting-down of Unit 3 and 8 as well as shutting-down of Unit 3, 6, 8 and 10.

In case of shutting-down of Unit 3 and 8, NO_2 emission is increased to 4,687ton/year compared to 4,636 ton/year before CCCGP No.2 in operation. SO_2 is, on the other hand, reduced after CCCGP No.2 in operation.

However in case of shutting-down of Unit 3,6,8 and 10, NO_2 emission is decreased to 4,146 ton/ year compared to 4,636 ton/year before CCCGPNo.2 in operation.

Table 8.4.1-4 Emissions of pollutants Generated from Navoi power plan

Pollutant	Before the project (t/y)		After the project (t/y)		
	EIA	Result of Review	EIA	Result of Review	
Nitrogen dioxide （NO_2）	3,543	4,636	3,454	4,687	4,146
Nitrogen oxide （NO）	575	753	561	729	693
Sulfur dioxide （SO_2）	510	1,132	911	1,118	1,109
Suspended particles （Dust）	＜1	＜1	＜1	＜1	＜1
others	＜1	＜1	＜1	＜1	＜1
notes	Unit 1and 2 stopped; CCCGP No.1 in operation.		Unit 3and 8 stopped; CCCGP No.2 in operation.		Unit 3,6, 8and 10 stopped; CCCGP No.2 in operation.

There is a possibility that NO_2 concentration around the project site slightly exceeds Uzbekistan environmental standard, taking into account the concentration value of residential area in Navoi city. And, it is significant that the environmental impact of the NO_2 generated from the total power plant can be diminished after CCCGP No.2 in operation.

In this regard, NO_2 diffusion prediction before and after operation of CCCGP No.2 was predicted under the meteorological condition of atmosphere stability B when the impact of CCCGP No.2 is the maximum. Of the major winds in the area East wind was selected.
The diffusion after CCCGP No.2 started operation was estimated assuming 2 different cases: the normal operation case that Unit 3, 6, 8, 10 are shut down, and the case Unit 3 and 8 are shut down.

The result of the diffusion estimation of NO_2 before and after operation is described in Table 8.4.1-5 and Figure 8.4.1-1~4.
The maximum ground concentration of NO_2 generated by the operation of the power plant before CCCGP No.2 starts operation is 56.4~62.0μg/m^3, whereas the maximum ground concentration after CCCGP starts operation and Unit3, 6, 8, 10 are shut down is 52.6~56.0μg/m^3.
Regarding the maximum ground concentration of NO_2, 2~9μg/m^3 will be decreased after CCCGP No.2 starts operation compared to before CCCGP No.2 operation in all wind speed.
In this case, assuming that the current concentration value around the power plant is the same level as the one in residential area of Navoi city and that the maximum concentration is 90μg/m^3, the concentration value will become about the same as the standard of Uzbekistan, 85μg/m^3, or even lower, considering this project makes it possible to decrease the concentration by 2 to 9μg/m^3.

In the case of shutting down of Unit 3 and 8, the maximum ground concentration of NO_2 will be 58.4~62.0μg/m^3 .
These concentration values are the same level after operation of CCCGP No.2 compared to the case before operation except at the wind speed of 1.0m/s.

The west side of the power plant is a mixture of residential area and farmland with no source of air pollution. It is expected that the current NO2 concentration value is lower than 90μg/ｍ^3, the value in residential area in Navoi City, and it is also expected that the value will become below the Uzbekistan standard of 85μg/m^3, as the result of the operation of CCCGP No.2.

Table 8.4.1-5 Prediction of the maximum ground concentration of NO_2 by Navoi Power plant

Items	Atmospheric conditions (stability)	Wind speed	Before Operation of CCCGP No.2 (μg/m^3)	After Operation of CCCGP No.2 (μg/m^3)		Environmental reference value of Uzbekistan (μg/m^3)	IFC/WB EHS General Guidelines (2007)
				Stoppage of unit 3,6, 8,10	Stoppage of unit 3, 8		
NO_2	B	1.0 m/s	56.4 (3.9km)	54.2 (3.6km)	58.4 (3.6km)	85	200
		2.0 m/s	61.2 (2.4km)	56.0 (2.4km)	61.9 (2.4km)		
		3.0 m/s	62.0 (1.6km)	54.8 (1.9km)	62.0 (1.9km)		
		4.0 m/s	61.4 (1.4km)	52.6 (1.7km)	60.1 (1.4km)		

Note: the value specified in (   ) is distance from stack of CCCGPNo.2:

Accordingly, it may be concluded that the implementation of the project will contribute to the mitigation of air pollution.

However, in the west side of the power plant, exhaust gas diffuses with the frequent eastern wind, so that the monitoring shall be conducted in the residential area and other areas to check the environmental impact.

(Before operation of CCCGP No.2.: Maximum ground concentration : 56.4 μg/m^3.distance: 3.9km)

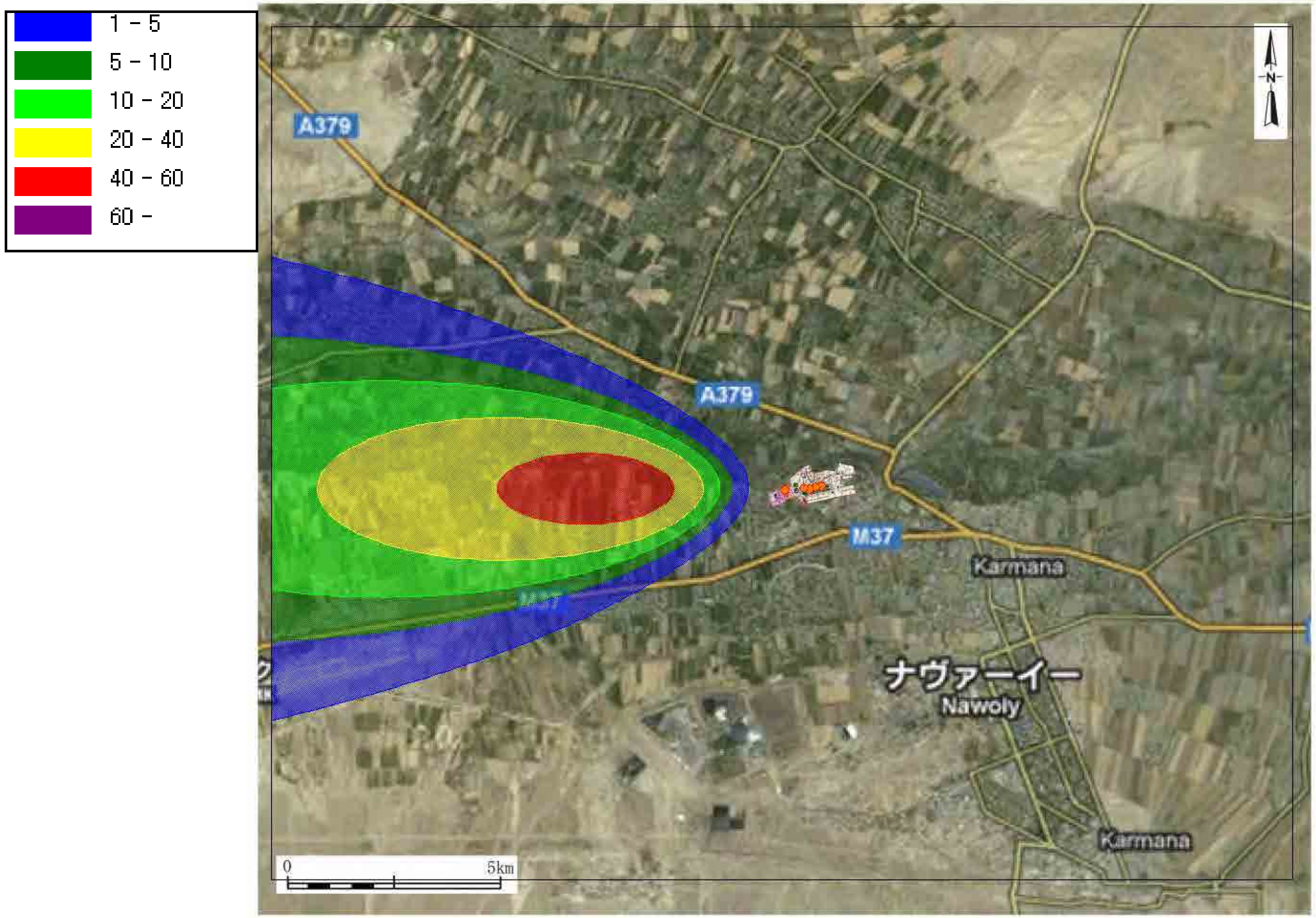


Figure 8.4.1-1(1) Ground level concentration of NO$_{2.}$, Stability: B, Wind; E, 1m/s

(After operation of CCCGP No.2.- stop of unit 3,6, 8,10:Maximum ground concentration 54.2 μ g/m^3, distance: 3.6km)

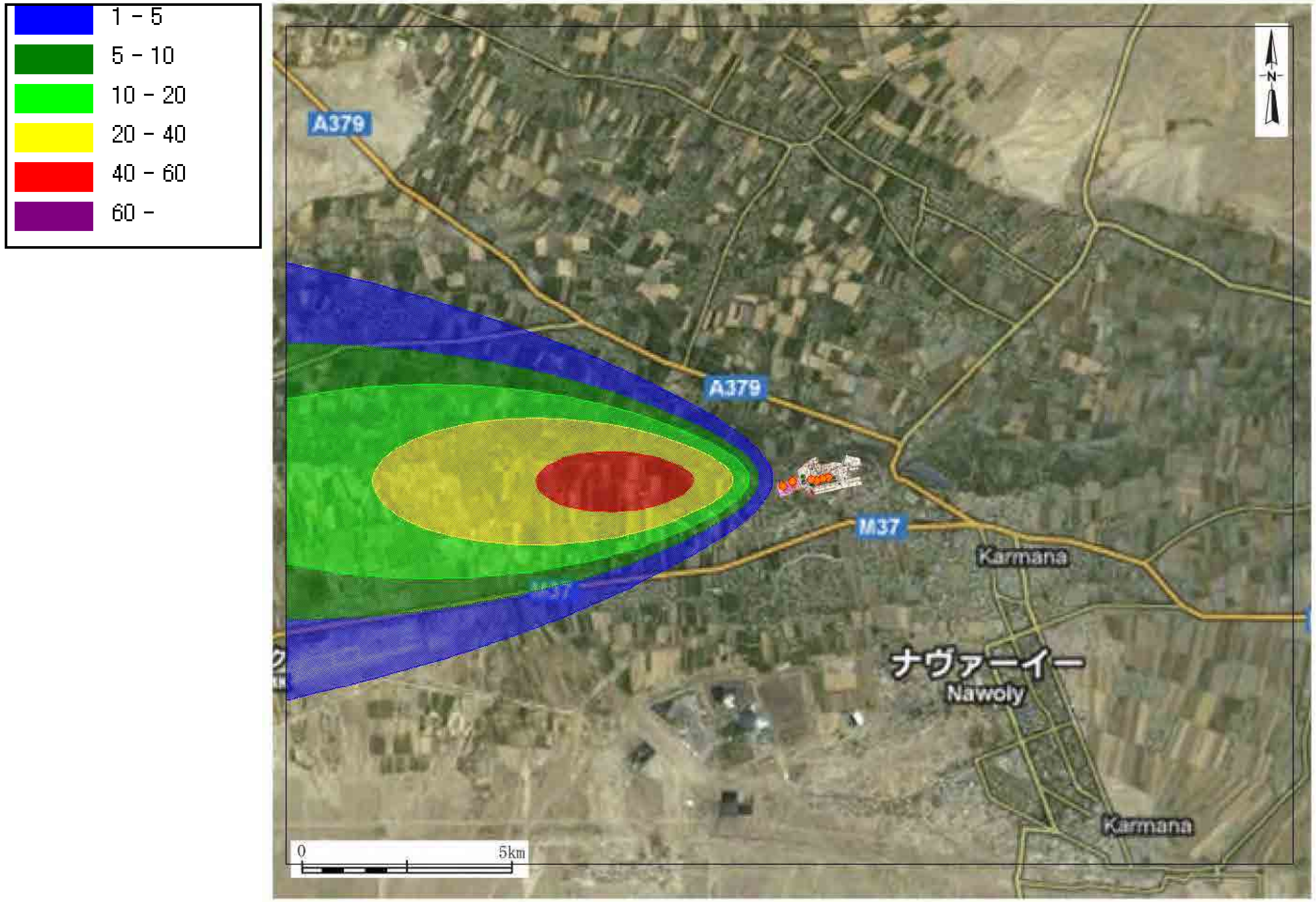


Figure 8.4.1-1(2) Ground level concentration of NO_2, Stability: B, Wind; E, 1m/s

(After operation of CCCGP No.2- stop of unit 3, 8:Maximum ground concentration 58.4 μ g/m^3,distance: 3.6km)

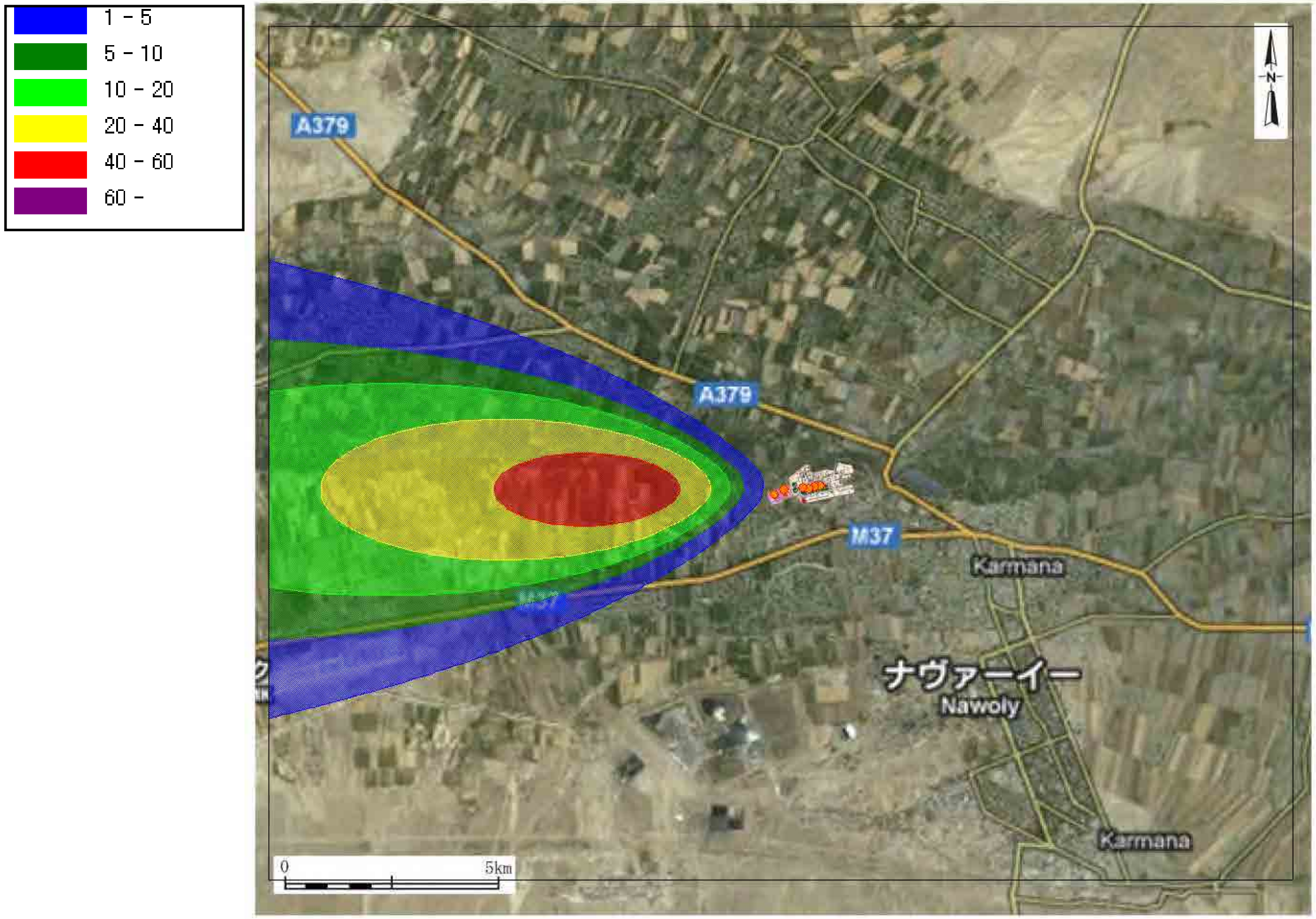


Figure 8.4.1-1(3) Ground level concentration of NO_2, Stability: B, Wind; E, 1m/s

(Before operation of CCCGP No.2:Maximum ground concentration 61.2 μ g/m^3 ,distance：2.4km）

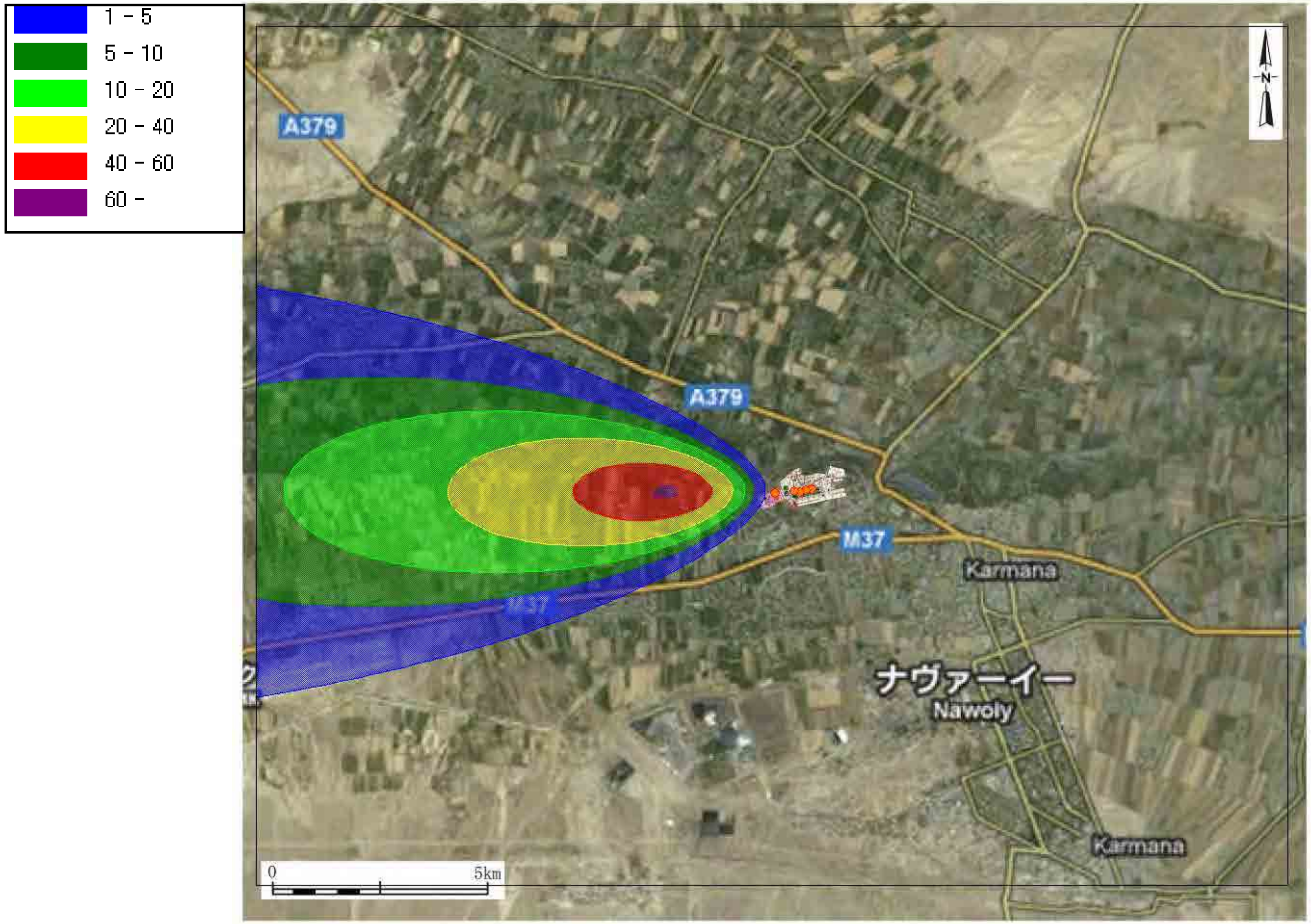


Figure 8.4.1-2(1) Ground level concentration of NO_2, Stability: B, Wind; E, 2m/s

(After operation of CCCGP No.2- stop of unit 3,6, 8,10:Maximum ground concentration 56.0 μ g/m^3 ,distance：2.4km)

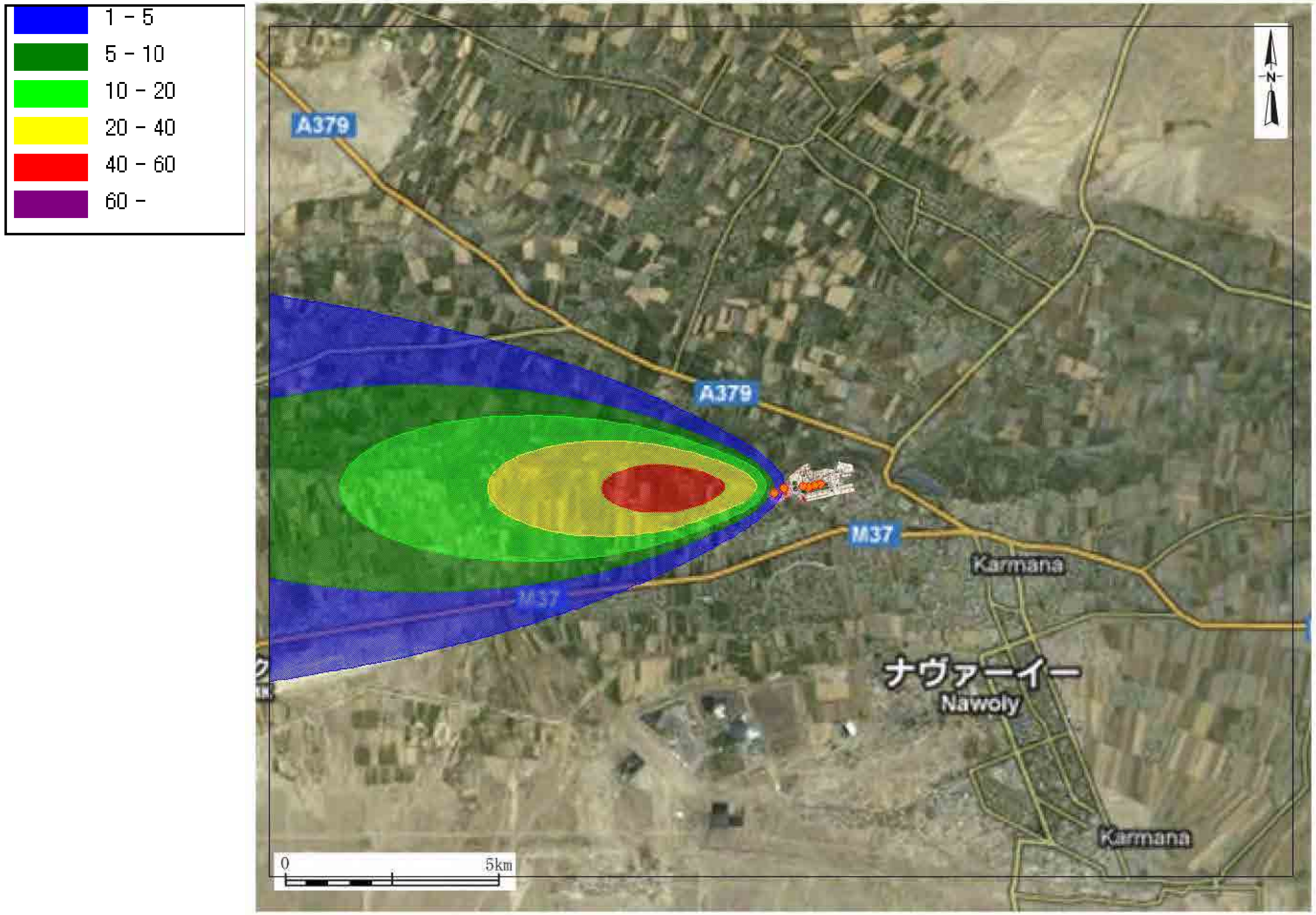


Figure 8.4.1-2 (2) Ground level concentration of NO_2, Stability: B, Wind; E, 2m/s

(After operation of CCCGP No.2- stop of unit 3, 8:Maximum ground concentration 61.9 μ g/m^3 ,distance: 2.4km)

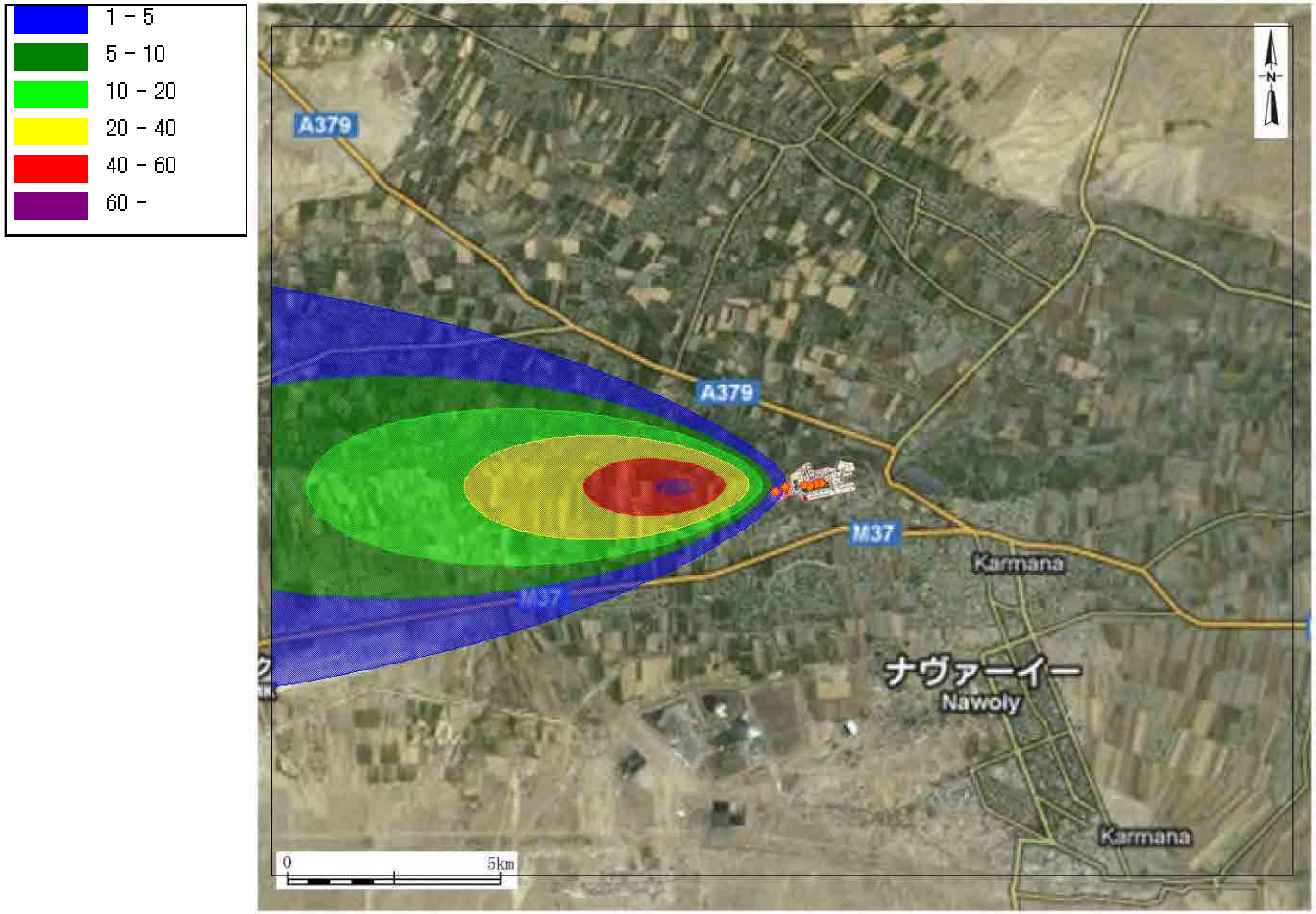


Figure 8.4.1-2 (3) Ground level concentration of NO_2, Stability: B, Wind; E, 2m/s

(Before operation of CCCGP No.2:Maximum ground concentration 62.0 μ g/m^3 ,distance: 1.6km）

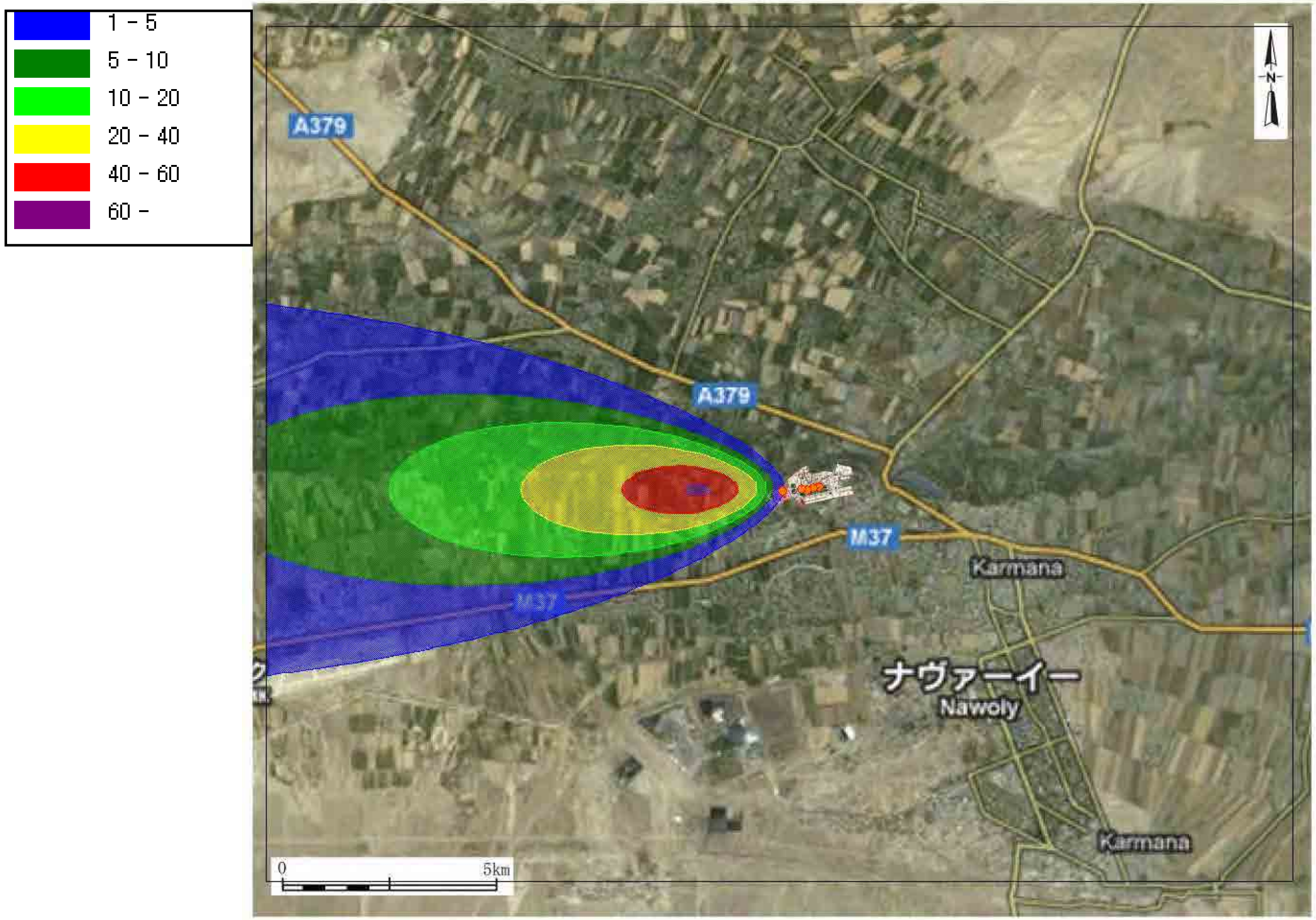


Figure 8.4.1-3(1) Ground level concentration of NO_2, Stability: B, Wind; E, 3m/s

(After operation of CCCGP No.2- stop of unit 3,6, 8,10:Maximum ground concentration 54.8 μ g/m^3 ,distance: 1.9km)

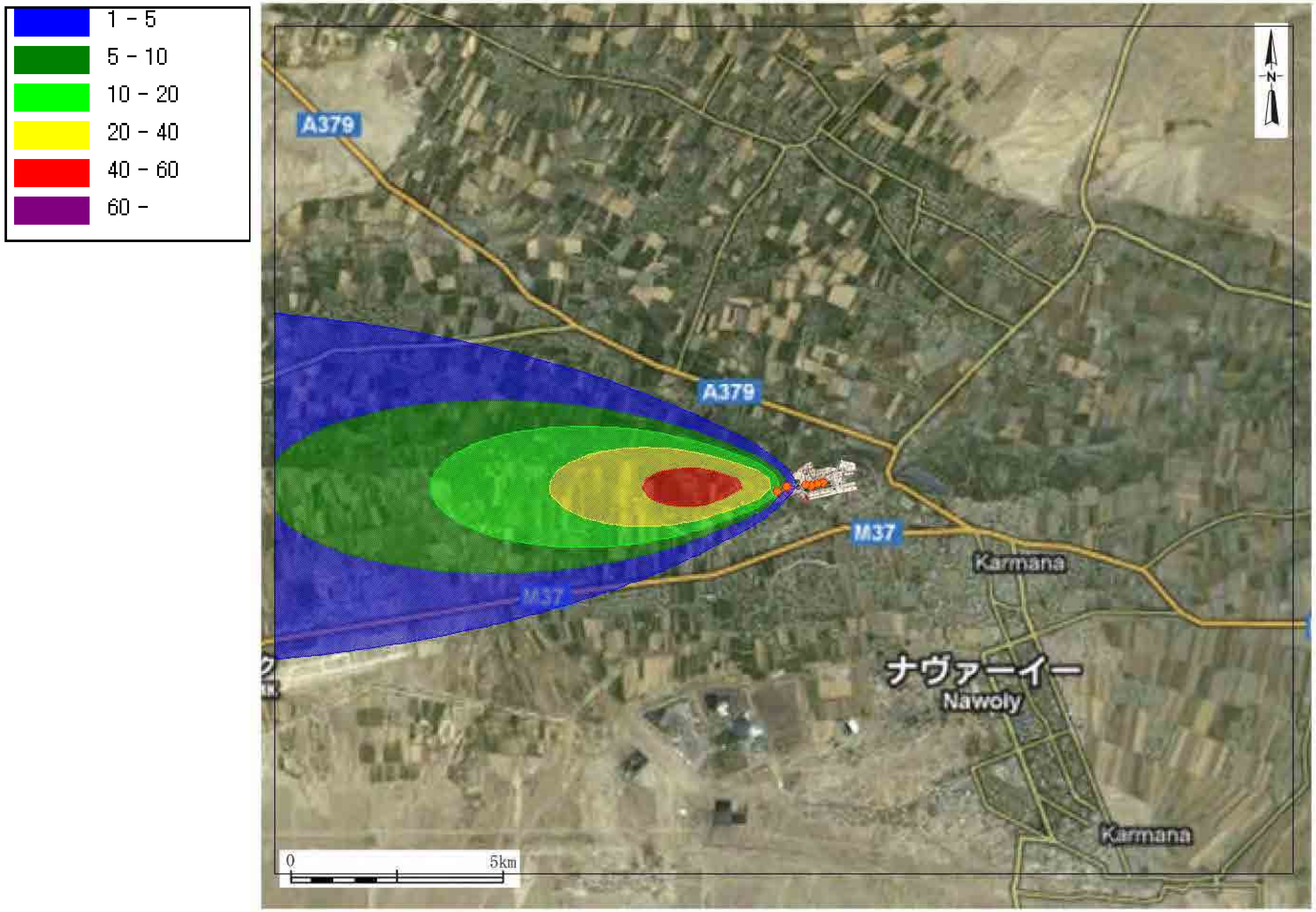


Figure 8.4.1-3 (2) Ground level concentration of NO_2, Stability: B, Wind; E, 3m/s

(After operation of CCCGP No.2- stop of unit 3, 8:Maximum ground concentration 62.0 μ g/m^3 ,distance: 1.9km)

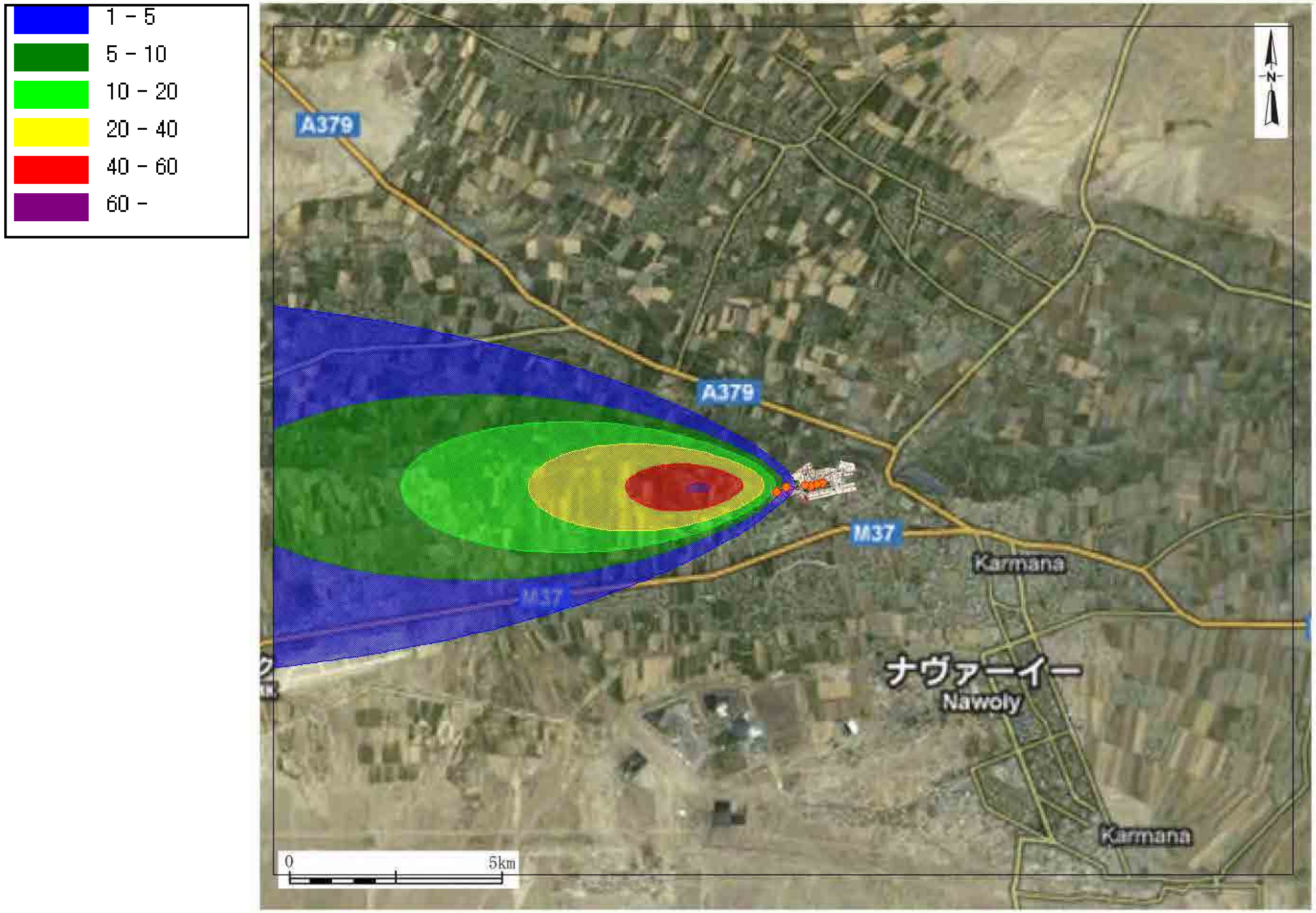


Figure 8.4.1-3 (3) Ground level concentration of NO_2, Stability: B, Wind; E, 3m/s

(Before operation of No.2:Maximum ground concentration 61.4 μ g/m^3 ,distance: 1.4km)

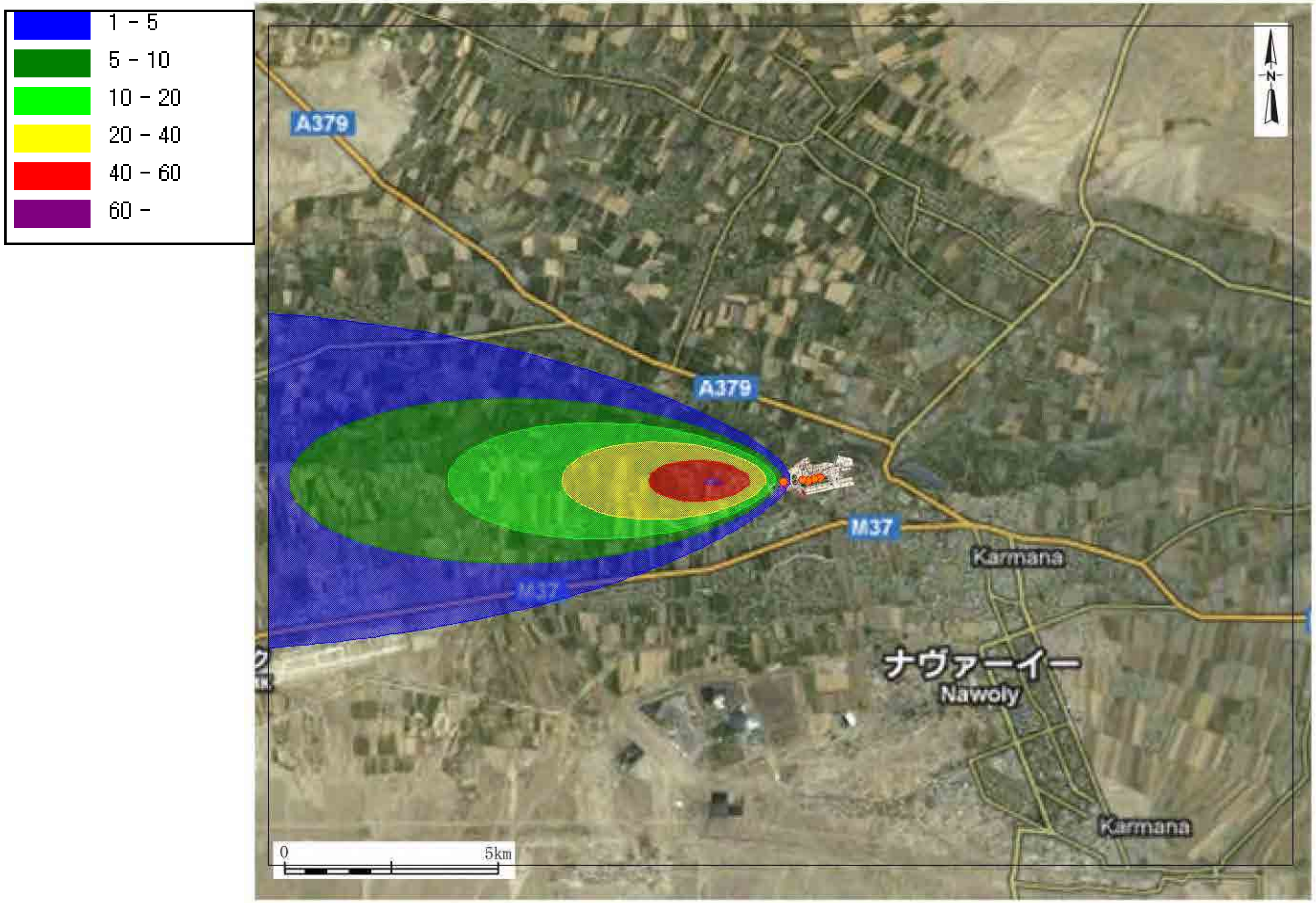


Figure 8.4.1-4(1) Ground level concentration of NO_2, Stability: B, Wind; E, 4m/s

(After operation of CCCGP No.2- stop of unit 3,6, 8,10:Maximum ground concentration 52.6 μ g/m^3, distance:1.7km)

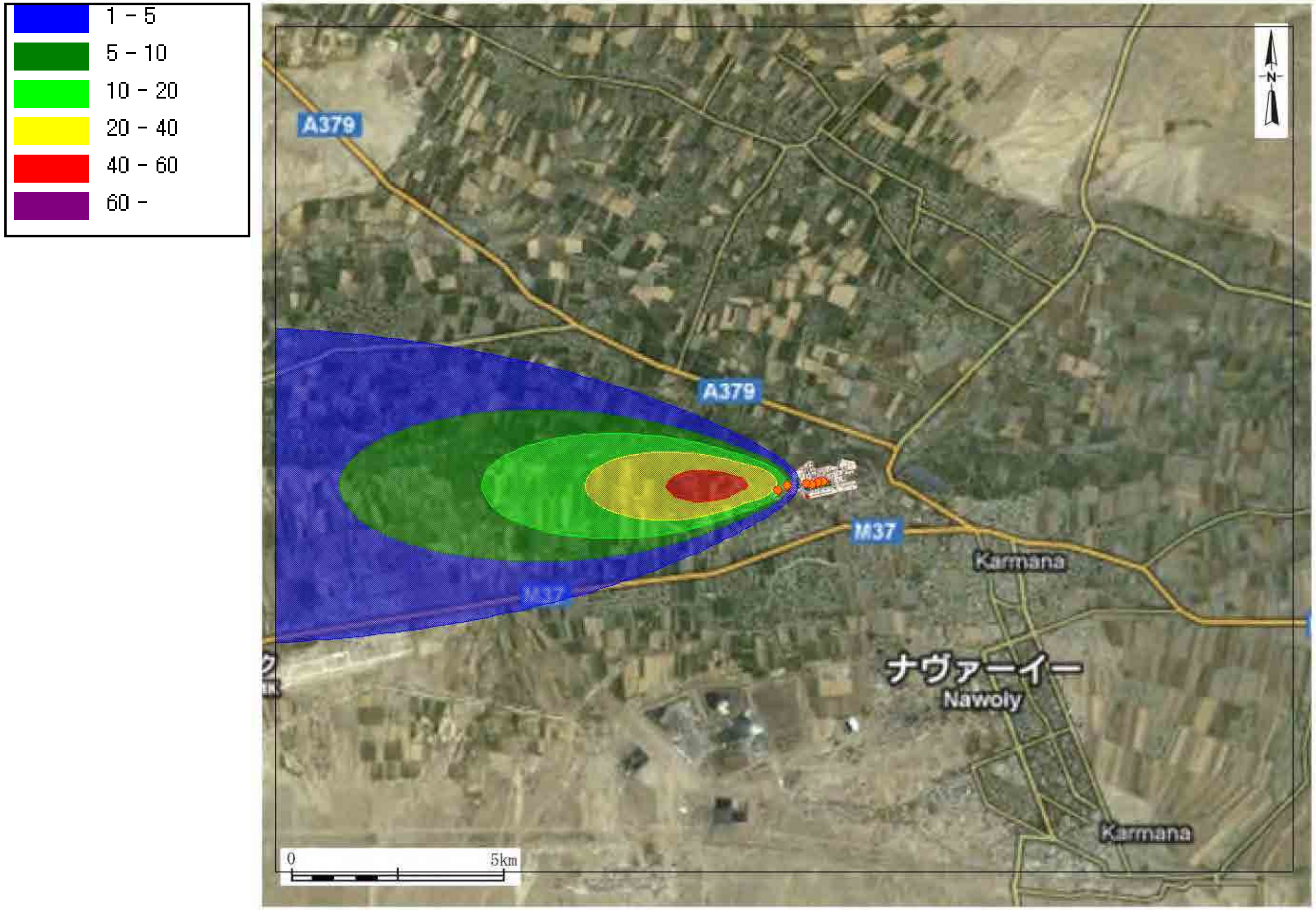


Figure 8.4.1-4 (2) Ground level concentration of NO_2, Stability: B, Wind; E, 4m/s

(After operation of CCCGP No.2- stop of unit 3, 8:Maximum ground concentration 60.1 μ g/m^3 .distance: 1.4km)

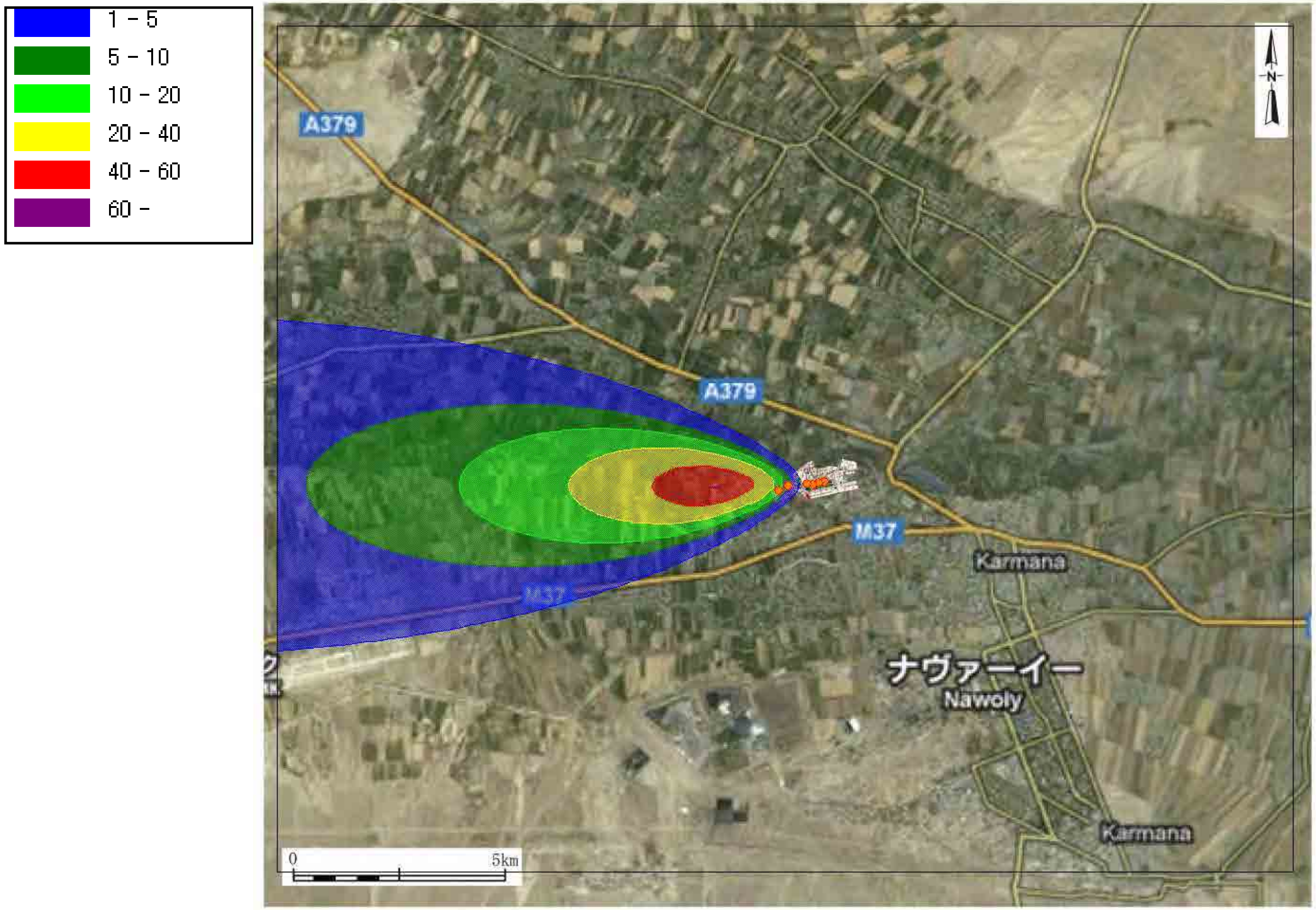


Figure 8.4.1-4 (3) Ground level concentration of NO_2, Stability: B, Wind; E, 4m/s

2) Water pollution and water use

a. Thermal effluent and blow-down from the cooling tower

As for the condenser cooling system in this project, forced-draft cooling tower system and air-cooling system were considered of which forced-draft cooling tower system was finally adopted.

This system does not generate large amount of thermal effluent as is the case of one-through system, and only the 240m^3/h of blow-down from cooling tower will be generated.by use river water.

The reduction of thermal effluent due to the shutdown of Unit 3 and 8 is 28,000m^3/h. The table below shows the amount of thermal effluent and blow-down from cooling tower both before and after this project. The total amount of effluent after this project will be about 65% with the reduction of about 27,760m^3/h.

	Before this project	After this project
The amount of Thermal Effluent (m^3/h)	78,000	50,000
The amount of blow-down from cooling tower (m^3/h)	303	543
Total	78,303	50,543

In the existing Unit 11 and 12, makeup water for cooling tower was supplied from Zerafshan River which is significantly polluted, and was used after only a simplified precipitation treatment. As a result, water quality of blow-down from the cooling tower exceeds the effluent standard in Uzbekistan.

Initially, makeup water of the cooling tower in this project will be supplied from the public water of Navoi whose quality is excellent. However, in response to the requirement of Uzbekenergo to use Zerafshan River water, the means to maintain water quality of blow-down is considered.

The basic policy is to maintain the best water quality from Zerafshan River water to the maximum extent through adequate water treatment such as coagulation-sedimentation method. Sludge generated by water treatment such as sedimentation method is disposed of as waste, and the amount of contaminant contained in intake water is thus reduced at the time of water discharge.

In the initial plan at he cooling tower, component of water quality is concentrated as the cooling water evaporates. In order to keep the concentration of the water quality within 3 times that of the original, supplying make-up water and conducting blowing down will be necessary in order to decrease the corrosion.

On the other hand, in case of using river water, the concentration of water quality will be kept within 2 times that of the original to maintain blow-down water quality, and the change in the amount of make-up water intake from 440m^3/h to 560m^3/h and of blow-down from 120m^3/h to 240m^3/h is considered.

In order to satisfy water quality standard of Uzbekistan as well as EHS Guideline of IFC/WB even when the concentration of waste water quality is kept within 2 times that of the make-up water, water treatment shall be conducted for intake water and waste water.

b. Washing waste water from water treatment facility

The existing power plant uses intake water from Zerafshan River for the boiler feed water after treatment, and washing wastewater to maintain this treatment facility has exceeded the wastewater standard of Uzbekistan.

Initially, there is requirement for using public water of Navoi City treated with the new water demineralizer for the boiler feed water. However, Uzbekenergo require use Zerafshan River water.

So, a water treatment system with higher performance than the existing one will be introduced to achieve reduction of contaminant.

72.5ｍ^3/h of washing waste water is regularly generated for the maintenance of the water treatment system, whereas the washing waste water used for Unit 3 and 8 is 85m^3/h, considering the power output of Unit 3 and 8 being 310MW, the total power output of the existing power plant being 1,250MW and washing wastewater for the whole power plant being 344m^3/h. Therefore, discharging amount of the washing waste water will be reduced by 10m^3/h.

In this project, thermal water used for heating of the local area and steam for local factories will be needed, and the same water treatment facility will be used; however, the amount of heat supply will not change as a whole before and after this project, washing wastewater will also not increase.

c. Domestic waste water

Domestic wastewater generated by the project will be discharged into the public sewage line and not into Zerafshan River.

d. Oily waste water

Storm water containing oil will be generated 19m3/ｈ at the maximum and treated by oil-separating system before being discharged. The total effluent will be reduced due to shutdown of Unit 3 and 8.

As described above, it is not expected that the waste water discharge into Zerafshan River will degraded water quality of Zerafshan River.

Washing wastewater, blow-down from the cooling tower and oily effluent will be appropriately treated by installing a new water treatment system （Treatment Capacity :＞ 340 m^3/h） and discharged through the existing water outlet.

Wastewater is mixed with other effluent at the outlet, and water quality at the outlet of the treatment facility shall be monitored to confirm the compliance to the effluent standard of Uzbekistan and IFC/WB.

e. Water intake from Zerafshan River

560m^3/h of water will be taken as make-up water for cooling tower will be taken. The reduction of intake water due to the shutdown of Unit 3 and 8 is 28,000m^3/h. The table below shows the amount of intake water and make up water for cooling tower both before and after this project. The total amount of intake water after this project will be about 66% with the reduction of about 27,440m^3/h.

	Before this project	After this project
The amount of Cooling water (m^3/h)	78,000	50,000
The amount of make up water for cooling tower (m^3/h)	1,750	2,310
Total	79,750	52,310

3) Noise

a. Construction phase

Quantitative noise prediction during construction phase is not conducted in EIA for CCCGP No.2. Since the residential area is located close by, prediction was conducted during this survey mission and environmental impact is confirmed.

Noise level caused by operation of construction equipment was estimated.
The nearest residence, excluding houses to be relocated, is located 300m west and south of the project site, and 400m radius including those houses is set as the prediction area.

【Theoretical Formula】

Noise level has been estimated from noise data of respective construction equipment according to the following theoretical formula.

$$L_{PA} = L_{WA} - 20\log_{10} r - 8 - A_\gamma - A_E$$

[Symbol]

L_{PA}: Noise level at the estimation point (dB)
L_{WA}: A-characteristic correction power level at noise source (dB)
r: Distance from noise source to estimation point
A_γ: Amount of attenuation by partition wall (dB)
A_E: Amount of attenuation by air suction (dB)

【Data of noise source】

The major construction machinery used in the construction work includes a dump truck, bulldozer and back hoe for excavation, a hydraulic hammer used for pile driving, a truck crane for transportation of the equipment and material, and a mixer for producing concrete. Table 8.4.1-6 shows the noise level of the construction machinery and the number of machines.

Table 8.4.1-6 Noise level of major construction machinery

Machine type	Scale	Noise source level (dB)	Number of machines
Truck crane	50t	116	4
Dump truck	11t	113	4
Back hoe	0.6m^3	110	2
Bulldozer	11t	99	1

Machine type	Scale	Noise source level (dB)	Number of machines
Hydraulic hammer	4.5t	95	2
Concrete pumping car	65～85m^3/h	113	2
Concrete mixer	4.5 m^3	105	4
Air compressor	10.5～11.0m^3/min	105	5

【Calculation conditions】

All the aforementioned machines are assumed to be operating simultaneously.

In actual practice, excavation and pile driving work are performed sequentially according to the work schedule, so simultaneous operation of all the aforementioned machines is not frequent.

【Prediction result】

Figure 8.4.1-5 shows the distribution of noise levels for each estimation point during the operation of the construction machinery.

The noise level resulting from the operation of the construction machinery is slightly over 55dB at 300m from the boundary of the site, and below 55 dB at 400m from the boundary, which meets daytime environmental standard of the Uzbekistan and IFC/WB guidelines, but exceeds the nighttime standard of 45dB.

In the actual construction work, the schedule management will be performed to ensure leveling of the amount of construction work wherever possible, and the state-of-the-art low-noise equipment will be introduced. Thus, efforts will be made to minimize the noise impact.

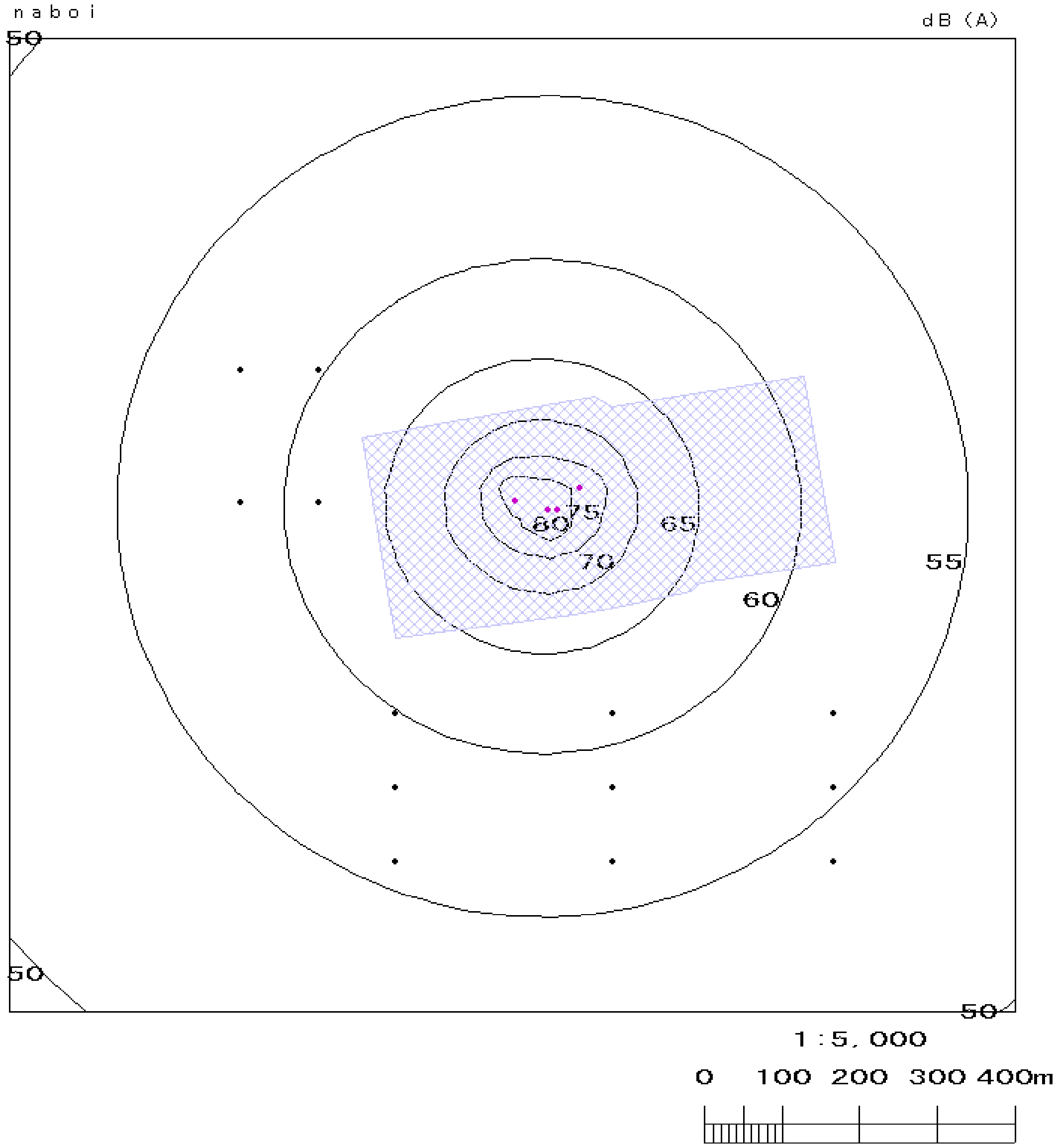


Figure 8.4.1-5 Distribution of noise levels during construction phase

b. Operation phase

Quantitative noise prediction during operation phase is not conducted in EIA for CCCGP No.2. Since the residential area is located close by, prediction was conducted during this survey mission and environmental impact is confirmed.

Noise level was simulated according to the same theoretical formula as in case of construction phase.
Likewise, the extent of prediction area is set to 400m radius from the project site.

【Data of noise source】

The major machinery of noise source in operation phase includes turbine, pumps, air compressors, and cooling towers at CCCGP No1 and CCCGP No.2
The noise level of power generation facility calculated from CCCGP project in Japan is described in Table 8.4.1-7.

Table 8.4.1-7 Noise level of power generation facility (CCCGP No1 and No.2)

Machine type	Noise source level(dB)	Octave band (Hz)							
		63	125	250	500	1000	2000	4000	8000
HRSG	75.0	73.7	51.3	59.3	57.4	59.8	62.5	66.2	47.6
Water supply pump	91.6	71.0	77.0	87.0	88.0	80.0	79.0	78.0	73.0
Cooling tower fan	85.0	68	70	78	78	80	75	75	70.00
Stack	80.4	76.4	76.7	70.5	68.2	60.8	53.5	52.1	55.9
Circulation water pump	98.9	85	85	88	91	94	92	89	86
Gas turbine	80.3	52.2	63.5	69	69.5	74.2	76	73.3	55.3
Steam turbine	80.0	48	52.2	72	73.1	75.1	74.8	62.2	49.5
Gas compressor	99.3	75.5	85.5	91.5	92.5	94.5	92.5	85.5	76.5
Condensate pump	90.4	49.2	63	72.4	80.8	86	85.8	81.7	73.9

Note:

1. Noise source level is calculated from A-characteristic correction power level at 1m from noise source.
2. Calculation under the condition that gas turbine and steam turbine are equipped with a cover.

【Prediction result】

Figure 8.4.1-6 shows the distribution of noise levels from CCCGP No1 and CCCGP No.2 during the operation phase of CCCGP No.2. The noise level is below 55dB at 300m from the boundary of the site, and 50 dB at 400m from the boundary, which meets daytime environmental standard of the Uzbekistan and IFC/WB guidelines. The nighttime noise standard, however, is not satisfied, and introduction of further mitigation measures such as low-noise type equipment, tree-planting on the boundary of the site, installation of soundproof wall, and monitoring will be necessary.

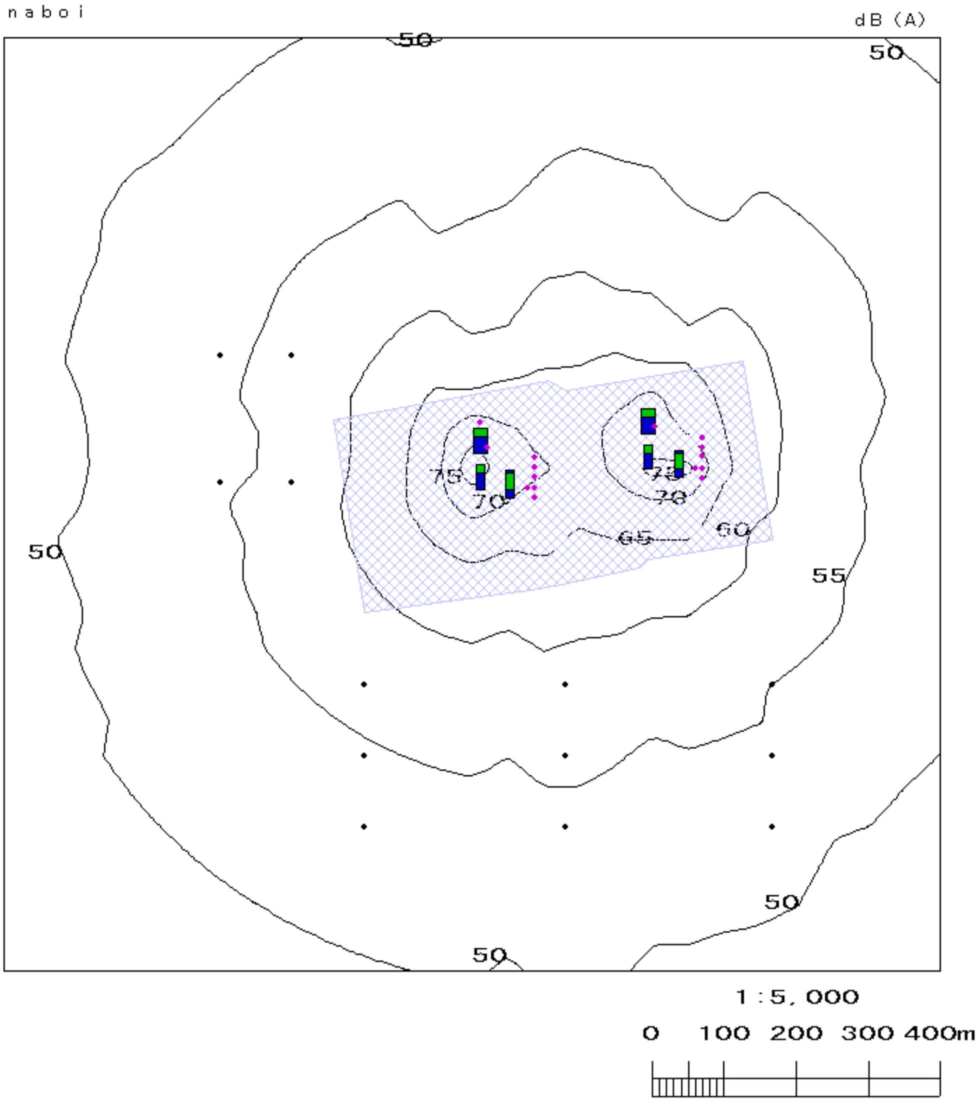


Figure 8.4.1-6 Distribution of noise levels during operation phase

3) Vibration

a. Construction phase

Quantitative vibration prediction during construction phase is not conducted in EIA for CCCGP No.2. Since the residential area is located close by, prediction was conducted during this survey mission and environmental impact is confirmed.

The major construction machinery used in the construction work includes a dump truck, bulldozer and back hoe for excavation, a hydraulic hammer used for pile driving, a truck crane for transportation of the equipment and material, and a mixer for producing concrete. Table 8.4.1-8 shows the vibration level of the construction machinery at different distance in the example of CCCGP project in Japan. Vibration level at the residential area 300m from the plant site is below 40dB which is very low.

Table 8.4.1-8 Vibration level of construction power plant machinery

Machine type	Scale	Vibration level by distance (dB)			
		5m	100m	200m	300m
Truck crane (hydraulic)	50t	69	47	36	25
Dump truck	11t	69	47	36	25
Back hoe	0.6m^3	80	59	47	37
Bulldozer	11t	75	64	53	42
Hydraulic hammer	4.5t	80	59	47	37

b. Operation phase

Quantitative vibration prediction during operation phase is not conducted in EIA for CCCGP No.2. Since the residential area is located close by, prediction was conducted during this survey mission and environmental impact is confirmed.

Machinery of vibration sources in the power plant is basically installed on a strong foundation, and therefore vibration level attenuates with distance.
Table 8.4.1-9 describes the vibration level of a circular water pump, a gas turbine, a steam turbine and a gas compressor by distance from the example of CCCGP project in Japan. Vibration level at the residential area 300m from the project site is 30dB, a sufficiently low level.

Table 8.4.1-9 Vibration level of power plant machinery

Machine type	Vibration level by distance (dB)		
	1m	100m	300m
Circulation water pump	67	38	16
Gas turbine	80	51	29
Steam turbine	74	45	23
Gas compressor	58	29	2

8.4.2 Environmental assessment

The environmental impact assessment according to the result of the survey is described in Table 8.4.2-1. Refer to the environmental checklist for more details.

Table 8.4.2-1 Result of the environmental assessment

No.	Items	Assessment at the scoping				Assessment based survey results				Reason for assessment (blue figure: construction period only)
		Construction period		Operation period		Construction period		Operation period		
		Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	
【Pollution】										
1	Air pollution	N	A	B	A	N	A	B+	B-	- Temporary emission of air pollutants (Sox, NOx, etc) from heavy machines and vehicles and flying dust may occur, and a residential area is nearby. - Fuel low-sulfur gas is used and very little SO_2 and soot is generated from the gas turbine, but NO_2 is emitted. - The old power plants will be shut down and total NO_2. emission of the power plant will be reduced. - Maximum ground concentration of NO_2 will also be improved by the stoppage of the existing facility.
2	Water pollution	N	A	B	A	N	A	B+	B-	- Muddy water after rain, domestic wastewater generated by workers is temporarily generated. - Forced draft cooling tower cooling system will be adopted, and large amount of thermal waste water discharge is not predicted. - Decommission of Unit 3 and 8 will also diminish the thermal waste water. - Cooling tower blow-down and washing wastewater from water demineralizer will be generated. - Washing waste water from the existing water demineralizer will be reduced as a result of stoppage of Unit 3 and 8. - Domestic wastewater generated by the project will be discharged into the public sewage line
3	Waste	N	B	B	B	N	B	B	B	- Domestic waste, waste oil, waste material will be generated. - Waste oil from the equipment and oil-separating system of the waste-water treatment system and sludge from the precipitation system of the waste-water treatment system will be generated, but will be diminished after decommissioning of the existing Unit 3 and 8. - As river water, not public water, will be used for boiler feed water and make-up water for cooling tower, sludge will be generated from the water treatment system.

No.	Items	Assessment at the scoping				Assessment based survey results				Reason for assessment (blue figure: construction period only)
		Construction period		Operation period		Construction period		Operation period		
		Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	
										- Domestic waste is generated from the project establishment.
4	Noise/vibretion	N	A	N	A	N	A	N	A	- Temporary noise from the construction machines and vehicles will be generated. There is a residential area nearby. Noise standard for daytime will be met, but nighttime will not be met. - Noise from cooling tower fan, turbine, pumps is predicted. Residential area is nearby. Noise standard for daytime will be met, but nighttime will not be met.
5	Subsidence	N	N	N	N	N	N	N	N	- No pumping of ground water.
6	Odor	N	N	N	N	N	N	N	N	- Materials generating bad smell will not be used during construction and operation phase.
【Natural environment】										
1	River water	N	N	B	N	N	N	B+	B-	- No pumping of river water. -- Decommission of Unit 3 and 8 will also diminish the intake of river. - River water, not public water, will be used for boiler feed water and make-up water for cooling tower, but may be diminished after stoppage of the existing facilities. . .
2	ground water	N	N	N	N	N	N	N	N	- No pumping of ground water.
3	Protected area	N	N	N	N	N	N	N	N	- The project site does not include protected area.
4	Terretrial ecosystem	N	B	N	B	N	B	B	B	- Air pollution and noise during construction may have temporary impact on terrestrial organisms. - Air pollution and noise/vibration resulting from power generation will cause negative effect to terrestrial organisms. - Air pollution will be mitigated by shutdown of the existing power plant. - The project site is adjacent to the residential area and the power plant already under influence of human activity.
5	River ecosystem	N	B	B	B	N	B	B+	B-	- Water turbidity caused by construction work may have temporary impact on river organisms. - Forced draft cooling tower cooling system will be adopted, and large amount of thermal waste water discharge is not predicted. - Decommission of Unit 3 and 8 will also diminish the thermal waste water.

No.	Items	Assessment at the scoping				Assessment based survey results				Reason for assessment (blue figure: construction period only)
		Construction period		Operation period		Construction period		Operation period		
		Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	
										- Cooling tower blow-down and washing wastewater from water demineralizer will be generated. - Washing waste water from the existing water demineralizer will be reduced as a result of stoppage of Unit 3 and 8. - Domestic wastewater generated by the project will be discharged into the public sewage line - Decommission of Unit 3 and 8 will also diminish the intake of river. - River water, not public water, will be used for boiler feed water and make-up water for cooling tower, but may be diminished after stopping of the existing facilities.
6	Precious species	N	B	N	B	N	B	B	B	- The project site is adjacent to the residential area and the power plant already under influence of human activity. - No existence of precious species in the project site and presence of four species in Zerafshan river are reported - Same effect above river Ecosystem.
【Social environment】										
1	resettlement	A	A	A	A	N	A	N	A	Land acquisition of 22ha for construction of transmission line and road will result in resettlement of 33 households.
2	Employment and livelihood	B	B	B	B	B	B	B	B	- The new employment and new business in the local area may increase the income of the local people in the surrounding area. - The number of workers employed from local resident will be about 450 persons in construction and 50 persons in operation - Income gap between the project workers and the local people may occur.
3	Local society	B	B	B	B	B	B	B	B	- Increased employment and new business will enhance the development of the local economy. - Access roads had already been constructed. .-Provide dormitories, recreation room, medical points during construction - In nearby Navoi City, hospitals and other social infrastructure are fully available. - During construction and operation, the workers will have a medical examination ・Nearly national road is wide and traffic volume is not so large

No.	Items	Assessment at the scoping				Assessment based survey results				Reason for assessment (blue figure: construction period only)
		Construction period		Operation period		Construction period		Operation period		
		Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	
										- Construction work will cause increased traffic in the road in the surrounding area, which may cause increased risk of traffic accident. - Increased traffic may damage the road in the surrounding area.
4	Cultural heritage	N	N	N	N	N	N	N	N	- No archeological, historical, cultural, and religious heritage site exists within the site.
5	Landscape	N	N	N	N	N	N	N	N	- The project site is adjacent to the residential area and the power plant with much human activity and is not a significant landscape area.
6	Minorities	N	N	N	N	N	N	N	N	- The project site is adjacent to the residential area and the power plant with much human activity and not an area for minorities to live in groups.
7	Labor environment	N	B	N	B	N	B	N	B	- The utility will implement the project in accordance with the labor law of the country and make a Safety Hygiene plan. - The utility will provide protective glasses, mufflers, earplugs, and other protective tools for workers - The utility will subcontract a security firm to deploy security guards.
【Others】										
1	Global warming	N	B	B	N	N	B	B	B	- Temporary emission of co2 from heavy construction equipment and vehicles. - CO_2 will be generated by fuel combustion - The reduction of CO_2 emission concerning this project compared with an average power generation facility in Uzbekistan is more than 684,150 tons per year.

Notes: The categorization criteria is as follows.
A: causes serious impact.
B: causes certain degree of impact.
N: No impact.

This project contains the construction of a newly built power plant as well as shut-down and demolition of the existing power plant. Therefore, in case that the degree of positive and negative impacts are similar to each other, both are to be rated as “B”, and in case that either positive or negative impacts is higher than the other, rating of “B+” is to be given to the higher impact one and “B-” is given to the lower impact one.

8.5 Comparison of alternatives including zero-option

8.5.1 Consideration of the zero option

In the case where CCCGP No.2 is not constructed and the existing old-type power plants (Unit 3 and Unit 8) continue operation, the air quality around the plant area will remain in a bad condition, the reliability of the facility will decrease, and the risk of accident will increase.

8.5.2 Consideration of the alternative project site

In the EIA, the north end of the existing power plant site is considered as an alternative site for constructing CCCGP No.2 (Figure 8.5.2-1).
However, further consideration of this plan was called off for by the reasons described in the table below.
The current proposed site facing the west of CCCGP No.1, even though resettlement of 33 households is predicted, is considered the most favorable alternative.

Table 8.5.2-1 Comparison of the alternative site

Item	The north end of the existing power plant site（Site A）	The site facing west of CCCGP No1 (proposed site) （SiteB）
Technics	-Construction of gas supply facility is necessary within the operating plant site and the construction activity involves high risk.	-New site and low risk for construction of gas supply facility.
Topology	-Not enough space for construction activity. -Not enough space for constructing a storage facility.	-Enough space for construction activity. -Enough space for constructing a storage facility.
Resettlement	-Destruction and resettlement of the existing 200 living houses and 400 summer house within the site is predicted.	-There are no houses within the site and no resettlement is predicted. -There are 23 houses and bases of 10 houses with in Transmission line.

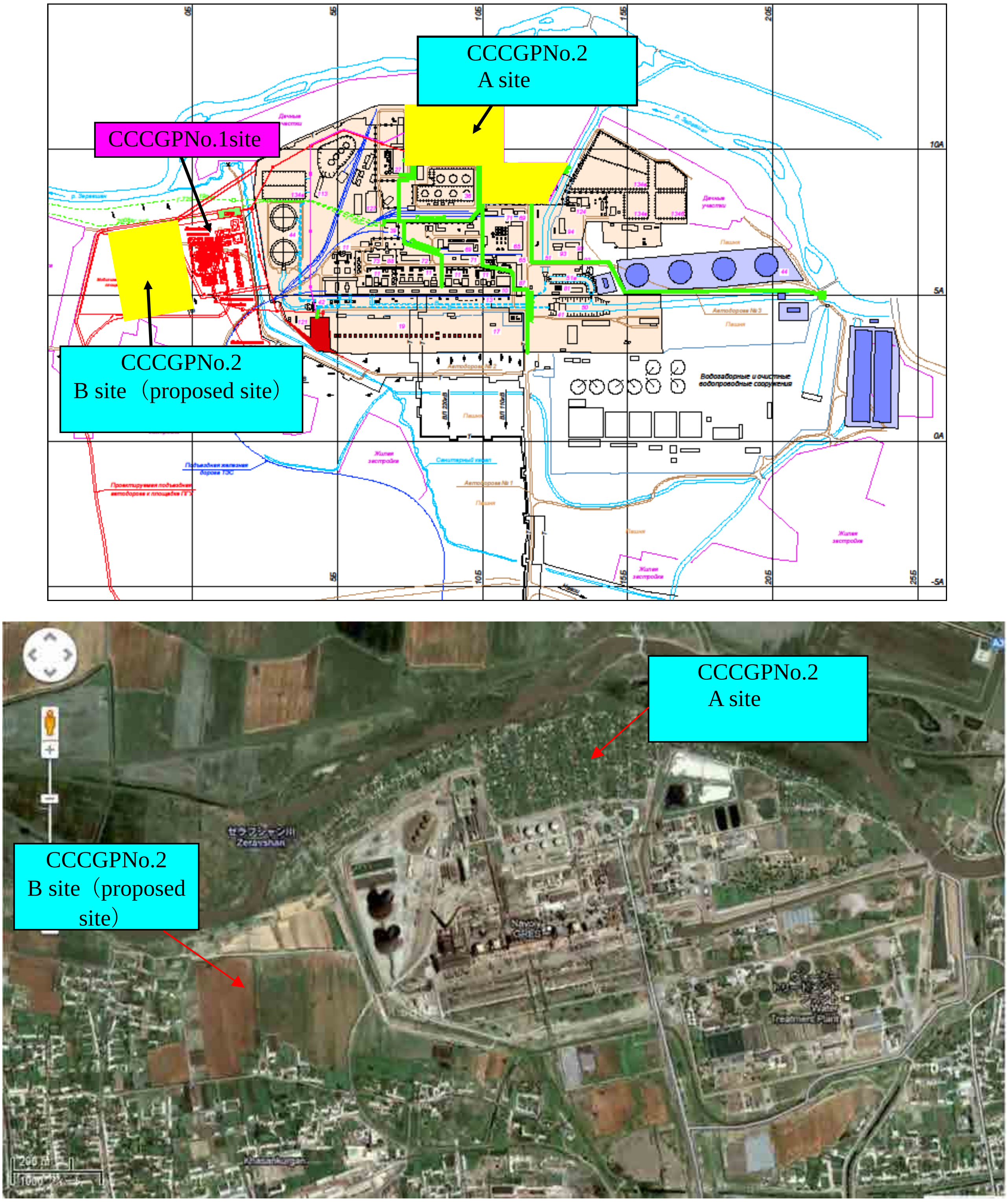
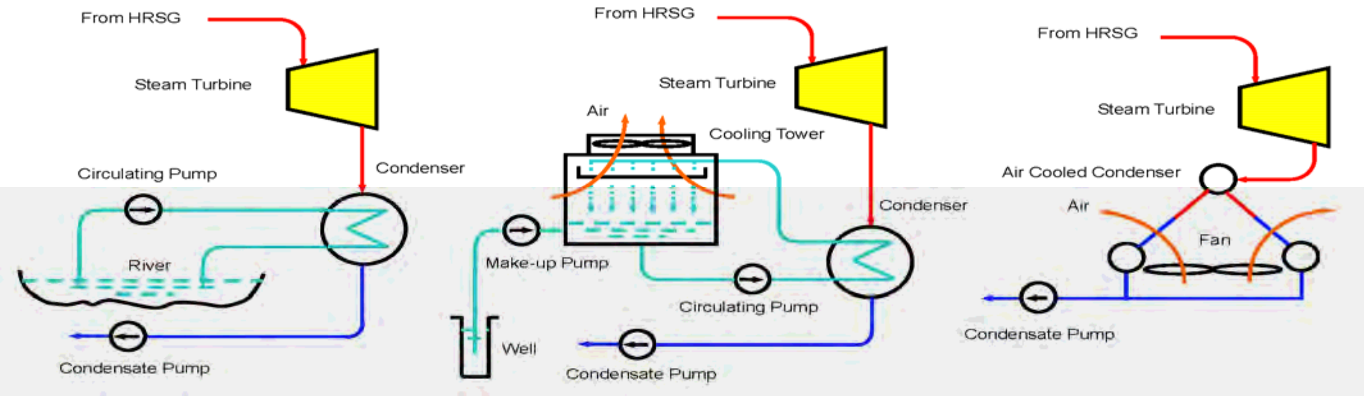


Figure 8.2.5-1 Location of Alternative project site A and B

8.5.3 Consideration of cooling system for the condenser

While the condensers in the existing power plants, except Unit 11 and 12, adopt one-through system, either forced draft cooling tower system or forced draft air cooling system will be adopted in the CCCGPNo.2 power plant.
The comparison of the above cooling systems is described below.



One-through type

Forced ventilation

Forced ventilation

Figure 8.5.3-1 Outline of the major condenser cooling system

The result of the consideration is shown in Table 8.5.3-1. The use of air-cooling system has no actual achievement in the past in Uzbekistan, and in conclusion the forced-draft cooling-tower cited in the EIA was adopted.

Table 8.5.3-1 Comparison of the cooling system

Items	**Forced-draft cooling tower system**	Forced draft air cooling system
Installation expense	Lower cost than the air-cooling system. **(17.5 million $)**	Higher cost than the air-cooling system (21.2 million $)
Water quality management	Water quality management of the utility water is necessary.	**Utility water is not necessary.**
Installation space	**Smaller than air cooling system** **(2,080m^2)**	Larger than cooling tower system (4,800m^2)
Heat efficiency	**Slightly higher than air cooling system**	Slightly lower than cooling tower system
Effluent	Blow-down is generated (240m^3/h)	**No effluent is generated.**
Noise	Noise is generated: 85dB	Generated: 85dB
Actual performance in Uzbekistan	**Practically used in CCCGP No.1 etc.**	No practical performance

Note: bold letter: advantage

8.6 Environmental management plan (mitigation measures)

8.6.1 Environmental management plan during construction phase

1) Implementation system

At the construction phase, the PIU of the SJSC Uzbekenergo and Navoi Power Plant shall carefully consider the construction activity with supervision consultant and encourage the EPC contractor to well understand the necessary mitigation measures and to implement them.

In this regard, an environmental management unit shall be organized prior to the construction activity and an expert environmental management administrator shall be placed. The unit will discuss and prepare the mitigation measures with supervision consultant and the EPC contractor prior to the construction activity.

During construction activity in which large inflow of workers and vehicles is predicted, the environmental management unit shall cooperate with Navoi power plant in promoting the understanding of the surrounding community about the contents and schedule of the construction activity and mitigation measures, collecting the local people’s opinion and correcting the mitigation measures as appropriate.

In order to confirm the implementation of the environmental management and to consider further mitigation measures, the EPC contractor should submit a regular report to the Supervision consultant and environmental management unit on the implementation status of the management plan.

The environmental management administrator shall regularly conduct explanation to the local people and submit a report to the State Committee for Nature Protection, JICA and other relevant organizations about the implementation status of the environmental management, in addition to the environmental monitoring described hereinafter.

Figure 8.6.1-1 describes the environmental management and monitoring implementation structure with the reporting flow in construction phase.

2) Mitigation measures

The major environmental impact, mitigation measures, responsible organization, and expense for each environmental item in construction phase is listed in Table 8.6.1-1.

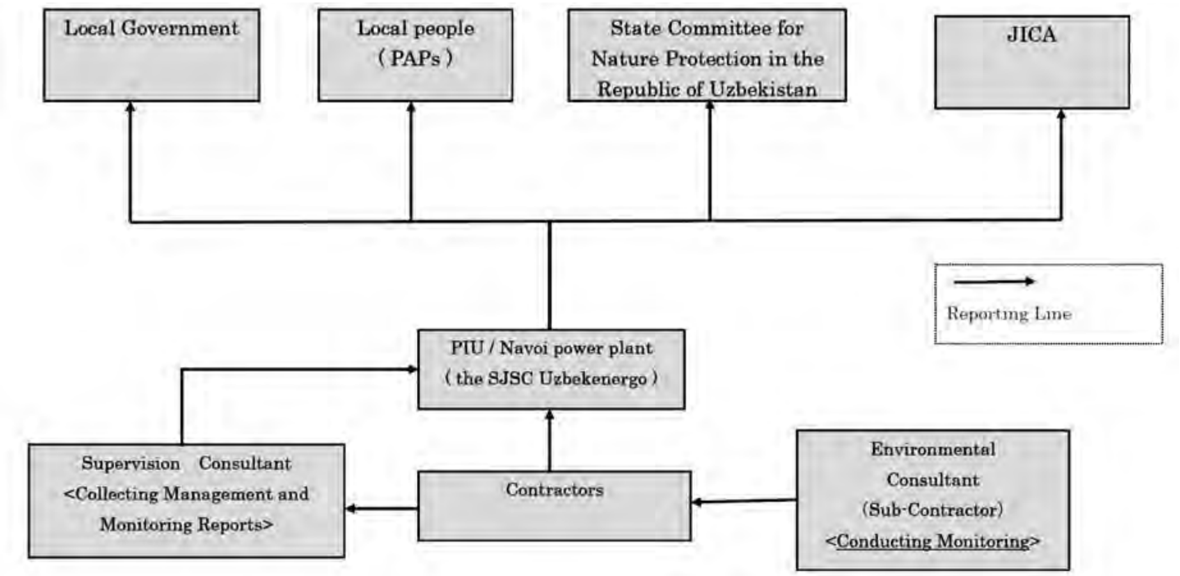


Figure 8.6.1-1 Environmental Management and Monitoring Implementation Structure in Construction Phase

Table 8.6.1-1 Major environmental impact during construction phase and mitigation measures

Items	Potential impact	Mitigation measures	Frequency	Responsible organization	Expense
Air pollution	Temporary emission of air pollutants (Sox, NOx, etc) from heavy machines and vehicles and flying dust may occur.	- Periodic check up and maintenance of vehicles. - Shutdown of engine during waiting time. - The rear deck of the sand-transport trucks shall be covered. Periodic car wash. - Periodic car wash - Periodic watering of the site and surrounding road in case of strong wind. - Monitoring of ambient air in the residential area compared to the standard of Uzbekistan and IFC/WB EHS guidelines.	continuously	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor. Watering equipment cost.
Water pollution	Muddy water after rain, domestic wastewater generated by workers is temporarily generated.	- Installation of temporary rainwater drainage. - Installation of temporary sedimentation pond and oil-separating system - Storage of waste oil and chemical materials in a storage site and method to prevent permeation into ground. - Installation of septic tank and temporary toilet. - Monitoring of river water quality compared to the standard of Uzbekistan	continuously	- Implementation: EPC Contractor/ Environmental Consultant -Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor. -Installation cost of rain drainage and sedimentation pond - Installation cost of oil-separating system - Installation cost of temporary toilet
Waste	Domestic waste, waste oil, waste material will be generated.	- Development of waste management program including education of workers to encourage reduction and reuse of waste. - Prohibition of illegal dumping. - Separation of waste by waste type, storage in an appropriate storage site and legal disposal in an appropriate disposal site.	continuously	- Implementation: EPC Contractor -Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor. - Installation of waste separation cases - Contract cost with waste disposal company
Noise and vibration	Temporary noise from the construction machines and vehicles will be generated.	- Periodic check up and maintenance of vehicles. - Construction activity and traffic of vehicles is essentially limited to daytime. - Use low-noise/vibration type equipment - Temporary soundproof wall around the project site. - Monitoring of Noise level at site boundary and the residential area compared to the standard of Uzbekistan and IFC/WB EHS guidelines.	continuously	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor. -Installation cost of soundproof wall.

Items	Potential impact	Mitigation measures	Frequency	Responsible organization	Expense
Terrestrial ecosystem	Air pollution, noise and vibration may be generated during construction.	- Implementation of mitigation measures for air pollution, noise and vibration.	continuously	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
River ecosystem	Water turbidity caused by construction work.	- Implementation of mitigation measure for water pollution		- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
Resettlement	Land acquisition of 22ha for construction of transmission line and road will result in resettlement of 33 households.	- Development of livelihood restoration measure with appropriate compensation and support. - Monitoring of the local residents shall be conducted. - Establishment of grievance system.	continuously	District administration / Navoi Thermal power plant	Expense is to be paid by Uzbekenergo
Employment and livelihood	Income gap between the project workers and the local people may occur.	- Priority in employment of local people, especially project-affected people. - Provision of job training for employment	continuously	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
Local society	-Influx of workers may generate infectious disease, HIV, conflict with local people. -Influx of workers and their family may require establishment of social infrastructure such as medical facility, schools, road, sewage line, etc. -Increase of traffic and damage of the	- Development of safety and sanitation management plan and implementation of regular medical checkup. -The workers will have a medical examination every year - Development of necessary infrastructures for the contractor's mobilization area according to the EPC contract. - Slowdown of vehicles in the residential and school area. - Traffic of construction vehicles during school commuting hours shall be avoided. - Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, klaxon).	continuously	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor. - Installation cost of traffic signal and signs. - Repair cost of roads.

Items	Potential impact	Mitigation measures	Frequency	Responsible organization	Expense
	road in the surrounding area.				
Labor environment	- There is a risk of labor accident of workers. - There is a risk that security agents threaten the security of the local people.	- Development of safety and sanitation management plan and implementation of regular medical checkup. - Restriction of long-time exposure to noise for workers. - Personal protective gear shall be used. - Construction of medical facility on the working site with nurse. - Establishment of cooperative relationship with the local medical facilities.	continuously	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
Global warming	Temporary emission of CO_2 from heavy machines and vehicles.	-Rationalization of construction schedule: minimization of heavy machine operation and material transportation.	Before starting construction activity	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.

8.6.2 Environmental management plan during operation phase

1) Implementation system

Navoi power plant is responsible for organizing an environmental management unit to develop and implement the environmental management plan as a mitigation measures.

An expert environmental management administrator shall be placed so that the environmental management plan is appropriately implemented.
The environmental management administrator shall enhance the understanding of the environmental management plan to the project staff prior to the operation, and continue regular education of the staff during operation phase.

The environmental management unit shall also function as a grievance organization to understand and address the grievance from the local people during operation phase, and conduct appropriate mitigation measures.

Basic policy of the environmental management plan is to coordinate with the local community, and sufficient explanation of the positive mitigation measures for the local people is very important. Inviting the local residents and school children to a visiting tour of the high-technology power station in the future may be useful.

The administrator shall report the contents and implementation status of the environmental management plan and the environmental monitoring plan described below to the director of the plant, with the director taking final responsibility.

The environmental management administrator shall regularly conduct explanation to the local people and submit a report to the State Committee for Nature Protection, JICA and other relevant organizations about the implementation status of the environmental management, in addition to the environmental monitoring described hereinafter.

Figure 8.6.2-1 describes the environmental management and monitoring implementation structure with the reporting flow in operation phase.

2) Mitigation measures

The major environmental impact, mitigation measures, responsible organization, and expense for each environmental item in operation phase are listed in Table 8.6.2-1.

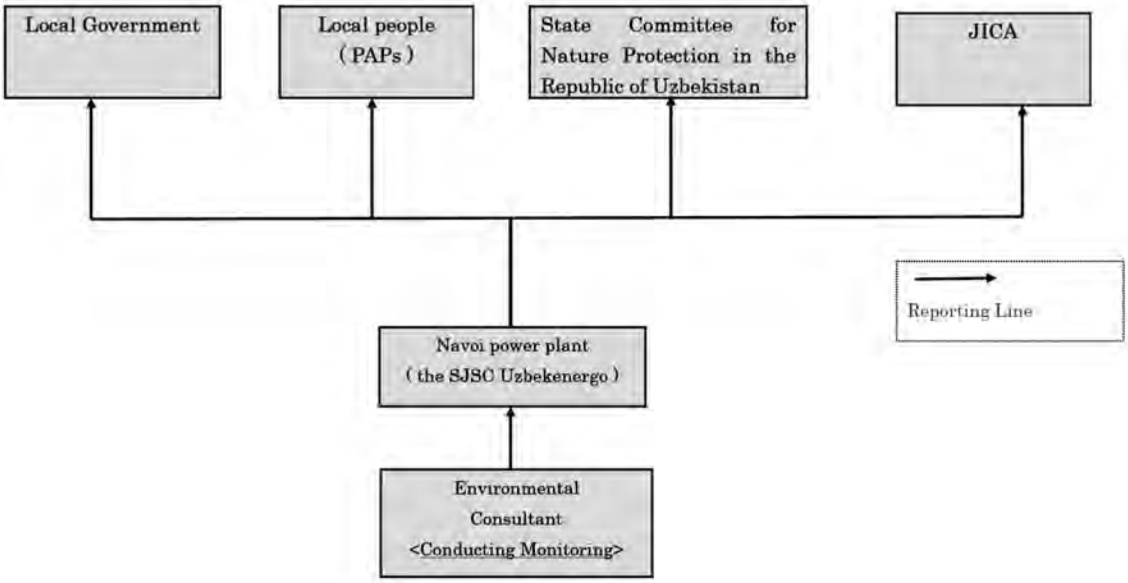


Figure 8.6.2-1 Environmental Management and Monitoring Implementation Structure in Operation Phase

Table 8.6.2-1 Major environmental impact during operation phase and mitigation measures

Items	Potential impact	Mitigation measures	Frequency	Responsible organization	Expense
Air pollution	Very little SO_2 and soot is generated from the gas turbine, but NO_2 and other NOx is emitted.	- Use of natural gas - Introduction of low NOx combustion appliances - Use of high stack - Gas emission with high speed (reducing the chance of emission gas blowing downward caused by high wind speed, which is called down-wash phenomenon) -Not constructing high building downstream of the wind direction from the stack location. (reducing the chance of emission gas blowing downward caused by high building, which is called down draft phenomenon - Monitoring of exhaust gas and ambient air in the residential area compared to the standard of Uzbekistan and IFC/WB EHS guidelines.	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
Water pollution	Cooling tower blow-down and washing wastewater from water demineralizer will be generated.	- Installation of water treatment facility. - Drain system will be introduced to gather oily rain water. - Monitoring of waste water and river water compared to the standard of Uzbekistan and IFC/WB EHS guidelines.	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
Waste	Waste oil, sludge, domestic waste will be generated.	- Development of waste management program including education of workers to encourage reduction and reuse of waste. - Prohibition of illegal dumping. - Return waste oil to the suppliers to treat it appropriately. - Separation of waste by hazard level, storage in an appropriate sites and legal disposal in an appropriate disposal site.	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
Noise and vibration	Noise from cooling tower fan, turbine and pumps is predicted.	- Use low-noise equipment. - Use of GT enclosure, GT intake silencer, louver for cooling tower, turbine building、 - Use of low-vibration equipment - Construction of buildings with strong foundation. - Regular maintenance of the equipment. - Tree-planting and installation of sound proof wall around the project site if needed.	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant

Items	Potential impact	Mitigation measures	Frequency	Responsible organization	Expense
		- Monitoring of Noise level at site boundary and the residential area compared to the standard of Uzbekistan and IFC/WB EHS guidelines.			
Terretrial ecosystem	Air pollution and noise/vibration resulting from power generation will cause negative effect to terrestrial organisms.	Implementation of mitigation measure for air pollution, noise/vibration.	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
River ecosystem	Water turbidity may be caused by power generation activity.	- Water pollution mitigation measures shall be conducted.		Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
resettlement	Land acquisition of 22ha for construction of transmission line and road will result in resettlement of 33 households.	- Development of livelihood restoration measure with appropriate compensation and support. - Monitoring of the local residents shall be conducted. - Establishment of grievance system.	continuously	District / Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
Employment and livelihood	Income gap between the project workers and the local people may occur.	- Priority in employment of local people, especially project-affected people. - Provision of job training for employment	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
Local society	- Influx of workers may generate infectious disease, HIV, conflict with local people. - Influx of workers and their family may require establishment of social infrastructure such as medical	- Development of safety and sanitation management plan and implementation of regular medical checkup. - Slowdown of vehicles in the residential and school area. - Traffic of vehicles during school commuting hours shall be avoided. - Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, klaxon).	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant

Items	Potential impact	Mitigation measures	Frequency	Responsible organization	Expense
	facility, schools, road, sewage line, etc. - Increase of traffic and damage of the road in the surrounding area.				
Labor environment	- There is a risk of labor accident of workers. - There is a risk that security agents threaten the security of the local people	- Development of safety and sanitation management plan and implementation of regular medical checkup. - Restriction of long-time exposure to noise for workers. - Personal protective gear shall be used. - Establishment of cooperative relationship with the local medical facilities. - Development of gas-leakage prevention management plan. - Gas-leakage alarm system - Installation of stationary fire prevention system, fire hydrant, fire extinguisher, fire escape exit, fire alarm, fireproof compartment, emergency exit, etc. - Installation of automatic control system.	continuously	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant
Global warming	Yearly CO2 emission will be reduced compared to an average power plant in Uzbekistan.	- Adoption of high-efficiency combined cycle power generation system and maintenance of capacity of the facility.	Prior to the construction.	Navoi Thermal Power Plant	Uzbekenergo/ Navoi Thermal Power Plant

8.7 Environmental monitoring plan

The details of the environmental monitoring plan during construction and operation phase is shown in Table 8.7-1, and the overview is described below. Environmental management and monitoring implementation structure with the reporting flow is described in Chapter 8.6.

8.7.1 Construction phase

1) Air quality monitoring
NOx（NO, NO_2） and Suspended particles (dust) are used as parameters.
The Monitoring location is a residential area in the vicinity. Monitoring of schools, hospitals and other environmentally sensitive sites may also be considered.

2) Noise monitoring
Noise level is used as a parameter.
The monitoring location is the boundary of the power plant site and the residential area in the vicinity. Monitoring of schools, hospitals and other environmentally sensitive sites may also be considered.

3) River water quality monitoring
TSS, pH, Oil & grease are used as parameters.
The monitoring location is the point in Zerafshan River around the outlet of wastewater from temporary sedimentation pond.

4) Waste
Waste management practice in storage and disposal are used as parameter.
The monitoring location is project site and camp and service facility for worker.

8.7.2 Operation phase

1) Exhaust Gas emission monitoring
NOx (NO, NO_2) is used as a parameter.
The monitoring point is gas ducts

2) Wastewater monitoring
Measurement parameter shall be based on the Uzbekistan regulations and IFC EHS Guidelines Thermal power plant (2008).
The monitoring points are the outlet of the wastewater treatment system for cooling tower blow-down and reclaimed waste water from the water demineralizer.

3) Air quality monitoring
NOx (NO, NO_2) is used as a parameter.
The monitoring points are essentially the existing monitoring points. Monitoring of schools, hospitals and other environmentally sensitive sites may also be considered.

4) Noise monitoring
Noise level is used as a parameter.
The monitoring points are essentially the project site boundary and the residential area in the vicinity. Monitoring of schools, hospitals and other environmentally sensitive sites may also be considered.

5) River water quality monitoring

Measurement parameter shall be based on the Uzbekistan regulations

The monitoring location is the point in Zerafshan River around the existing outlet of wastewater.

6) Waste

Waste management practice in storage and disposal are used as parameter.

The monitoring location is project site.

Table 8.7-1 Items, location, method, frequency, responsibility and expense of the environmental monitoring plan

Classification	**Item**	Parameter	**Method**	**Location**	**Frequency**	**Responsibility**	Expense
Construction phase	Air quality	Nox (NO, NO_2), Suspended particles (Dust)	Automatic mobile ambient air quality analyzers	2 point: west and south residential area in the vicinity	- Quarterly - Once a week at the time	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/Navoi Thermal power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
	Noise	Noise level	Sound-level meter	2 point :project site west and south boundary 2 point:west and south residential area in the vicinity	- Quarterly - Once a week at the time	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/ Navoi Thermal power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
	River water quality	TSS, pH, Oil	- Analysis by sampling	2 point: in Zerafshan River, 100m upstream and 100m downstream of the outlet of waste water from temporary sedimentation pond.	- Quarterly	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/ Navoi Thermal power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
	Waste	Waste management practice in storage and disposal	- Contract and record	- Project site and camp and service facility for worker.	-Continuously	- Implementation: EPC Contractor -Supervisor: PIU/ Navoi Thermal power	Expense is included in EPC contract cost by

Classification	Item	Parameter	Method	Location	Frequency	Responsibility	Expense
						plant/Supervision Consultant	EPC Contractor.
	Grievances	Numbers, contents, and processing results of grievances	Record	Navoi Thermal Power Plant	-Continuously	Navoi Thermal Power Plant / Karamana Khokimiyat	Navoi Thermal Power Plant/PIU
Operation phase	Exhaust gas	NOx	Continuous. Emission Monitoring System(CEMS)	Gas duct	-Continuously	Navoi Thermal power plant	CEMS: Expense is included in EPC contract cost by EPC Contractor.
	Waste water	Temperature , pH, SS., Oil, DO, Nitrite, Nitrate, Sulfate, Chloride, Ca, Mg, Residual chlorine, Cr, Cu, Fe, Zn, Pb, Cd, Hg	- Analysis by sampling	Outlet of waste treatment facility	-Quarterly	Navoi Thermal power plant	Navoi Thermal power plant
	Air quality	NOx (NO, $NO_{2.}$）	- Automatic ambient air quality analyzer and recorder	1 point:west residential are 2km from site	-Quarterly - Once a week at the time	Navoi Thermal power plant or Environmental Consultant	Equipment 80,000$ （Consultant） 50,000$/year
	River Water quality	Temperature, pH, DO, BOD, SS, Oil, Ammonia, Nitrite, Nitrate, Sulfate, Phenol, Chloride,	- Analysis by sampling	2 point: in Zerafshan River, 100m upstream and 100m	- Quarterly	Navoi Thermal power plant	Navoi Thermal Power Plant

Classification	Item	Parameter	Method	Location	Frequency	Responsibility	Expense
		Ca, Na, K, Phosphate, Fe, Cu, Zn, Cr, Pb		downstream of the existing outlet of wastewater. (the current monitoring points)			
	Noise	Noise level	Sound-level meter	2 point :project site west and south boundary 2 point:west and south Residential area in the vicinity	Twice a year	Navoi Thermal power plant or Environmental Consultant	Navoi Thermal Power Plant
	Waste	Waste oil, sludge, domestic waste	Record	Storage sites	Twice a year	Navoi Thermal Power Plant	Navoi Thermal Power Plant
	Grievances	The numbers, contents, and processing results of grievances	Record	Navoi Thermal Power Plant	Everyday	Navoi Thermal Power Plant / Karamana Khokimiyat	Navoi Thermal Power Plant

8.8 Stakeholder meeting and others

8.8.1 EIA explanation meeting

The public consultation has been held on 10 January 2012. In this meeting, the explanation about the project component and the result of EIA has been given to the attendants. There was no record of questions or comments on the compensation or livelihood restoration plan posed from the attendants. However, the meetings regarding resettlements have been held several times (see 8.8.4) (EIA p.3, 6 Pre-Feasibility Study Appendix 7).
52 people attended this meeting. They were the representatives of the residents and the local village office in Yangiobod Village and Uyrot Village in Karmana District in Navoi area. The details of the 52 attendants are as follows (EIA Appendix 7).

Residents of Yangiobod Village: 20
Residents of Uyrot Village: 18 (including the village mayor)
OJSC Navoi TPS: 7
OJSC Teploelektroproekt: 4
Transcriber: 1
Independent: 2

All the attendants of the meeting showed agreement by Prepared Questionnaire to the project, and there was none against the project (EIA Appendix 7).
Main items of Questionnaire are as follows

1) Full Name
2) Address
3) How do you evaluate the environmental status in your residential district? :
   atmospheric air (good, satisfactory, bad)
   water (good, satisfactory, bad)
   vegetation (good, satisfactory, bad)
4) Do you think that the quality of the environment affects your and your children's health?
   (yes, no, don't know)
5) Do you know about the forthcoming construction of 450MW CCGT unit construction at Navoi TPS? (yes, no)
6) Do you know that environmental impact assessment of 450MW CCGT unit construction at Navoi TPS has been conducted? (yes, no)
7) Have you received information about the results of environmental impact assessment of 450MW CCGT unit construction at Navoi TPS has been conducted?
   (yes, no, if yes, when, where and from whom)
8) Do you expect any environmental improvement (atmospheric air, soil, vegetation) and better health after 450MW CCGT unit construction at Navoi TPS?
   (yes, no, don't know)
9) Do you expect any improvements in your life after 450MW CCGT unit construction at Navoi TPS? (yes, no, don't know)
10) Do you object to 450MW CCGT unit construction at Navoi TPS?
11) Your comments and wishes

The attendants did not reply most of the questions (No.3-10) of the Questionnaire but simply replied that they agreed to the project. It is assumed that the attendants did not have much environmental concern in principle, and if any, all the necessary clarifications and comments were made at the last part of the meeting.

Questions and comments	Answers from project owner
When will CCGT450MW be constructed and start operation? < Uyrot villager>	It is not officially determined yet. We hope to start as soon as possible.
Does CCGT operation make noise in my house? < Yangiobod villager>	According to the example of the existing power plant, noise level will be below the environmental standard.
Will CCGT be added to the existing power plant, or will it replace the old ones? < Chair of Uyrot village>	The existing power plant Unit 3 and 8 will be shut down after CCGT starts operation. These are more than 40 years old.
How old is the existing 2 boilers to be decommissioned? < Yangiobod villager>	
Why does CCGT cause less environmental impact compared to the existing units? <Chair of Yangiobod village>	Because CCGT has higher generation efficiency and less environmental impact.

8.8.2 Supplementary Interview with Affected People

Interview with the families in Uyrot and Yangiobod villages were conducted on 30 August 2012 to supplement stakeholder meetings held by the project owner because it was not quite sure whether opinions from the residents were properly obtained at the public meeting on 10 January 2012.
Interviewees were two families in Uyrot village and two families in Yangiobod village, which were selected at random.

1. Uyrot village

(1) First family:
The number of family member:5 person (parents and 3 children)
Residence year: 5 years
Main income source:: Salary from Navoi TPP
Other incomes: 0.08ha fruit garden and two cows
Other:

- Electricity and tap water are available.
- It takes 15 minutes on foot to go to school.
- They knew that EIA explanation meeting was held and know that they have to remove to the resettlement area.
- They agree with resettlement. However they would like to be informed about monetary compensation price (they have signed the census paper to show agreement of resettlement).
- As of CCGT Unit 1 construction, they mind noise, vibration and dust from traffic.

(2) Second family:
The number of family member：5 person (parents and 3 children)
Main income source: livestock, 2 children working at Navoi Power Plant and 400,000 Uzbekistani sum (16,000 JPY) of monthly pension for retired parents.
Other:

- Electricity and water supplied at house.
- Informed about the resettlement, and heard about resettlement several times since

January this year. However, not yet known about the compensation process nor resettlement site.

−Informed that stakeholder meeting for EIA was held.
−Clinics located close to the house.
−Gas supplied at the house, but sometimes not used during winter season.
−Concerned about noise pollution during construction of CCCGP No.1

2. Yangiobod village

(1) First family:
The number of family member：3 person（parents and 1 child）
The number of residing years：2year
Main income source：Working for electricity supply company as an accountant
Other:
−Electricity and water supplied at house, but gas is not supplied
−No house to live in until new house is constructed, if the present house is demolished.
−Visited by local government officer to discuss with residents about resettlement.
−Concerned about noise pollution during construction of CCCGP No.1
−Informed that stakeholder meeting for EIA was held.

(2) Second family
The number of family member：6 person（parents and 4 children）
The number of residing years：5year
Main income source：Working for Navoi Power Plant
Other:
−Electricity and water supplied at house. Gas can be used during summer, but not in winter.
−20 minutes of walk to school from house
−Concerned about noise pollution and dust caused by vehicles during construction of CCCGP No.1
−Informed that stakeholder meeting for EIA was held.

8.8.3 Additional Stakeholder meeting on Environmental and Social Consideration

Additional Stakeholder meeting was held at recreation room adjacent to Navoi CCCGP No.1 on October 30, 2012 by the project owner with help from the survey team. This is because JICA's Guideline was not included in the explanation and it was not quite sure whether opinions from the residents were properly obtained at the public meeting on 10 January 2012.
Affected residents were not notified of the meeting through their representative. In addition, the stakeholder meeting was publicized in the newspaper as well. The Director of Navoi thermal power station explained outline of project, objective and contents of Stake Holder Meeting to residential people who participated in the meeting. After the Director's speech, JICA Guidelines for Environmental and Social Consideration, Environmental Management Plan, Environmental Monitoring Plan and Land Acquisition and Resettlement Action Plan for this project were briefly presented. Main questions from the participants were related to resettlement plan. The detail of the meeting is as follows;

Place of meeting: Recreation Room in Navoi CCCGP No.1's camp site
Method of notification to residential people: informing neighboring residents through their representatives and newspaper.

Number of participants: 52 people

resettled residents	34
Navoi Region, Karmana District, Hokim (Major)	1
Karmana District, Makhalla "Yangiobod", Posbon (Commissary)	1
Karmana District, Rural Citizen Assembly "Yangiobod", Chairman	1
Karmana District, Makhalla "Uirot", Chairman	1
Karmana District, Makhalla "Yangiobod", Chairman	1
Karmana District, Makhalla "Yangiobod", Female Issues Consultant	1
Karmana District, Makhalla "Yangiobod", Secretary	1
Karmana District, Chief of Land and Assets Cadaster	1
Karmana District, Deputy Chief of Architecture and Construction Department	1
Staff of Navoi TPP	9

1. Opening remarks, the project description -Director of Navoi TPP (09.20).
2. Presentation of the project – JICA's study team (09.40).
3. Speech by Governor of Karamana District, Navoi Region (10.45).
4. Questions and answers. Discussion with residents to be resettled. (11.00).

Main speech, questions and answers are the following;

Speakers;	Contents;
The first speech <pensioner from makhalla "Uyrot">	Supports modernization of Navoi TPP because it will give new energy to the development of the economy of Navoi region and the country as a whole
Answer <Project Owner>	We appreciate your support.
The second speech < Representative of the residents, who did not introduce himself.>	Residents have no objection to the new project. He expressed dissatisfaction with the fact that the evaluation of their homes was made with earlier date of construction, which makes the value of their homes lower than it should be.
Answer < Governor>	The problem can be solved. Compensation money for resettled residents can be paid "even today". But then, the residents will have to relocate in the cold season. So he proposed them that they begin construction on new allocated sites today at their own expense. Compensation money will be paid in spring, so that they could start construction the main building.
The third speech <Residents>	We prefer to get monetary compensation by cash rather than by bank remittance.
Answer <Project owner>	According to the law, we cannot provide monetary compensation by cash.

It is alleged as of November 2012 that the owners of 10 houses under construction in Yangiobod village are not to be eligible for compensation. Therefore the 10 houholds appealed to Mayor of Karamana District and Navoi TPP to receive the compensation.

8.8.4 Stakeholder meetings related to resettlement

The following is a Summary of stakeholder meetings on resettlement. Project Owner made several meetings in order to obtain consent from the residents. Finally, all resettlement households agreed with the relocation to new places.

Summary of Project Consultations (LARAP page26-28);

1st

Date and Time	December 20th, 2012
Language	Uzbek
Attendance	Representatives of Makhalla Representatives of District Managing Director of Navoi HES 31 affected households (The other 2 households did not attend this meeting. These households are about to start constructing houses, not residing at this moment.)
Agenda	Project Description Land Acquisition and resettlement
Remarks	

2nd

Date and Time	February, 2012
Language	Uzbek
Attendance	Navoi State Governor Representatives of Makhalla Representatives of District Managing Director of Navoi HES 33 affected households
Agenda	Compensation to the affected households
Remarks	- Navoi State Governor explained to the affected households that 33 households were not entitled to receive compensation since they are illegal residents. - Navoi State Governor, however, decided to provide compensation to the affected households because of the complaints from the residents.

3rd

Date and Time	May, 2012
Language	Uzbek
Attendance	Navoi State Governor Representatives of Makhalla Representatives of District Managing Director of Navoi HES 33 affected households
Agenda	Compensation to the affected households
Remarks	- Resolution was issued, and only residents that are actually residing in the affected properties are entitled to receive compensation. - Uzbekenergo hired an independent agency for evaluating replacement cost of buildings, and the cost survey started in July.

4th

Date and Time	August 29th, 2012
Language	Uzbek
Attendance	Representatives of Makhalla Staff of Navoi HES JICA's study team members Special Commission on determining the amount of the compensation and type of compensation for the citizen (Chairman of local resettlement, Uyrot Village Citizen's Gathering, Chairman of local residential area "Yangiobod", Chairman of local residential area "Uyrot"), Deputy of Navoi HEP
Agenda	Explanation of JICA project Progress of resettlement
Remarks	- Real estate agency has been conducting asset inventory survey at each affected household. The survey on 12 households to be relocated in Uyrot village has already been finished, and approval signatures on the survey result have been acquired. The survey on the remaining 11 households in Yangiobod village will be completed by September 10th. - The resettlement site will be prepared about 2km away from the power plant site. - One household receives 600m^2 of land at the resettlement site, totaling 4.4ha of land been prepared. - The procedure of the resettlement is as follows: 1) notifying the residents, 2) conducting social survey, 3) acquiring residents' approvals on asset inventory survey and the survey result, 4) calculating compensation cost, 5) paying compensation, 6) preparing land by local government, 7) constructing houses by residents, 8) relocating to the new site. - Consultation to the residents has been conducted since NO.16-68 was issued on December 27th, 2011. - Compensation will be paid based on the market price. - The alternative site located north of the existing power plant has about 400 summer houses (temporary residential houses) and about 200 permanent residential houses.

8.9 Brief resettlement Action plan

8.9.1 Analysis of the legal framework concerning land acquisition and resettlement

Refer LARAP VII.LEGAL FRAMEWORK

8.9.2 Necessity of land acquisition and resettlement

Refer LARAP III.SCOPE OF LAND ACQUISITION AND RESETTLEMENT

8.9.3 Implementation of socioeconomic survey concerning land acquisition

1) Population census survey
Refer LARAP IV.SOCIOECONOMIC INFORMATION AND PROFILE, IV.1. Economic and Social Development in Navoi Province and Karmana District

2) Property/estate survey
Refer LARAP I.EXECUTIVE SUMMARY, I.2.Summary of Impacts

3) Household finance/life survey
Refer LARAP IV.SOCIOECONOMIC INFORMATION AND PROFILE, IV.3. Project Census

8.9.4 Requirement of compensation for lost assets and livelihood restoration

1) Compensation of lost assets
Refer LARAP VIII.ENTITLEMENTS, ASSISTANCE, AND BENEFITS, VIII.1.Entitlements for Compensation, VIII.2.Formalization of Title/Registration, VIII.3.Calculation of Compensation

2) Livelihood restoration
Refer LARAP VIII.ENTITLEMENTS, ASSISTANCE, AND BENEFITS, VIII.5. Entitlement Matrix

8.9.5 Grievance system

Refer LARAP VI.GRIEVANCE REDRESS MECHANISM

8.9.6 Implementation system

Refer LARAP XII.INSTITUTIONAL ARRANGEMENTS

8.9.7 Implementation schedule

Refer LARAP XIII.IMPLEMENTATION SCHEDULE

8.9.8 Cost and funding

Refer LARAP XI.RESETTLEMENT BUDGET AND FINANCIAL PLAN

8.9.9 Monitoring system/monitoring form

Refer LARAP XIV.MONITORING AND REPORTING

8.10 Other

8.10.1 Environmental Checklist

Table 8.10.1-1 shows the result of environmental and social consideration reviewed according to the checklist attached to JICA Guideline.

Table 8.10.1-1 Environmental Checklist

Main Check Items		**Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)**	**Yes: Y No: N**
1 Permits and Explanation	**(1) EIA and Environmental Permits**		
	(a) Have EIA reports been officially completed?	**The EIA report was completed.** ・The EIA of this project has been prepared in accordance with the laws of the country concerned.	**Y**
	(b) Have EIA reports been approved by authorities of the host country's government?	**The EIA report have been approved by the Uzbekistan government** ・The EIA was approved on February 21, 2012 by the National Nature Protection Committee.	**Y**
	(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	**Project owner prepared another EIA, which has been approved by the committee.** ・Project owner once submitted an EIA draft of CCCGP2 to the National Nature Protection Committee. As a result of the review, however, the committee ordered us to conduct another EIA on November 23, 2011. ・The major reasons were the EIA failed to study on the impact from pollutants and the risk of gas explosion, including new CCCGP1 and CCCGP2 facilities and discontinuance of existing 1 and 2 units and 3 and 8 units. ・To meet the order, project owner prepared another EIA, which has been approved by the committee.	**Y**
	(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	**Environmental permits other than EIA have not been obtained yet, and these will be approved till operation.** ・Project owner is required to submit draft notice on Environmental impact consequence to the State Ecological Expertise before operation In this procedure, all permit will be obtained	**N**
	(2) Explanation to the Stakeholder		
	(a) Are contents of the project and the potential impacts adequately explained to the stakeholder based on appropriate procedures, including information disclosure? Is understanding obtained from the stakeholder?	**The public consultation shall be conducted.** **＜EIA explanation meeting＞** ・Project owner held a meeting on explaining this project on January 10, 2012 at the Karmana District in the Navoi area. The meeting was attended by local residents of the Yangiobod village and the Uyrot village and representatives of the village offices. The number of the attendees totaled 52. (EIA p.3, 6, Pre-Feasibility Study Appendix 7). ・According to the meeting minutes, the attendees were in favor of implementing this project. No attendees were against this project. (Pre-Feasibility Study Appendix 7). **＜Additional Stakeholder meeting＞** ・Additional Stake Holder Meeting was held at recreation room adjacent to Navoi CCCGP No.1 on October 30, 2012 by the project owner with helping by the survey team. This is because JICA's Guideline was not included in the explanation and it was not quite sure whether opinions from the residents were properly obtained at the public meeting on 10 January 2012. ・The stakeholder meeting was notified to the affected residents through the representative of the residents, as well as by newspaper. ・Director of Navoi thermal power station explained outline of project, objective and contents of Stake Holder Meeting to residential people who participated the meeting. Then, JICA Guidelines for Environmental and Social Consideration, Environmental Management Plan, Environmental Monitoring Plan and Land Acquisition and Resettlement Action Plan for this project were briefly presented.	**Y**

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
<tr><td>1 Permits and Explanation</td><td>(b) Are proper responses made to comments from the stakeholder and regulatory authorities?</td><td>The comments of the local people collected at the public consultation were all answered by the project owner.
・At the meeting held on January 10, 2012 for local residents, Project owner answered all the questions and comments made by the attendees. (Pre-Feasibility Study Appendix 7)
Questions and answers were described as follows:
<table>
<tr><th>Question and opinion</th><th>Answer</th></tr>
<tr><td>When will CCCGP450MW start construction and operation?</td><td>The time is not decided officially. However, we would like to start operation at our earliest convenience.</td></tr>
<tr><td>Will CCCGP operation cause noise in the surroundings of houses?</td><td>The noise level will be lower than the standard in reference to cases of existing power plants.</td></tr>
<tr><td>Will CCCGP be added to the existing facilities, or will the existing facilities be replaced by CCCGP?</td><td rowspan="2">CCCGP will replace existing Nos. 3 and 8 plants and their operations will be discontinued because they were built more than 40 years ago.</td></tr>
<tr><td>How old are the existing two boilers to be discontinued?</td></tr>
<tr><td>Why will CCCGP have less impact on the environment, compared with the existing plants?</td><td>CCCGP has higher efficiency of power generation, which will result in less impact on the environment.</td></tr>
</table>
</td><td>Y</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
1 Permits and Explanation	**(3) Alternatives**		
	(a) Were any alternatives of the project plan, including the environmental social items, examined	**EIA report and JICA Mission Team provides consideration of alternatives concerning the zero option, site selection and cooling system.** **< Zero option>** ・In the case where CCCGP No.2 is not constructed and the existing old-type power plants (Unit 3 and Unit 8) continue operation, the air quality around the plant area will remain in a bad condition, the reliability of the facility will decrease and the risk of accident will increase. （EIA p.67） < Site selection > ・In the EIA, the north end of the existing power plant site is considered as an alternative site for constructing CCCGP No.2. ・However, further consideration of this plan was called off for the reasons described in the table below. ・The current proposed site facing the west of CCCGP No.1, even though resettlement of 33 households is predicted, is considered the most favorable alternative.	**Y**

Comparison of the alternative site

Item	The north end of the existing power plant site （Site A）	The site facing west of CCCGP No1 (proposed site) (SiteB）
Technics	-Construction of gas supply facility is necessary within the operating plant site and the construction activity involves high risk.	-New site and low risk for construction of gas supply facility.
Topology	-Not enough space for construction activity. -Not enough space for constructing a storage facility.	-Enough space for construction activity. -Enough space for constructing a storage facility.
Resettlement	-Destruction and resettlement of the existing 200 living houses and 400 summer house within the site is predicted.	-There are no houses within the site and no resettlement is predicted. -There are 23 houses and bases of 10 houses within Transmission line route.

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
<tr><td>1 Permits and Explanation</td><td>(b) Were any alternatives of the project plan, including the environmental social items, examined?</td><td>
＜Cooling system for the condenser＞
・While the condensers in the existing power plants, except Unit 11 and 12, adopt one-through system, either forced draft cooling tower system or forced draft air cooling system will be adopted in the CCCGPNo.2 power plant.
The result of the consideration is shown in Table. The use of air-cooling system has no actual achievement in the past in Uzbekistan, and in conclusion the forced-draft cooling-tower cited in the EIA was adopted.

Table: comparison of the cooling system
<table>
<tr><th>Items</th><th>Forced-draft cooling tower system</th><th>Forced draft air cooling system</th></tr>
<tr><td>Installation expense</td><td>Lower cost than the air-cooling system.
(17.5 million $)</td><td>Higher cost than the air-cooling system
(21.2 million $)</td></tr>
<tr><td>Water quality management</td><td>Water quality management of the utility water is necessary.</td><td>Utility water is not necessary.</td></tr>
<tr><td>Installation space</td><td>Smaller than air cooling system
(2,080m^2)</td><td>Larger than cooling tower system
(4,800m^2)</td></tr>
<tr><td>Heat efficiency</td><td>Slightly higher than air cooling system</td><td>Slightly lower than cooling tower system</td></tr>
<tr><td>Effluent</td><td>Blow-down is generated ($240m^3/h$)</td><td>No effluent is generated.</td></tr>
<tr><td>Noise</td><td>Noise is generated: 85dB</td><td>Generated: 85dB</td></tr>
<tr><td>Actual performance in Uzbekistan</td><td>Practically used in CCCGP No.1 etc.</td><td>No practical performance</td></tr>
</table>
Note: bold letter means advantage
</td><td>Y</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
2 Mitigation Measures	**(1) Air Quality**		
	(a)Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards?	**The gas emission from CCCGP No.2 meets the gas emission standard in Uzbekistan and satisfies the IFC guideline.** **According to the atmospheric diffusion modeling, the maximum ground concentration of NO_2 from all Navoi power plants will be improved after operation CCCGP No.2 and will comply with the Uzbekistan environmental standard for NO_2 concentration.** **＜Status＞** ・Annual atmospheric survey was conducted in 2010 at three measurement points (residential, industrial and roadside area) in Navoi City by Uzbek Hydro meteorological Institution"Uzgidromet". ・The nitrogen dioxide (NO_2) concentration is 0.015~0.11mg/m^3（30-minute value）, higher than the maximum permissible concentration (MPC) at the maximum level, with annual average of 0.04 mg/m^3. But these values satisfy 1-hour value of the IFC/WB EHS Guideline, In addition, annual average of NO_2 concentration satisfies the annual average value of IFC/WB EHS Guidelines. ・The sulfur dioxide (SO_2) concentration is 0.001~0.009 mg/m^3, which is well below MPC at the maximum level. This value satisfies the 24-hour value of IFC/WB EHS General Guideline. ・It is also predicted that nitrogen dioxide (NO_2) concentration around power plant site will become much lower, since the number of vehicles, which is the generation source of NO_2, around the power plant site is lower than that in Navoi City. Therefore, the NO_2 concentration value around the power plant site is predicted to be about the same as the value （0.015~0.09 mg/m^3）of residential area in Navoi City at most with conservative point of view. **<Emission standard >** ・In the Republic of Uzbekistan, ground concentration of air pollutant discharged from each stack is estimated by a designated method, and the estimated concentration from CCCGP No.2 meet with the standard value. In this project, NOx concentration will be compliant to the Russian standard (GOST 29328-92). This standard value is equivalent to the guideline value for thermal power plant stipulated in IFC/WB EHS Guideline. **＜Prediction＞** ➢ **Impact of CCCGPNo.2** ・The maximum ground concentration (30 min value) from CCCGP No.2 is 9.1μg/m^3 and occurs under the condition that air stability is B, wind speed is 1.0m/s, and this is about 10% of Uzbekistan environmental standard, and about 5 % of IFC/WB guideline 1hour value. NO_2 concentration value in residential area of Navoi City is 90μg/m^3 at the maximum, which exceeds environmental standard of Uzbekistan (85μg/m^3), but it is below 1-hour value of IFC/WB EHS General guideline (200μg/m^3). ➢ **The total cumulative impact of the power plant** ・In case of shutting-down of Unit 3 and 8, NO2 emission is increased to 4,687ton/year compared to 4,636 ton/year before CCCGP No.2 in operation. SO2 is, on the other hand, reduced after CCCGP No.2 in operation. ・In case of shutting-down of Unit 3, 6, 8 and 10, NO_2 emission is decreased to 4,146 ton/ year compared to 4,636 ton/year before CCCGPNo.2 in operation. ・At condition of atmosphere stability B,the maximum ground concentration of NO_2 generated by the operation of the power plant before CCCGP No.2 starts operation is 56.4~62.0μg/m^3, and it becomes 52.6~56.0μg/m^3 after CCCGP No.2 starts operation and Unit3, 6, 8, 10 are shut down. Between 2~9μg/m^3 that will be decreased after CCCGP No.2 started operation compared to before CCCGP No.2 operation in all wind speed. Assuming that the current concentration value around the power plant is the same level (90μg/m^3) as the one in residential area of Navoi city, the concentration value will become about the same as the standard of Uzbekistan, 85μg/m^3, or even lower.	Y

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
<tr><td rowspan="2">2 Mitigation Measures</td><td></td><td>・In the case of shutting down of Unit 3 and 8, the maximum ground concentration becomes 58.4~62.μg/m^3. These concentration values are same level after operation of CCCGP No.2 compared to the case before operation except at the wind speed of 1.0m/s.
Table Prediction of the maximum ground concentration of NO$_2$ by Navoi Power plant
<table>
<tr><th rowspan="2">Items</th><th rowspan="2">Atmospheric conditions (stability)</th><th rowspan="2">Wind speed</th><th rowspan="2">Before Operation of CCCGP No.2 (μg/m^3)</th><th colspan="2">After Operation of CCCGP No.2 (μg/m^3)</th><th rowspan="2">Environmental reference value of Uzbekistan (μg/m^3)</th><th rowspan="2">IFC/WB EHS General Guidelines (2007)</th></tr>
<tr><th>Stoppage of unit 3,6, 8,10</th><th>Stoppage of unit 3, 8</th></tr>
<tr><td rowspan="4">NO$_2$</td><td rowspan="4">B</td><td>1.0 m/s</td><td>56.4 (3.9km)</td><td>54.2 (3.6km)</td><td>58.4 (3.6km)</td><td rowspan="4">85</td><td rowspan="4">200</td></tr>
<tr><td>2.0 m/s</td><td>61.2 (2.4km)</td><td>56.0 (2.4km)</td><td>61.9 (2.4km)</td></tr>
<tr><td>3.0 m/s</td><td>62.0 (1.6km)</td><td>54.8 (1.9km)</td><td>62.0 (1.9km)</td></tr>
<tr><td>4.0 m/s</td><td>61.4 (1.4km)</td><td>52.6 (1.7km)</td><td>60.1 (1.4km)</td></tr>
</table>
・The west side of the power plant is mixture of residential area and farmland with no source of air pollution. It is expected that the current NO$_2$ concentration value in residential area of Navoi City is lower than 90μg/m^3, and it is also expected that the value will drop below the Uzbekistan standard of 85μg/m^3, as a result of the operation of CCCGP No.2.</td><td></td></tr>
<tr><td>(b) In the case of coal-fired power plants, is there a possibility that fugitive coal dust from coal piles, coal handling facilities, and dust from coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?</td><td>CCCGP No.2 is not a coal-fired power plant.</td><td>Y</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
2 Mitigation Measures	**(2) Water Quality**		
	(a) Do effluents including thermal effluents from the power plant comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause a significant temperature rise in the receiving waters?	**Waste water and thermal effluent discharge from Navoi power plant into Zerafshan River will be decreased in this project as the existing Unit 3 and 8 is shut down. Washing wastewater, blow-down from the cooling tower and oily effluent from CCCGP No2. will be appropriately treated by installing a new waste water treatment system. Water quality at the outlet of the treatment facility shall be monitored to confirm the compliance to the effluent standard of Uzbekistan and IFC/WB.** ＜Current status ＞ ➢ Zerefshan River ・It should be noted that water quality of Zerefshan River in Navoi, upstream of the power plant, exceeds the MPC in oil content, heavy metals, sulfate, nitrous acid, suspended solids (SS) and other items.Salinity and water temperature are increasing every year, for which the existing power plant is said to be one of the pollution source. (EIAp23,34-35) ➢ Effluent from the existing power plant ・The condenser cooling system in Unit 1~4, Unit 7~9 of the existing power station adopts once-through system. The load of pollutant is not predicted in this system, however, as described above, the high concentration of oil, sulfate and SS are observed in the effluent which reflects the water quality of Zerafshan River. ・The condenser cooling system in Unit 11 and 12 of the existing power station adopts natural-draft system, and water is usually supplied from Zerafshan River and treated with simple precipitation system before use. As a result, concentration of pollutant in the blow-down from the cooling tower exceeds the effluent standard in many items (EIA p.24). ＜Disparage＞ ➢ Thermal effluent and blow-down from the cooling tower ・As for the condenser cooling system in this project, forced-draft cooling tower system was finally adopted.This system does not generate large amount of thermal effluent as is the case of one-through system, and the shutdown of the Unit 3 and 8 will also contribute to the reduction of thermal effluent. Forced-draft cooling tower involves supply of makeup water and generation of heated cooling tower blow-down. ・The reduction of thermal effluent due to the shutdown of Unit 3 and 8 is 28,000m^3/h, and amount of blow-down from the cooling tower is 240m^3/h. Approximately 27,760 m^3/h of thermal effluent will be reduced. ・In the existing Unit 11 and 12, makeup water for cooling tower was supplied from Zerafshan River which is significantly polluted, and was used after only a simplified precipitation treatment. As a result, water quality of blow-down from the cooling tower exceeds the effluent standard in Uzbekistan. ・In order to satisfy water quality standard of Uzbekistan as well as EHS Guideline of IFC/WB even when the concentration of waste water quality is kept within 2 times of the make-up water, water treatment shall be conducted for intake water and waste water. ➢ .Washing waste water from water treatment facility ・The boiler in this project will use river water treated with the new water demineralizer. 72.5m^3/h of washing waste water is regularly generated for the maintenance of the water treatment system, whereas the washing waste water from the existing water demineralizer will be reduced as a result of shutdown of Unit 3 and 8. ・The output of the steam turbine of this project is 138MW, and that of the Unit 3 and 8 being shutdown is 300MW. As necessary amount of treated water and washing waste water are both larger in the existing Unit 3 and 8, the total effluent will be reduced by the implementation of the project. ・In this project, makeup water treatment facility and water demineralizer will be constructed to supply thermal water used for heating of the local area and steam for local factories, which regularly generates washing waste water. This waste water substitutes the waste water generation of the existing power plant and the total amount of water discharge does not increase.	

Main Check Items		**Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)**	**Yes: Y** **No: N**
2 Mitigation Measures		➢ Domestic waste water ・Domestic wastewater generated by the project will be discharged into the public sewage line and not into Zerafshan River. ➢ Oily waste water ・Storm water containing oil will be generated $19m^3/h$ at the maximum and treated by oil-separating system before being discharged. The total effluent will be reduced due to shutdown of Unit 3 and 8. ＜Mitigation measures＞ ・Washing wastewater, blow-down from the cooling tower and oily effluent will be appropriately treated by installing a new waste water treatment system and discharged through the existing water outlet. ・Wastewater is mixed with other effluent at the outlet, and water quality at the outlet of the treatment facility shall be monitored to confirm the compliance to the effluent standard of Uzbekistan and IFC/WB.	
	(b) In the case of coal-fired power plants, do leachates from coal piles and coal ash disposal sites comply with the country's effluent standards?	**CCCGP No.2 is not a coal-fired power plant.**	N
	(c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?	**Waste water will be appropriately treated by introducing a treatment system or other mitigation measure and serious water pollution is not predicted.** ＜Mitigation measures ＞ ・Washing wastewater, blow-down from the cooling tower and oily effluent will be appropriately treated by installing a new waste water treatment system and discharged through the existing water outlet. ・Wastewater is mixed with other effluent at the outlet, and water quality at the outlet of the treatment facility shall be monitored to confirm the compliance to the effluent standard of Uzbekistan and IFC/WB. ・Drain system will be introduced to gather rain water and prevent oily contamination	**Y**
	(3) Wastes		
	(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's standards?	**Industrial waste generated from the power plant operation will be correctly collected and treated by authorized treatment business according to the Uzbekistan regulation, so no significant environmental impact is predicted.** ＜Disposal Waste in Navoi power plant＞ ・Standard for treatment of waste shall be established for all economical activities regardless of the types of industry in Republic of Uzbekistan. ・Transportation of waste for disposal site or reuse is delegated to the licensed company. Final disposal is conducted at the licensed disposal facility. ・In Navoi power plant, scrap metal and oil are reused by a special company, and sludge is disposed of at a designated disposal site. Domestic waste is disposed of at a disposal site in Navoi. ・Waste oil from the equipments and oil-separating system of the waste-water treatment system and sludge from the precipitation system of the waste-water treatment system will be generated, but may be diminished after stopping of the existing facilities. As river water, not public water, will be used for boiler feed water and make-up water for cooling tower, sludge will be generated from the water treatment system. Sludge will be treated and disposed of as in the case of the existing power plant. ＜Mitigation measures＞ ・Development of waste management program including education of workers to encourage reduction and reuse of waste. ・Prohibition of illegal dumping. ・Separation of waste by hazard level, storage in an appropriate storage site and legal disposal in an appropriate disposal site.	

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
2 Mitigation Measures	**(4) Noise and Vibration**		
	(a) Do noise and vibrations generated by the power plant operations comply with the country's ambient standards, and occupational health and safety standards?	**Mitigation measures for noise will be conducted, complying with the regulation standard of environmental noise level as well as working environment of Uzbekistan.** ➢ Noise ＜Prediction＞ ・Noise levels from CCCGP No1 and CCCGP No.2 is below 55dB at 300m from the boundary of the site, and 50 dB at 400m from the boundary, which meets daytime environmental noise standard of the Uzbekistan and IFC/WB guidelines.The nighttime noise standard, however, is not satisified. ➢ Vibration ＜Prediction＞ ・Vibration level at the residential area 200m from the project site is 40dB, a sufficiently low level. ＜Mitigation measures＞ ・Use low-noise equipment (silencer, muffler) ・Installation of soundproof cover. ・Use of low-vibration equipment. Construction of buildings with strong foundation. ・Regular maintenance of the equipment. ・Tree-planting and installation of sound proof wall around the project site. ・Complying with the noise standard of working environment and keeping the noise level 80dB or lower inside the power plant	**Y**
	(5) Subsidence		
	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	**There is no possibility that land subsidence may arise because ground water will not be used.** ・Groundwater will not be taken at the power plant.	N
	(6) Odor		
	(a) Are there any odor sources? Are adequate odor control measures taken?	**Odor source is ammonia, but CCCGP No2 will not install de-nitrification equipment, which uses ammonia.**	N
3 Natural Environment	**(1) Protected Areas**		
	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	**There is no protected area in near and around project site.** ・The project site is adjacent to the residential area and the power plant already under influence of human activity.	N
	(2) Ecosystem and biota		
	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	**Project site does not encompass primeval forests, tropical rain forests and ecologically valuable habitats.** ・The project site is adjacent to the residential area and the power plant is already under influence of human activity.	N
	(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	**Project site does not encompass habitats of endangered species.** .・Precious species designated by IUCN (International Union for Conservation of Nature and Natural Resources) and by the Uzbekistan Red Data Book are not observed in the land around site.	N

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
3 Natural Environment	(c) If significant ecological impacts are anticipated, are adequate environmental protection measures taken to reduce the impacts on ecosystem?	**Air pollution will be mitigated by shutdown of the existing power plant.** ・The project site is adjacent to the residential area and the power plant is already under influence of human activity. - Air pollution will be mitigated by shutdown of the existing power plant.	Y
	(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	**Intake water from Zerafshan River will be decreased in this project as the existing Unit 3 and 8 is shut down. As a result, the impact on aquatic organisms will be decreased and mitigated.** - Forced draft cooling tower cooling system will intake of cooling water from the river. - Lower amount of river water will be taken compared to the old Unit 3 and 8 which used river water for cooling system.	Y
	(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	**Intake water from Zerafshan River will be decreased in this project as the existing Unit 3 and 8 is shut down. Waste water and thermal effluent discharge from Navoi power plant into Zerafshan River will be decreased in this project as the existing Unit 3 and 8 is shut down. Waste water will be appropriately treated by installing a new waste water treatment system As a result, the impact on the ecosystem of the surrounding water areas will be decreased and mitigated.** - Either forced draft cooling tower cooling system or forced draft air cooling system will be adopted, and large amount of thermal waste water discharge is not predicted. Stopping of Unit 3 and 8 will also diminish the thermal waste water. - Forced draft cooling tower will generate cooling tower blow-down. - Plant waste water and oily waste water is generated but shutting down of the existing facilities is also decided. - Domestic waste water will be generated by project workers. - River water, not public water, will be used for boiler feed water and make-up water for cooling tower, butt may be diminished after shutting down of the existing facilities.	Y
4 Social Environment	**(1) Resettlement**		
	(a)Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	Yes. - The Project will affect 33 households located at two makhallas “Uyrot” and “Yangiobod”. These households will be entirely demolished because they are within the zone of action of the high voltage power line closer to the existing highway M-37(LARAP para18). - Thus, there are 120 DPs at this zone. All of the DPs will be needed of the compensations and another types of help. The complete list of affected households with DPs(LARAP para19). - Alternative study for project site was conducted to reduce the impact of land acquisition and resettlement.	

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
4 Social Environment	(b) Is adequate explanation on relocation and compensation given to affected persons prior to resettlement?	Yes. **Stakeholder meetings related to resettlement** The followings are a Summary of stakeholder meetings on resettlement. Project Owner made several meetings in order to obtain consent from the residents. Finally, all resettlement households agreed with the relocation to new places. Summary of Project Consultations (LARAP page26-28);	**Y**

1st

Date and Time	December 20th, 2012
Language	Uzbek
Attendance	Representatives of Makhalla、Representatives of District、Managing Director of Navoi HES 31 affected households (The other 2 households did not attend this meeting. These households are about to start constructing houses, not residing at this moment.)
Agenda	Project Description、Land Acquisition and resettlement
Remarks	

2nd

Date and Time	February, 2012
Language	Uzbek
Attendance	Navoi State Governor、Representatives of Makhalla、Representatives of District、Managing Director of Navoi HES 33 affected households
Agenda	Compensation to the affected households
Remarks	- Navoi State Governor explained to the affected households that 33 households were not entitled to receive compensation since they are illegal residents. - Navoi State Governor, however, decided to provide compensation to the affected households because of the complaints from the residents.

3rd

Date and Time	May, 2012
Language	Uzbek
Attendance	Navoi State Governor、Representatives of Makhalla、Representatives of District、Managing Director of Navoi HES 33 affected households
Agenda	Compensation to the affected households
Remarks	- Resolution was issued, and only residents that are actually residing in the affected properties are entitled to receive compensation. - Uzbekenergo hired an independent agency for evaluating replacement cost of buildings, and the cost survey started in July.

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
<tr><td>4 Social Environment</td><td></td><td>

4th

<table>
<tr><td>Date and Time</td><td>August 29th, 2012</td></tr>
<tr><td>Language</td><td>Uzbek</td></tr>
<tr><td>Attendance</td><td>Representatives of Makhalla、Staff of Navoi HES、JICA’s study team members
・Special Commission on determining the amount of the compensation and type of compensation for the citizen (Chairman of local resettlement, Uyrot Village Citizen’s Gathering, Chairman of local residential area “Yangiobod”, Chairman of local residential area “Uyrot”), Deputy of Navoi HEP</td></tr>
<tr><td>Agenda</td><td>Explanation of JICA project
Progress of resettlement</td></tr>
<tr><td>Remarks</td><td>- Real estate agency has been conducting asset inventory survey at each affected household. The survey on 12 households to be relocated in Uyrot village has already been finished, and approval signatures on the survey result have been acquired. The survey on the remaining 11 households in Yangiobod village will be completed by September 10th.
- The resettlement site will be prepared at about 2km away from the power plant site.
- One household receives 600m^2 of land at the resettlement site, totaling 4.4ha of land been prepared.
- The procedure of the resettlement is as follows: 1) notifying the residents, 2) conducting social survey, 3) acquiring residents’ approvals on asset inventory survey and the survey result, 4) calculating compensation cost, 5) paying compensation, 6) preparing land by local government, 7) constructing houses by residents, 8) relocating to the new site.
- Consultation to the residents has been conducted since NO.16-68 was issued on December 27th, 2011.
- Compensation will be paid based on the market price.
- The alternative site located north of the existing power plant has about 400 summer houses (temporary residential houses) and about 200 permanent residential houses.</td></tr>
<tr><td></td><td></td></tr>
</table>

Additional Stakeholder meetings related to resettlement (the third survey.)

Additional Stakeholder Meeting was held at recreation room adjacent to Navoi CCCGP No.1 on October 30, 2012 by the project owner with helping from the survey team. This is because JICA’s Guideline was not included in the explanation and it was not quite sure whether opinions from the residents were properly obtained at the public meeting on 10 January 2012.

The meeting was notified of the meeting through their representative. In addition, the stakeholder meeting was publicized in the newspaper as well. The Director of Navoi thermal power station explained outline of project, objective and contents of Stake Holder Meeting to residential people who participated in the meeting. After the Director’s speech, JICA Guidelines for Environmental and Social Consideration, Environmental Management Plan, Environmental Monitoring Plan and Land Acquisition and Resettlement Action Plan for this project were briefly presented. Main questions from the participants were related to resettlement plan.

</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
<tr><td rowspan="2">4 Social Environment</td><td></td><td>Place of meeting: Recreation Room in Navoi CCCGP No.1’s camp site
Method of notification to residential people: informing neighboring residents through their representatives and newspaper
Number of participants: 52 people
Breakdown of participants
<table>
<tr><td>Representatives of residents</td><td>34</td></tr>
<tr><td>Navoi Region, Karmana District, Hokim (Major)</td><td>1</td></tr>
<tr><td>Karmana District, Makhalla “Yangiobod”, Posbon (Commissary)</td><td>1</td></tr>
<tr><td>Karmana District, Rural Citizen Assembly “Yangiobod”, Chairman</td><td>1</td></tr>
<tr><td>Karmana District, Makhalla “Uirot”, Chairman</td><td>1</td></tr>
<tr><td>Karmana District, Makhalla “Yangiobod”, Chairman</td><td>1</td></tr>
<tr><td>Karmana District, Makhalla “Yangiobod”, Female Issues Consultant</td><td>1</td></tr>
<tr><td>Karmana District, Makhalla “Yangiobod”, Secretary</td><td>1</td></tr>
<tr><td>Karmana District, Chief of Land and Assets Cadaster</td><td>1</td></tr>
<tr><td>Karmana District, Deputy Chief of Architecture and Construction Department</td><td>1</td></tr>
<tr><td>Staff of Navoi TPP</td><td>9</td></tr>
</table>
1. Opening remarks, the project description - Director of Navoi TPP (09.20).
2. Presentation of the project – JICA’s survey team (09.40).
3. Speech by Governor of Karmana district (10.45).
4. Questions and answers. Discussion with residents to be resettled. (11.00).</td><td></td></tr>
<tr><td>(c)Is the resettlement plan, including compensation by the replacement cost, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?</td><td>Yes.
However, some points are still being confirmed.
The following are referred to the LARAP.
Compensation plan: alternative land will be provided to affected households.
As for buildings, crops and transport fee will be provided as monetary compensation.

Please see the below table.(LARAP Table 12)</td><td>Y</td></tr>
</table>

Table: **Entitlement Matrix**

Loss Item 1: Residential Land

Unit of entitlement	Entitlements	Application Guidelines	Additional Services
1. Legal owner(s) as identified by Karamana District in the process of payment	1. Land compensation of 0.06 ha per each household.	1. Karmana District will receive budget from Navoi TPS for land compensation and provide the land (0.06 ha per household) to the affected households.	1. Legal owners will be assisted by UE to organize legal documents in support of their ownership. 2. The households which own more than 0.06 ha of their building area, are entitled to receive monetary compensation or land compensation for the additional land (per ha).

Loss Item 2: Housing and structures

Unit of entitlement	Entitlements	Application Guidelines	Additional Services
1. Legal owner(s) as identified by Karamana District in the process of payment	1. Replacement Value of Housing and structures	1. Replacement Value will be recommended by the independent agency. 2. Project owner will pay cash compensation under law for the land to APs. 3. If Replacement value is higher than law, the difference will be paid by project owner.	1. Legal owners will be assisted by UE to organize legal documents in support of their ownership. 2. Regarding the 10 uninhabited illegal houses, the expense for the houses will be paid by the Navoi TPS as a support activity.

Loss Item 3: Standing Trees

Unit of entitlement	Entitlements	Application Guidelines	Additional Services
1. Legal owner(s) as identified by Karamana District in the process of payment	1. Replacement Value of Standing Trees	1. Replacement Value will be recommended by the independent agency. 2. Project owner will pay cash compensation under law for the land to APs. 3. If Replacement value is higher than law, the difference will be paid by project owner.	

Livelihood Restoration

Unit of entitlement	Entitlements	Application Guidelines	Additional Services
PAPs whose livelihood level are lowered after the relocation	1. Job training 2. Preferential hiring for works in Navoi Thermal Power Plant	1. Identifying PAPs whose livelihood levels are lowered after the relocation. 2. Uzbekenergo will provide job trainings. 3. Navoi Thermal Power Plant will hire some of them if necessary.	

Support for Vulnerable Groups

Unit of entitlement	Entitlements	Application Guidelines	Additional Services
Households who are regarded as vulnerable	1. Support for receiving public assistance. 2. Providing assistances such as training, job-opportunities, and allowances	1. Identifying the number of PAPs who are categorized in vulnerable groups. 2. Uzbekenergo will assist the application process for the public assistance. 3. Uzbekenergo will provide assistances such as training, job-opportunities, and allowances following the established order in accordance with the regulations of Uzbekistan.	

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
4 Social Environment	(d)Is payment of compensation made prior to resettlement?	Confirming As the schedule, payment of compensation will be made prior to resettlement.	Confirming
	(e)Is the compensation plan formulated in documents?	Yes. Please refer to the above table.	Y
	(f)Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	Yes Livelihood Allowance. – For those DPs who are vulnerable – female-headed, poor, or face significant hardship due to elderly or disabled family members – an allowance of $35 per household member for three months will be paid. (LARAP para 97)	Y
	(g)Are agreements with the affected persons obtained prior to resettlement?	Yes. (from the second and third survey)	Y

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
4 Social Environment	(h)Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	・In accordance with Clause 41 of the Land Code, the types of compensations were decided. The Special Committee was also set up to estimate the sums of compensations (Decree No. 605-K dated July 11, 2012). ・The Special Committee may determine the types of compensations and the sums of compensations in accordance with Cabinet Decision No. 97 dated May 29, 2006 titled the "Approval of Regulations concerning Loss Compensations of Legal Entities and Citizens for Land Expropriation by the Government and for Public Purposes" and Clause 41 of the Land Code (Decree No. 605-K). ・The First Deputy of District was appointed as acting Supervision Controller of Decree No. 605-K (Decree No. 605-K). ・The Special Committee consists of two sub-committees, namely the relocation special committee to build roads and the relocation special committee to build the CCCGP2 unit. The members of the subcommittees are named below. Members of relocation special committee to build roads: ・ First Deputy of District Khokim (Governor) ・ Chairman of the Special Commission ・ Director of Navoi AutoYul (Navoi branch of Road Agency) ・ Head of the District Department of Finance ・ Chief of State Unitary Enterprise District Land and Immovable Cadastre Service ・ Head of the District Architecture and Construction Department ・ Director of the Branch of Karmana District Gas Agency ・ Head of the District Electric Power networks ・ Head of the Anti-Fire Department of Interior ・ Chief Doctor of the District State Sanitary Epidemiology Agency ・ Head of the District Nature Protection Department ・ Acting Director of the Karmana Drinking water production Liability Limited Company ・ Chairman of the District Makhalla Charity Public Foundation ・ Yangi Arik Village Citizen's Gathering ・ Argun Makhalla Citizen's Gathering ・ Yangi Arik Makhalla Citizen's Gathering ・ Talkok Makhalla Citizen's Gathering ・ Citizen, whose housing is being demolished for the state and public needs Relocation special committee to build the CCCGP2 unit. ・ First Deputy of District Khokim (Governor) ・ Chairman of the Special Commission ・ Director of the Open Joint Stock Company Navoi Thermal Power Station ・ Head of the District Department of Finance ・ Chief of State Unitary Enterprise District Land and Immovable Cadastre Service ・ Head of the District Architecture and Construction Department ・ Director of the Branch of Karmana District Gas Agency ・ Head of the District Electric Power networks ・ Head of the Anti-Fire Department of Interior ・ Chief Doctor of the District State Sanitary Epidemiology Agency ・ Head of the District Nature Protection Department ・ Acting Director of the Karmana Drinking water production Liability Limited Company ・ Chairman of the District Makhalla Charity Public Foundation	Y

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
<tr><td rowspan="5">4 Social Environment</td><td></td><td>・ Uyrot Village Citizen’s Gathering
・ Uyrot Makhalla Citizen’s Gathering
・ Yangi Obod Makhalla Citizen’s Gathering
・ Citizen, whose housing is being demolished for the state and public needs
The systems are unknown to implement the relocation of local residents and provide the budget. They must be checked.</td><td></td></tr>
<tr><td>(i)Is a plan developed to monitor the impacts of resettlement?</td><td>All activities in Land Acquisition and Resettlement are time bounded. Internal monitoring (IM) will be carried out by the PIU and the Land Acquisition and Resettlement Committee in the District Hokimiyat. Process indicators will relate to implementation outputs and deliverables. These will be collected directly from the field, and will be reported monthly to the PIU to assess the LARAP implementation progress and adjust the work plan if necessary. These reports will be quarterly consolidated and submitted to JICA.(LARAP para135)</td><td>Y</td></tr>
<tr><td>(j)Is the structure of grievance mechanism established?</td><td>(LARAP para 54~59)
1) The APs will be informed in prepared brochures on all contacts and contacts persons (GFPs) responsible for the realization of the resettlement project. They will be able to call or submit personally any complaints to these persons. There should also be envisaged a possibility of a GFP’s visit directly to a place of resettlement.
2) The duration for redressing all the complaints or requests submitted by the APs is one week. If there is no reaction to the APs’ complaints within this period, APs should be able to turn to District GFP (e.g. in writing a complaint, faxing it, etc.) if necessary.
3) The District GFP will have one week from the day of submission of a complaint to provide a well-reasoned reply to APs and take an appropriate decision. The written complaint and attempts will be registered in order to be solved it. If complaint is not resolved in one week, it is passed by the GFP to the Province LARC for resolution.
4) In the event that a satisfactory answer cannot be provided, The written complaint and attempts with the AP will be registered in the Land Acquisition and Resettlement Committee (LARC) the Province Hokimiyat in order to be resolved it. If a solution is not reached within two weeks, the LARC refers it to UE PIU.
5) UE PIU will assist the activities of the GFP and LARC to resole the complaints and makes a decision within two weeks. If the District and Province are not able to resolve the dispute within the elapsed time, the UE PIU will have further two weeks to resolve the issue. If the decision is still unacceptable to the AP, the APs can take it to the District Court although all court costs (preparation and representation) will be paid for by the project – no matter the outcome.
6) The District Court will make a final decision. The decision will bind on all parties.</td><td>Y</td></tr>
<tr><td>(2) Living and Livelihood</td><td></td><td></td></tr>
<tr><td>(a)Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?</td><td>Pollution control will be conducted and local residents will be preferentially employed for this project.
・The project will reduce the risk that workers and/or nearby residents face by the inhalation of hazardous substances. In addition, the level of noise and vibration caused by machinery will become lower. Compared with present conditions, the extent of impact will be improved (EIA p. 74).
・The exact number of workers to employed for the construction of CCCGP2 will not be decided until the EPC contractor is appointed. However, the construction of CCCGP2 is expected to employ a similar number of workers of CCCGP1. The table below shows the number of workers employed for CCCGP1.
<table>
<tr><th></th><th>During construction (max. number of workers)</th><th>During operation</th></tr>
<tr><td>Local residents</td><td>Up to 460 persons</td><td>54 persons</td></tr>
<tr><td>Foreigners</td><td>Up to 800 persons</td><td>More than a dozen persons</td></tr>
</table>
・This project plans to employ local residents. Vocational training of local workers will be provided, if necessary (2nd survey).</td><td>Y</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
4 Social Environment		＜Mitigation measures＞ ・Pollution control such as air and noise pollution ・Priority in employment of local people, especially project-affected people. ・Provision of job training for employment	
	(b)Is sufficient infrastructure (e.g., hospitals, schools, roads) available for the project implementation? If existing infrastructure is insufficient, is a plan developed to construct new infrastructure or improve existing infrastructure?	**Social infrastructures are fully available, and access roads had already been constructed.** ・In the time of constructing CCCGP1, necessary access roads had already been constructed. (2nd survey). ・Like CCCGP1, dormitories, recreation room, sports gym, and ground for workers will be furnished (2nd survey). ・The construction site will be near Navoi City. Thus, hospitals and other social infrastructure are fully available (2nd survey).	**Y**
	(c)Is there a possibility that large vehicle traffic associated with the project will affect road traffic in the surrounding areas? Are adequate measures considered to reduce the impacts on traffic, if necessary?	**Adequate mitigation measures are provided during construction period.** ＜Current Status＞ ・Nearby national road is wide and traffic volume is not so large (2nd survey). ＜Mitigation measures＞ ・ Slowdown of vehicles in the residential and school area. ・Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, klaxon).	Y
	(d)Is there a possibility that diseases (including communicable diseases, such as HIV) will be introduced due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	**Adequate mitigation measures are provided during construction period.** ＜Mitigation measures＞ ・Development of safety and sanitation management plan and implementation of regular medical checkup. ・The workers will have a medical examination every year ・Medical points will be set up ・The workers are required to submit the result of their medical examinations before they are employed (2nd survey).	Y
	(e)Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishing)?	- Forced draft cooling tower cooling system will be adopted, and intake of cooling water from the river is not necessary. - Less amount of river water will be taken compared to the old Unit 3 and 8 which used river water for cooling system.	**N**

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
4 Social Environment	**(3) Heritage**		
	(a)Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	**There is no historical, cultural, religious monument in the project site.** . The site is not known to have any precious archeological, historical, cultural and religious heritages and monuments (2nd local survey).	N
	(4) Landscape		
	(a)Is there a possibility that the project will adversely affect the local landscape, if there is any aesthetic landscape near the site? Are necessary measures taken?	**Serious influence on landscape is not assumed** ・The construction site is a place where people have many activities bound to power plant and houses. ・There is no particular scenery of which to give consideration (2nd local survey).	N
	(5) Ethnic Minorities and Indigenous Peoples		
	(a)Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	**The project site is not an area for minorities to live in groups.** ・The construction site is a place where people have many activities that is bound to power plant and houses. It is not a place where a minority group live together (2nd l survey).	N
	(b)Are the rights about the land and resources of an ethnic minority and indigenous people respected?	**The project site is not an area for minorities to live in groups.** ・The construction site is a place where people have many activities that is bound to power plant and houses. It is not a place where a minority group live together (2nd l survey).	N
	(6) Working conditions		
	(a)Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	**Laws and ordinances associated with the working conditions of the country will be enforced.** ・Project owner will implement the project in accordance with the labor law of the country (2nd survey). **Measures to individuals involved in the project on tangible safety considerations will be developed and conducted.** ＜Mitigation measures＞	**Y**

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
4 Social Environment	(b)Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?		**Y**
	(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public sanitation) for workers etc.?	**Measures to individuals involved in the project on intangible safety considerations will be planned and conducted.** ＜Mitigation measures＞ - Development of safety and sanitation management plan and implementation of regular medical checkup.	N
	(d)Are appropriate measures being taken to ensure that security guards involved in the project do not violate safety of other individuals involved, or local residents?	**Security guards will be placed from the security company** ＜Mitigation measures＞ ・Project owner will subcontract a security firm to deploy security guards. The security personnel trained by the security firm will be deployed (2nd l survey).	N

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
5 Others	**(1) Impacts during Construction**		
	(a)Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	**Adequate mitigation measures are provided during construction period.** ➢**Noise** ＜Mitigation measures＞ ・Periodic check up and maintenance of vehicles. ・Construction activity and traffic of vehicles is essentially limited to daytime. ・Use low-noise type equipment (silencer, muffler). ・Temporary soundproof wall around the project site. ➢**Vibration** ＜Mitigation measures＞ ・Periodic check up and maintenance of vehicles. ・Construction activity and traffic of vehicles is essentially limited to daytime. ・Use low-vibration type equipment (silencer, muffler). ➢ **Water pollution** ＜Mitigation measures＞ ・Installation of temporary rainwater drainage. ・Installation of temporary sedimentation pond and oil-separating system ・Storage of waste oil and chemical materials in a storage site and method to prevent permeation into ground. ・Installation of septic tank and temporary toilet. ➢ **Air pollution** ＜Mitigation measures＞ ・Periodic check up and maintenance of vehicles. ・Shutdown of engine during waiting time. ・The rear deck of the sand-transport trucks shall be covered. Periodic car wash. ・Periodic watering of the site and surrounding road in case of strong wind. ➢**Waste Solid waste** ＜Mitigation measures＞ ・Development of waste management program including education of workers to encourage reduction and reuse of waste. ・Prohibition of illegal dumping. ・Separation of waste by waste type, storage in an appropriate storage site and legal disposal in an appropriate disposal site.	N

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
5 Others	(b)If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	**Adequate mitigation measures for Air pollution, water pollution, etc. are provided during construction period.** ➢**Water pollution** ＜Mitigation measures＞ ・Installation of temporary rainwater drainage. ・Installation of temporary sedimentation pond and oil-separating system ・Storage of waste oil and chemical materials in a storage site and method to prevent permeation into ground. ・Installation of septic tank and temporary toilet. ➢ **Air pollution** ＜Mitigation measures＞ ・Periodic check up and maintenance of vehicles. ・Shutdown of engine during waiting time. ・The rear deck of the sand-transport trucks shall be covered. Periodic car wash. ・Periodic watering of the site and surrounding road in case of strong wind.	Y
	(c)If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	**Adequate mitigation measures are provided during construction period.** ➢ Employment ＜Mitigation measures＞ ・Priority in employment of local people, especially project-affected people. ・Provision of job training for employment ➢ Local community ・Access roads had already been constructed. ・In near Navoi City, hospitals and other social infrastructure are fully available. ＜Mitigation measures＞ ・.Provide dormitories, recreation room, medical points during construction - Development of safety and sanitation management plan and implementation of regular medical checkup. -The workers will have a medical examination -Slowdown of vehicles in the residential and school area. - Traffic of construction vehicles during school commuting hours shall be avoided. - Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, klaxon).	Y
	(2)Accident Prevention Measures		
	(a)In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles? (e.g., sprinkler systems).	**CCCGP No.2 is not a coal-fired power plant.**	N

	Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
5 Others	**(3)Monitoring**		
	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	**Monitoring during construction and operation phase will be conducted in order to assure the environmental impacts caused by the project.** ・Monitoring plan about potential impacts during construction and operation phase was prepared.	**Y**
	(b)How are the item of a monitoring plan, a method, frequency, etc. defined?	・Environmental Monitoring Plan (Item, Method, Frequency etc) are as below.	**Y**

Items, location, method, frequency, responsibility and expense of the environmental monitoring plan

Classification	**Item**	Parameter	**Method**	**Location**	**Frequency**	**Responsibility**	Expense
Construction phase	Air quality	NOx (NO, NO_2), Suspended particles (Dust)	Automatic mobile ambient air quality analyzers	2 point: west and south Residential area in the vicinity	- Quarterly - Once a week at the time	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/Navoi Thermal power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
	Noise	Noise level	Sound-level meter	2 point: project site west and south boundary 2 point: west and south residential area in the vicinity	- Quarterly - Once a week at the time	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/ Navoi Thermal power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
	River water quality	TSS, pH, Oil	- Analysis by sampling	2 point: in Zerafshan River, 100m upstream and 100m downstream of the outlet of waste water from temporary sedimentation pond.	- Quarterly	- Implementation: EPC Contractor/ Environmental Consultant - Supervisor: PIU/ Navoi Thermal power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
	Waste	Waste management practice in storage and disposal	- Contract and record	- Project site and camp and service facility for worker.	-Continuously	- Implementation: EPC Contractor -Supervisor: PIU/ Navoi Thermal power plant/Supervision Consultant	Expense is included in EPC contract cost by EPC Contractor.
	Grievances	Numbers, contents, and processing results of grievances	Record	Navoi Thermal Power Plant	-Continuously	Navoi Thermal Power Plant / Karamana Khokimiyat	Navoi Thermal Power Plant/PIU

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)								Yes: Y No: N
		Operation phase	Exhaust gas	NOx,	Continuous. Emission Monitoring System(CEMS)	Gas duct	-Continuously	Navoi Thermal Power Plant	CEMS: Expense is included in EPC contract cost by EPC Contractor.	
			Waste water	Temperature, pH, SS., Oil, DO, Nitrite, Nitrate, Sulfate, Chloride, Ca,Mg. Residual chlorine, Cr, Cu, Fe, Zn, Pb, Cd, Hg	- Analysis by sampling	Outlet of waste treatment facility	-Quarterly	Navoi Thermal Power Plant	Navoi Thermal power plant	
			Air quality	NOx (NO, NO_2.)	- Automatic ambient air quality analyzer and recorder	1 point: west residential are 2km from site	-Quarterly - Once a week at the time	Navoi Thermal power plant or Environmental Consultant	Equipment 80,000$ （Consultant）50,000$/year	
			River Water quality	Temperature, pH, DO, BOD, SS, Oil, Ammonia, Nitrite, Nitrate, Sulfate, Phenol, Chloride, Ca, Na, K, Phosphate, Fe, Cu, Zn, Cr, Pb	- Analysis by sampling	2 point: in Zerafshan River, 100m upstream and 100m downstream of the existing outlet of wastewater. (the current monitoring points)	- Quarterly	Navoi Thermal power plant	Navoi Thermal power plant	
			Noise	Noise level	Sound-level meter	2 point: project site west and south boundary 2 point: west and south Residential area in the vicinity	Twice a year	Navoi Thermal power plant or Environmental Consultant	Navoi Thermal power plant	
			Waste	Waste oil, sludge, domestic waste	Record	Storage sites	Twice a year	Navoi Thermal Power Plant	Navoi Thermal Power Plant	

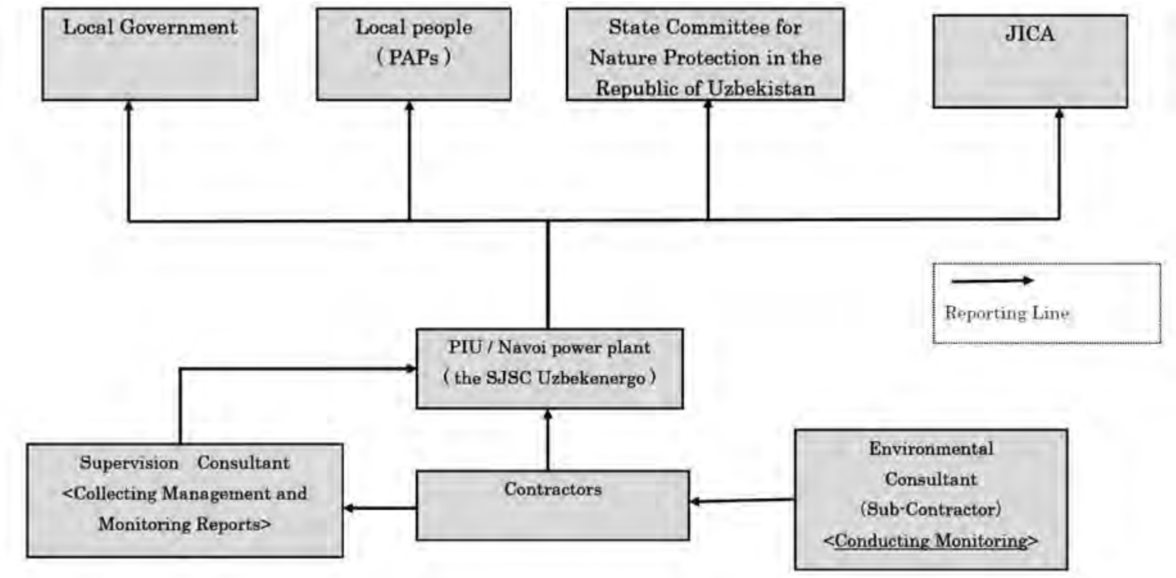
<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
<tr><td></td><td></td><td><table><tr><td></td><td>Grievances</td><td>The numbers, contents, and processing results of grievances</td><td>Record</td><td>Navoi Thermal Power Plant</td><td>Everyday</td><td>Navoi Thermal Power Plant / Karamana Khokimiyat</td><td>Navoi Thermal Power Plant</td></tr></table></td><td></td></tr>
<tr><td></td><td>(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?</td><td>**Monitoring framework including organization and equipment will be established, and adequate budget will be secured.**
・Same as the existing power plant, monitoring framework including organization and equipment will be established, and adequate budget will be secured.
・Organization structure for environmental monitoring implementation during construction and operation phase will be described as below.


Figure: Environmental Management and Monitoring Implementation Structure in Construction Phase</td><td>Y</td></tr>
</table>

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th><th>Yes: Y
No: N</th></tr>
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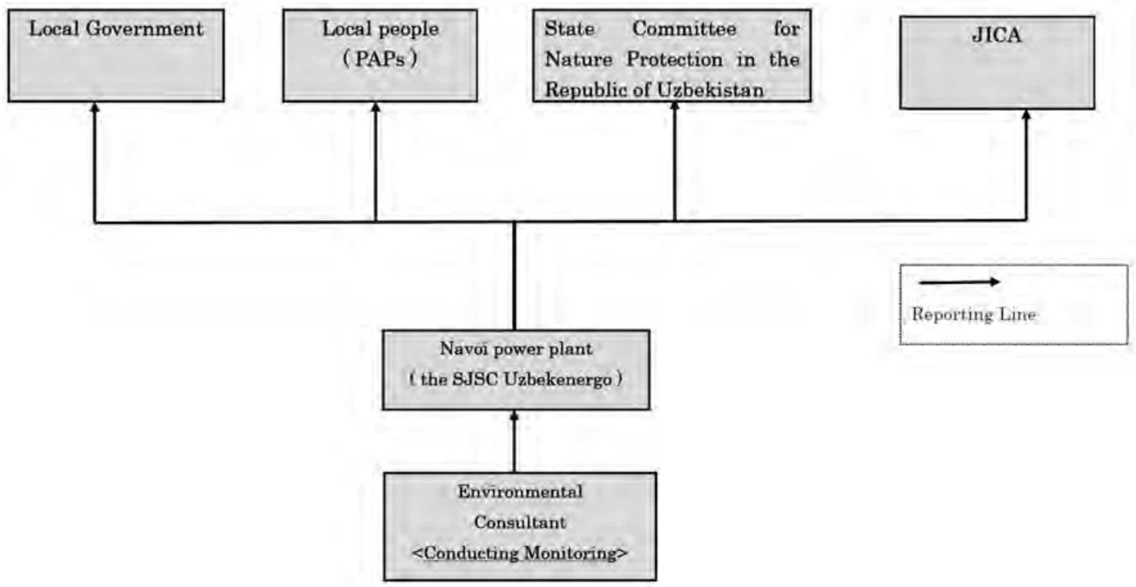

Figure: Environmental Management and Monitoring Implementation Structure in Operation Phase

</td><td></td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)	Yes: Y No: N
	(d)Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	**Regular reporting to the regulatory authorities will be conducted.** ・The environmental management administrator shall regularly conduct explanation to the local people and a report to the State Committee for Nature Protection, JICA and other relevant organizations about the environmental monitoring with frequency of twice a year during construction phase and once a year during operation phase.	Y
6 Note	**Reference to Checklist of Other Sectors**		
	(a)Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	・The existing power plants have already constructed most of the transmission lines. Thus, constructing new transmission lines for this project will be small in scale.	Y
	(b)Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	・This project will build no harbors.	N
	Note on Using Environmental Checklist		
	(a)If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).	・Adoption of high-efficiency combined cycle power generation system and maintenance of capacity of the facility. ・The reduction of CO2 emission concerning this project compared with an average power generation facility in Uzbekistan is more than 684,150 tons per year.	N

8.10.2 Monitoring Form

Items that require monitoring shall be decided on according to the sector and nature of the project, with reference to the following list of items.

1.Construction phase

1) Air pollution
Location: 2points (west and south residential area in the vicinity)
Regulation: Sanitary norms, rules and hygiene normative documents of the Republic of Uzbekistan. San PinNo.0015-94

Location:

(Parameter: NO_2 Unit μg/m^3)

Date	Measured Value		Uzbekistan maximum permissible concentration (MAC)		IFC/ EHC Guideline General;2007
	30min Min－Max	24hr Average Min－Max	30min	24hr	1hr
			85	60	200
				-	-
				-	-
				-	-
				-	-

Location:

(Parameter: Suspended particles,Unit μg/m^3)

Date	Measured Value		Uzbekistan maximum permissible concentration (MAC)		IFC/ EHC Guideline (General; 2007)
	30min Min－Max	24hr Average Min－Max	30min	24hr	24hr
			150	100	150
				-	-
				-	-
				-	-
				-	-

2) Noise
Location: 4 points (2 points :project site west and south boundary 2 points:west and south residential area in the vicinity)
Regulation: Protection from noise” (State committee of Uzbekistan for architecture and construction. Tashkent. 1996) (Norms for household construction)（KMK 2001.08-96）

Date;

(Unit: dBA)

Location	Min－Max	Uzbekistan Noise standards	IFC/ EHC Guideline (General; 2007) residential area	Remarks
Site west boundary		Residential area day: 55 night: 45	Residential area day: 55 night: 45	
Site south boundary				
Site west residential area				
Site south residential area				

3) Water pollution

・River water quality
Location: 2 points (100m upstream and 100m downstream of the outlet of waste water from temporary sedimentation pond in Zerafshan River)
Regulation: Rules for protection of surface water from contamination by discharge water.（San Pin No.0056-98）

Location:
Sampling Date:

Item	Unit		Environmental standard in Uzbekistan	Remarks
pH	—		6.5- 8.5	
DO	mg/ℓ		Summer: 4.0 or higher Winter: 6.0 or higher	
BOD	mgO2/ℓ		3.0	
SS	mg/ℓ		30	
Oil	mg/ℓ		0.05	
Ammonia	mg/ℓ		0.08	
Nitrite	mg/ℓ		0.08	
Nitrate	mg/ℓ		40	
Sulfate	mg/ℓ		100	
Phenol	mg/ℓ		0.001	
Chloride	mg/ℓ		300	
Calcium	mg/ℓ		180	
Sodium	mg/ℓ		120	
Potassium	mg/ℓ		50	
Phosphate	mg/ℓ		0.01	
Fe	mg/ℓ		0.5	
Cu	mg/ℓ		0.001	
Zn	mg/ℓ		0.01	
Cr	mg/ℓ		0.5	
Pb	mg/ℓ		0.03	

4) Waste

Location: site and camp and service facility for worker.
Regulation: RD 118,0027714.60-97
Nature protection.Treatment of waste from production and consumption.Terms and definitions. Goskompriroda of Uzbekistan. Tashkent. 1997.

Date;

(Unit: t or kg)

Item	Hazardou Class	Place of generated waste	Storage amount	Disposal amount	Disposal method and place

5) Grievance

Date	Name	Contents	Status	Results	Remarks

2 Operation phase

1) Air pollution

- **Emission concentration**

Location: Gas duct
Regulation: GOST 29328-92
Date:

Parameter	Unit	Min –Max	Excess period of the standard	GOST 29328-92	IFC/ WB EHC Guideline (Thermal Power Plant; 2008) <Gas fuel>	Remarks
NO_X	mg/Nm^3			51	51	Gas

Note dry gas base,O_2=15%

- **Ambient air quality**

Location:1point (west residential are at 2km from site)
Regulation:Sanitary norms, rules and hygiene normative documents of the Republic of Uzbekistan. San Pin No. 0015-94
Date:

(Parameter: NO_2 Unit μg/m^3)

Month	Measured Value			Uzbekistan maximum permissible concentration (MAC)		IFC/WB EHC Guideline General;2007	
	30min Min－Max	24hr Average Min－Max	All Average	30min	24hr	1hr	1year
				85	60	200	40

2) Noise

Location: 4 point (2 points :project site west and south boundary 2points:west and south residential area in the vicinity)
Regulation: Protection from noise” (State committee of Uzbekistan for architecture and construction. Tashkent. 1996) (Norms for household construction)（KMK 2001.08-96）
Date;

(Unit: dBA)

Location	Min－Max	Uzbekistan Noise standards	IFC/ EHC Guideline (General; 2007) residential area	Remarks
Site west boundary		Residential area day: 55 night: 45	Residential area day: 55 night: 45	
Site south boundary				
Site west residential area				
Site south residential area				

3) Water pollution

a. Waste water

Location: Outlet of waste treatment facility

Regulation: Rules for protection of surface water from contamination by discharge water.（San Pin No.0056-98）

Sampling Date:

Parameter	Unit		Uzbekistan Standard for Navoi Power plant	IFC/ WB EHC Guideline (Thermal Power Plant; 2008)	Remarks
Temperature	—		—	—	
pH	—		6.5－8.5	6.5－9.0	
SS	mg/ℓ		487	50	
Oil	mg/ℓ		0.112	10	
Dissolved inorganic	mg/ℓ		1,500	―	
Nitrite	mg/ℓ		3.3	―	
Nitrate	mg/ℓ		45	―	
Sulfate	mg/ℓ		500	―	
Chloride	mg/ℓ		350	―	
Calcium	mg/ℓ		487	―	
Magnesium	mg/ℓ		170.1	―	
Residual chlorine	mg/ℓ		―	0.2	
Total chromium	mg/ℓ		―	0.5	
Copper	mg/ℓ		―	0.5	
Iron	mg/ℓ		4.62	1.0	
Zinc	mg/ℓ		―	1.0	
Lead	mg/ℓ		―	0.5	
Cadmium	mg/ℓ		―	0.1	
Mercury	mg/ℓ		―	0.005	
Arsenic	mg/ℓ		―	0.5	

ｂ.River water quality

Location: 2 points (100m upstream and 100m downstream of the existing outlet of wastewater in Zerafshan River)

Regulation: Rules for protection of surface water from contamination by discharge water.（San Pin No.0056-98）

Location:

Sampling Date:

Item	Unit		Environmental standard in Uzbekistan	Remarks
pH	―		6.5- 8.5	
DO	mg/ℓ		Summer: 4.0 or higher Winter: 6.0 or higher	
BOD	mgO2/ℓ		3.0	
SS	mg/ℓ		30	
Oil	mg/ℓ		0.05	

Ammonia	mg/ℓ		0.08	
Nitrite	mg/ℓ		0.08	
Nitrate	mg/ℓ		40	
Sulfate	mg/ℓ		100	
Phenol	mg/ℓ		0.001	
Chloride	mg/ℓ		300	
Calcium	mg/ℓ		180	
Sodium	mg/ℓ		120	
Potassium	mg/ℓ		50	
Phosphate	mg/ℓ		0.01	
Fe	mg/ℓ		0.5	
Cu	mg/ℓ		0.001	
Zn	mg/ℓ		0.01	
Cr	mg/ℓ		0.5	
Pb	mg/ℓ		0.03	

4) Waste

Location: Stroage sites

Date:

Item	Storage Amount	Disposal Amount	Remarks
Sludge			
Waste oil			

5) Grievance

Date	Name	Contents	Status	Results	Remarks

Appendix 8-1 LARAP

UZBEKENERGO LAND ACQUISITION AND RESETTLEMENT ACTION PLAN (LARAP)

for the Navoi Thermal Power Station Modernization Project

January, 2013

TABLE OF CONTENTS

ABBREVIATIONS

AB	Affected Business
ANSI	American National Standard Institute
APs	Affected Persons
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
C/P	Counterpart
CCCGP	Combined Cycle Cogeneration Plant
CCPP	Combined Cycle Power Plant
CDM	Clean Development Mechanism
CSS	Country Safeguard System
Df/R	Draft Final Report
DI	Design Institute
DP	Displaced Person
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMA	External Monitoring Agency
ES	Engineering Stage
EPC	Engineering, Procurement and Construction Contract
FIRR	Financial Internal Rate of Return
F/R	Final Report
F/S	Feasibility Study
GFP	Grievance Focal Point
GRC	Grievance Redress Committee
GT	Gas Turbine
GTW	Gas Turbine World
HH	Household
HHV	Higher Heating Value
HP	High Pressure
HRSG	Heat Recovery Steam Generator
I&C	Instrumentation and Control
Ic/R	Inception Report
IA	Implementing Agency
IMA	Internal Monitoring Agency
IFC	International Finance Corporation
IP	Illegal Persons
IPP	Independent Power Producer
ISO	International Standard Organization
JICA	Japan International Cooperation Agency
JSC	Joint Stock Company
LAR	Land Acquisition and Resettlement

LARAP	Land Acquisition and Resettlement Action Plan
LARC	Land Acquisition and Resettlement Committee
LC	Land Code
LHV	Lower Heating Value
LP	Low Pressure
MW	Mega Watt
NG	Natural Gas
NGO	Non-Governmental Organization
NHC	National Holding Company
NOx	Nitrogen Oxide
O&M	Operation and Maintenance
ODA	Official Development Assistance
OEM	Original Equipment Manufacturer
PIU	Project Implementation Unit
PSA	Poverty and Socio-Economic Assessment
PSS/E	Power System Simulator for Engineering
RP	Resettlement Plan
ROW	Right Of Way
SPS	Safeguard Policy Statement
SJSC	State Joint Stock Company
SOx	Sulfur Oxide
ST	Steam Tribune
SUELICS	State Unitary Enterprise Land and Immovable Cadastre Service
TA	Technical Assistance
TEPSCO	Tokyo Electric Power Services Co., LTD.
TPP	Thermal Power Plant
TPS	Thermal Power Station
UE	State Joint Stock Company “Uzbekenergo”
USD	United States Dollar
Uzbekistan	Republic of Uzbekistan
VAT	Value Added Tax
W/S	Work Shop
WB	World Bank

GLOSSARY OF TERMS

Affected Persons	Term used to describe all people that are affected by the project impacts. In the context of LARAP it refers to those that are economically or physically displaced by the project.
Compensation	Term means payment in cash or kind for an asset to be acquired or affected by a project at replacement cost at current market value.
Cut-off-date	Term means the date after which people will NOT be considered eligible for compensation, i.e. they are not included in the list of APs as defined by the census. Normally, the cut-off date is the date of the detailed measurement survey.
Displaced Persons	Sometimes referred to as Affected Persons (APs).In the context of involuntary resettlement, displaced persons are those who are physically displaced (relocation, loss of residential land, or loss of shelter) and/or economically displaced (loss of land, assets, access to assets, income sources, or means of livelihoods) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas.
Economic Displacement	Loss of land, assets, access to assets, income sources, or means of livelihoods as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas.
Encroachers	Term means those people who move into the project area after the cut-off date and are therefore not eligible for compensation or other rehabilitation measures provided by the project.
Entitlement	Term means the range of measures comprising cash or kind compensation, relocation cost, income rehabilitation assistance, transfer assistance, income substitution, and relocation which are due to /business restoration which are due to APs, depending on the type and degree nature of their losses, to restore their social and economic base.
Hokim	An Executive Head in the Republic of Uzbekistan (the same as governor or mayor). There are province, district and city/town hokims. Hokim is a head of local authority organization – Hokimiyat.
Inventory of losses	Term means the pre-appraisal inventory of assets as a preliminary record of affected or lost assets.
Land acquisition	Term means the process whereby a person is compelled by a public agency to alienate all or part of the land s/he owns or possesses, to the ownership and possession of that agency, for public purposes, in return for fair compensation.
Makhalla	A traditional neighboring community. At present the term means an administrative and territorial unit in the Republic of Uzbekistan. The unit has local public authorities – makhalla committee.
Meaningful Consultation	A process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v)enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.
Non-titled	Term means those who have no recognizable rights or claims to the land that they are occupying and includes people using private or state land without permission, permit or grant i.e. those people without legal title to land and/or

	structures occupied or used by them. JICA's policy explicitly states that such people cannot be denied compensation.
Poor	Official government statistics for share of people living under poverty line[1] is not available. The method used to determine poverty, was based on the World Bank's under $2.15 per person per day measure (see: http://www.undp.uz/en/mdgs/?goal=1).This figure was calculated with respect to climate conditions and other set of factors. The local equivalent was calculated based on the official exchange rate.
Physical Displacement	Relocation, loss of residential land, or loss of shelter as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas.
Replacement cost	Term means the method of valuing assets to replace the loss at current market value, or its nearest equivalent, and is the amount of cash or kind needed to replace an asset in its existing condition, without deduction of transaction costs or for any material salvaged.
TEPSCO	Study Team of Preparatory Survey on Navoi Thermal Power Station Modernization Project.
Vulnerable	Term means any people who might suffer disproportionately or face the risk of being marginalized from the effects of resettlement and includes; (i) female-headed households with dependents; (ii) disabled household heads; (iii) poor households (within the meaning given previously); (iv) landless; (v) elderly households with no means of support; (vi) households without security of tenure; (vii) ethnic minorities; and (viii) marginal farmers (with landholdings of five acres or less).

CURRENCY EQUIVALENTS

(as of 15 September, 2012)
Currency Unit – Uzbekistan Sum (UZS)
UZS 1.00 = $0.00052
$1.00 = UZS 1,930.25

NOTE

In this report,

– "$" refers to United States dollars (USD)

– "UZS" refers to Uzbekistan Sum (UZS)

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[1] There is no term "poverty line" in the official usage of Uzbek Government. The terms "be in straitened circumstances" and "lower-income families" are using in the legal documents. The social aid is paying for "lower-income families" if the average total monthly income per family member is less than 1.5 minimum monthly wage fixed by Government. At the moment the minimum monthly wage is equal 79,590 UZS (40.3 USD). So, an average monthly income per family member must be less than 119,385 UZS (60.4 USD) for receipt of the social aid.

I. EXECUTIVE SUMMARY

This Land Acquisition and Resettlement Action Plan has been prepared based on the information as of January 2013. If there are gaps between this LARAP and the Minutes of Discussions of Appraisal which has done subsequently, the Minutes of Discussion of Appraisal should prevail.

1. This Land Acquisition and Resettlement Action Plan (LARAP) has been developed by Center for Social and Marketing Research “Expert-Fikri”. It follows the format and includes the required information as specified in JICA’s Guidelines for Environmental and Social Considerations[2] and The World Bank’s Operational Policy (OP 4.12 – Involuntary Resettlement). It is based on survey carried out in October 2012.

2. The data provided by this LARAP is not completed, so final alignment during detailed design will require a new review and additional information on the part of State Joint Stock Company “Uzbekenergo”. To ensure that impact and other data is updated based on the final design and guarantee that the DPs are fully compensated or rehabilitated before their land is taken, the following basic project implementation conditions related with this LARAP have been established:

- Contract awards for civil work construction will be approved only after LARAP has been reviewed and confirmed the final detailed design.

3. The main objective of this LARAP is to provide an effective guideline to the State Joint Stock Company “Uzbekenergo” (UE) and the Project Implementation Unit (PIU) to implement land acquisition and compensation along JICA’s Guideline and the World Bank OP’s principles; the requirements of the prevailing legal norms of Uzbekistan; and, in compliance with the JICA’s Guidelines. The Table 1 shows the summary of LAR cost.

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[2] See: www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/guideline100326.pdf

Table 1. LAR Cost Summary		
	'000 UZS	**$US**
Compensation for land		
Land Preparation Costs*	20,000	10,361
Compensation		
Housing and Structures	1,233,656	641,501
Trees	7,831	4,072
Support and Assistance		
Structures for illegal	39,400	20,488
Other Costs		
Resettlement Consultant under PIU**	to be estimated later	to be estimated later
Sub-Total	**1,300,887**	**676,422**
Contingency (10%)	130,089	67,642
TOTAL	**1,430,976**	**744,064**

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*"Land Preparation Costs" may be increased because 20 mil sum is cost of independent company who estimate cost of land and houses only. Other land preparation cost such as land registration cost is not estimated yet.

** Resettlement consultant is to be estimated later because TOR of Resettlement consultant is not determined yet.

I.1. Project Scope

4. The Project comprises the construction of a new Unit of combined-cycle plant at Navoi Thermal Power Station. The new Unit (450MW) is going to be adjacent to another combined-cycle plant, which has been constructed in 2012, on the side of the local highway M-37 (see the Map 1). Construction of this Unit involves relocation of a high voltage (220kV) power lines, - as shown in Map 1.

5. This project intends to decommission units No. 3 and 8 (310 MW in total) of the existing Navoi Thermal Power Plant (1,250 MW) near the Navoi City, Uzbekistan by 2015 and to construct CCCGP No. 2 featuring high efficient cogeneration plant with a power generation capacity of 450 MW on the site adjacent to this plant. It is considered that CCCGP No. 2 may have different systems from CCCGP No. 1, since this plant contains facilities for supplying a large quantity (200 Gcal/hr. at the maximum) of heat (in the form of steam and hot water).For example, the heat recovery steam generator (HRSG) is equipped with a duct firing system and the firing capacity may be much greater than CCCGP No. 1 to produce far more amount of heat energy (please see Map 1).

I.2. Summary of Impacts

6. Tables 2 and 3 show a summary of the key of assets that will be acquired. 33 households will be affected due to the project. 23 inhabited households will be provided the alternative land and monetary compensation.

7. Although, 10 uninhabited houses are determined to be illegal at the court, the expense for the uncompleted houses will be paid by the Navoi TPS as a support activity.

Table 2. Summary of Impacts

No.	**Type of impact**	**Quantity**
1	Private structure completed – inhabited	23
	Vulnerable households	(11)
2	Uncompleted houses (without roof or walls) ‐ uninhabited	10
	Total households	**33**

Table 3. Summary of Affected Structures

Households		Land (Ha)			Structures Lost		Displaced Persons	
No.	*Household'sNumber (ID)*	*Total*	*Lost*	*%*	*No.*	*m^2*	*M*	*F*
"Uyrot" makhalla								
1	Household No. 1	0.07	0.07	100%	1	405.0	2	1
2	Household No. 2	0.33	0.33	100%	1	1,460.3	4	1
3	Household No. 3	0.06	0.06	100%	1	258.3	1	4
4	Household No. 4	0.13	0.13	100%	1	524.2	2	2
5	Household No. 5	0.03	0.03	100%	1	385.4	3	1
6	Household No. 6	0.28	0.28	100%	1	323.2	1	1
7	Household No. 7	0.08	0.08	100%	1	158.4	2	3
8	Household No. 8	0.18	0.18	100%	1	310.9	1	4
9	Household No. 9	0.07	0.07	100%	1	167.8	1	4
10	Household No. 10	0.06	0.06	100%	1	227.2	1	1
11	Household No. 11	0.17	0.17	100%	1	177.1	2	2
12	Household No. 12	0.24	0.24	100%	1	348.1	3	3
"Yangiobod" makhalla								
13	Household No. 13	0.02	0.02	100%	1	275.0	2	4
14	Household No. 14	0.14	0.14	100%	1	158.9	2	2
15	Household No. 15	0.01	0.01	100%	1	47.5	1	2
16	Household No. 16	0.02	0.02	100%	1	168.6	3	1
17	Household No. 17	0.06	0.06	100%	1	108.2	2	1
18	Household No. 18	0.07	0.07	100%	1	219.5	2	2
19	Household No. 19	0.05	0.05	100%	1	173.0	1	2
20	Household No. 20	0.07	0.07	100%	1	215.2	3	2
21	Household No. 21	0.05	0.05	100%	1	160.7	2	2
22	Household No. 22	0.06	0.06	100%	1	192.1	2	2
23	Household No. 23*	0.08	0.08	100%	2	293.5	1	2
24	Household No. 24**	0.06	0.06	100%	2	54	1	7
25	Household No. 25**	0.08	0.08	100%	1	180	3	1
26	Household No. 26**	0.08	0.08	100%	1	192	2	3
27	Household No. 27**	0.08	0.08	100%	2	178	1	4
28	Household No. 28**	0.12	0.12	100%	1	200	3	3
29	Household No. 29**	0.08	0.08	100%	1	108	1	1
30	Household No. 30**	0.08	0.08	100%	1	76	2	2
31	Household No. 31**	0.08	0.08	100%	2	92	1	3
32	Household No. 32**	0.06	0.06	100%	1	45	2	2
33	Household No. 33**	0.06	0.06	100%	2	103	1	3
Total		**3.11**	**3.11**	**100%**	**38**	**7,986**	**61**	**78**

* This household was included in the "legal" list after Decree of Hokim on 17 October 2012 was issued.

** These are uninhabited households that didn't get registration in District Cadastre.

Map 1. Location of the Areas of Resettlement within the Project Zone

II. PROJECT DESCRIPTION

8. This section provides a general description of the project, its components and the alternatives considered to avoid or minimize resettlement.

II.1. General Description

9. According to Resolution by President of the Republic of Uzbekistan dated 19.08.2009 No. PP-1196 the construction of combined-cycle at Navoi Thermal Power Station was approved and included in the Investment Program of Uzbekistan for 2009-2012.

10. The proposed investment program targets the construction of combined-cycle plant at Navoi Thermal Power Station (TPS) project is financed through JICA. The Executing Agency for the Project is the State Joint Stock Company "Uzbekenergo".

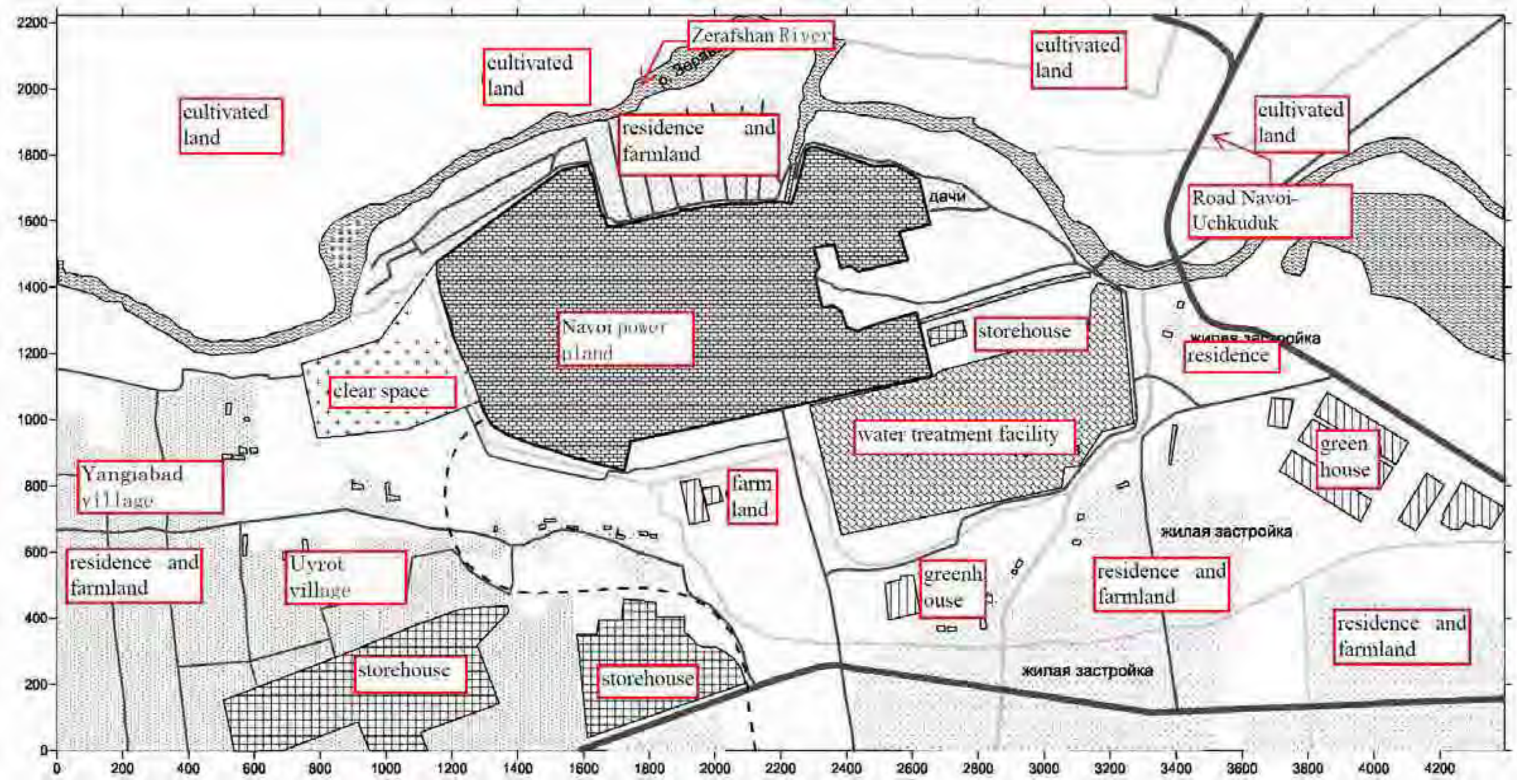
II.2. Project Area

11. This Project intends to decommission units No. 3 and 8 (310 MW in total) of the existing Navoi Thermal Power Plant (1,250 MW) near the Navoi City, Uzbekistan by 2015 and to construct CCCGP No. 2 featuring high efficient cogeneration plant with a power generation capacity of 450 MW on the site adjacent to this plant.

12. Uzbekistan is characterized by typical continental climate consisting of a very hot summer, comparatively cold winter, a great temperature difference between daytime and night time, and dry weather with little precipitation. The planned project site is adjacent to the existing Navoi thermal power plant located in the suburbs of Navoi of Uzbekistan approximately 360 km west-southwestern (WSW) of Tashkent, capital of Uzbekistan. The CCCGP No.2 (450MW) power plant is considered to require a site area of approximately 9.0 ha.

13. The existing Navoi power plant site is located 6km northwest of Navoi City, at altitude of 334.2m, with the area of approximately 100ha. The land facing the north side of the site is farmland and residential area, and the south side is the residential area of Uyrot Village and the road connecting Tashkent and Bukhar. In the east side, the residential area of Michurin Village, Zerafshan River, and the road connecting Navoi and Uchkuduk are located. The west side is the mixture of residential area and farmland of Yangiobod Village; the residential area is located up to about 2.5km from the power plant, and only farmland exists beyond that point. The near residential area from the existing power plant site is located 650m west and 400m south west of the site (Map 2).

Map 2: Land use around Navoi thermal power plant



Ⅱ.3. Alternatives Considered

14. Consideration of the zero option: In the case where CCCGP No.2 is not constructed and the existing old-type power plants (Unit 3 and Unit 8) continue operation, the air quality around the plant area will remain in a bad condition, the reliability of the facility will decrease, and the risk of accident will increase.

15. Consideration of the alternative project site: In the EIA, the north end of the existing power plant site is considered as an alternative site for constructing CCCGP No.2 (Figure 1).However, further consideration of this plan was called off by the reasons described in the table 4 below. The current proposed site facing the west of CCCGP No.1, even though resettlement of 33 households is predicted, is considered the most favorable alternative.

Table 4: Comparison of the alternative site

Item	The north end of the existing power plant site（Site A）	The site facing west of CCCGP No1 (proposed site) （Site B）
Techniques	-Construction of gas supply facility is necessary within the operating plant site and the construction activity involves high risk.	New site and low risk for construction of gas supply facility.
Topology	-Not enough space for construction activity. -Not enough space for constructing a storage facility.	-Enough space for construction activity. -Enough space for constructing a storage facility.
Resettlement	-Destruction and resettlement of the existing 200 living houses and 400 summer houses within the site is predicted.	-There is no house within the site and no resettlement is predicted. -There are 23 houses and basis of 10 houses within ROW of Transmission line.

16. Consideration of the ROW of transmission line: In order to reduce the number of resettlement, the ROW of transmission line was considered.

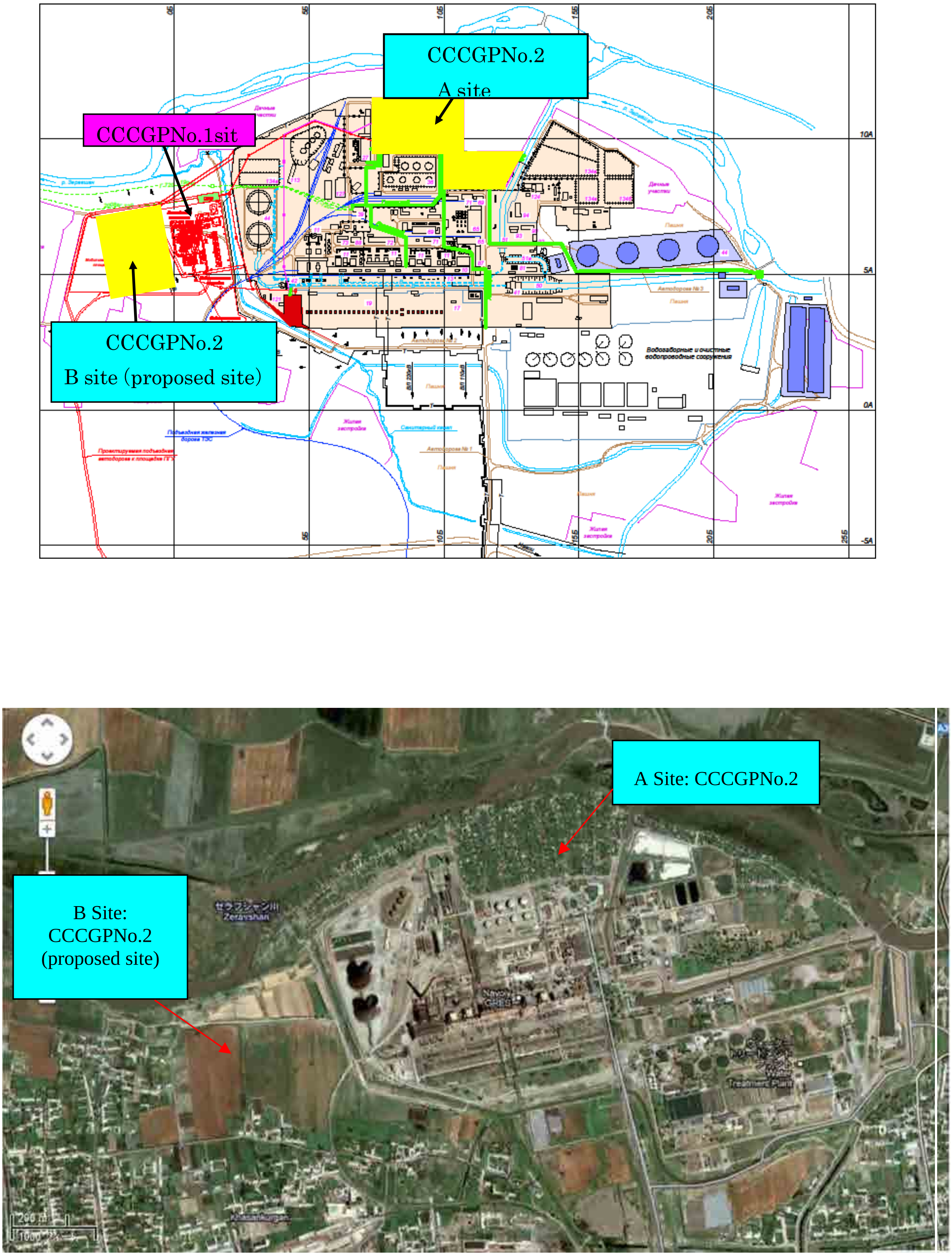


Figure 1: Location of Alternative project site A and B

17. The DI has designed the proposed Units with relocation of high voltage power line within the constraints of several criteria.

18. **Key Infrastructure Objects** – The proposed General Plan tries to lay the high voltage power line closer to the existing highway M-37 and another small rural road (not marked in Map 1), and to avoid all significant telecom, water, gas, electricity and cell-phone infrastructure where possible.

19. **Existing Businesses and Households** – Where possible, businesses, households, agricultural fields and temporary structures have been avoided in the designs provided by the DI. This follows existing Uzbekistan Law that requires the minimization of all impacts. Nevertheless, the high voltage power line exposure area is going to cover a number of residential households and agricultural plots of land which will need to be relocated for the realization of the Project. These will be the subject of this Land and Resettlement Action Plan (LARAP).

III. SCOPE OF LAND ACQUISITION AND RESETTLEMENT

20. This section discusses the project potential impacts, the scope of land acquisition and summarizes the key effects in terms of acquired assets and displaced persons.

III.1. Project Impacts

21. The Project is going to significantly affect two makhallas located in close proximity to the designed second Unit of Navoi TPS – “Uyrot” (12 HHs) and “Yangiobod” (11 HHs). All the residential buildings and household outbuildings in these makhallas are to be alienated and demolished since they fall into the area of the high voltage power line relocation (see Annex 2).

22. A resolution was issued by Karmana District Hokim № 605-K of 11th July, 2012 (see Annex 4) on forming a special commission to estimate the size of compensation to citizens whose households fall into the resettlement zone.

23. Besides, there are 10 households located at makhalla “Yangiobod” that were refused by local authorities to register as the legal owners of assets on the using land plots. The main official cause for this decision is that these owners didn’t live on the land plots. According to the rule of the State Cadastre the persons who didn’t complete the construction on their land plots and didn’t live there can be refused in the registration. Anyway, this is the official cause to refuse them in registration.[3]

III.2. Scope of Land Acquisition and Resettlement

24. The Project will affect to 33 households located at two makhallas “Uyrot” and “Yangiobod” (see Annex 8). These households will be entirely demolished because they are into the zone of action of the high voltage power line closer to the existing highway M-37.

25. Thus, there are 139 DPs at this zone. All of the DPs will be needed of the compensations and another types of help. The complete list of affected households with DPs you can see in the Table 3 above.

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[3] There are the legal causes to refuse in registration. In the “Directions on the procedure for official registration of the rights to land plots in the Republic of Uzbekistan” registered by Ministry of Justice of the Republic of Uzbekistan (No. 736 May 27, 1999) it is the following: “4.3. The rights to land plots are registered on the basis of the following documents: - when there emerges the right of ownership of the land plot - on the basis of the official warrant to the right of ownership, purchase-and-sale contracts and other documents specified under the law; - when there emerges the right of possession and use of the land plot - on the basis of a decision to allocate a land plot taken by an appropriate authority (an official)…”. The “illegal households” have no any required by law documents.

IV. SOCIOECONOMIC INFORMATION AND PROFILE

IV.1. Economic and Social Development in Navoi Province and Karmana District

26. Navoi Province is located in the central part of Uzbekistan. The area of the province constitutes 110.8thousand square kilometers or 24.8% of total area of the country. Population is 886 thousand. The volume of GDP of Navoi Province was 3,681 billion UZS ($1.907 billion), GDP per capita – $2,152.[4]

27. The structure of Navoi Province GDP is formed from industry (45% GDP), construction (25% GDP) and agriculture (22% GDP). The biggest enterprises of Navoi Province are Navoi mining-and-metallurgical Integrated works, “Navoiazot”, “Electrokhimzavod”, “Kyzylkum-cement”, Navoi TPS, etc.[5]

28. Karmana District is located in the south of Navoi Province. The area of the district constitutes 0.95 thousand square kilometers or less than1% of total area of the province. Population is 105.6 thousand (12% of total population of the province, ethnic Uzbeks – 91%).

29. The main specialization of Karmana District is the agriculture (cotton, wheat). There are some enterprises on the territory of Karmana District, including one of the biggest –Navoi TPS.[6]

IV.2. Poverty and Socioeconomic Assessment

30. This Project is going to affect the territory adjacent to Navoi TPS, with 33 households falling into the resettlement zone. According to the TEPSCO survey, the households are going to be relocated within the same settlement, at a distance of, approximately, 2-3 kilometers from their current location.

31. The relocation place was selected because the place is near the current residential area, main road, public facilities such as schools, basic infrastructures like electricity and gas line has been installed close to the site. Affected households agree with the relocation places.

IV.3. Project Census

32. The project census was undertaken over period 10th to 18th September, 2012. The census data were added during the second and third visits in the affected area in November 1st to 4th and December 1st to 3rd. It comprised the household questionnaire made by TEPSCO and Expert-Fikri. Most of the respondents were willing to answer the questions and tell about their concerns as to their possible resettlement. There were no problems with gathering information in makhalla “Uyrot” because all the households in this makhalla are residential; however, there were some difficulties in gathering information in makhalla “Yangiobod” where most of the buildings are not residential but yet incomplete, hence not listed in the State Cadastre.

33. In addition, the resettlement survey by the district and the survey by an independent evaluation consultant/agency that “Uzbekenergo” hires which was been conducted for land resettlement by this project.

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[4] The State Committee of the Republic of Uzbekistan on statistics: http://www.stat.uz/en/reports/214/

[5] The official site of Navoi Province Hokimiyat: http://www.navoi.uz/ru/aboutnavoi/potential/general_info/

[6] The official site of Navoi Province Hokimiyat: http://www.navoi.uz/ru/abouthokim/cityhokimiyats/

Household Structure

Table 5. Household Composition by Gender and Age

№	Household No.	Gender		Number of household's member:				
		Male	*Female*	*working*	*college student*	*pensioner, housewife*	*school and preschool children younger 18 years old*	*unemployed older 18 years old*
Makhalla "Uyrot"								
1	Household No. 1	2	1	1	1	1		
2	Household No. 2	4	1	2			3	
3	Household No. 3	1	4	2			3	
4	Household No. 4	2	2				2	2
5	Household No. 5	3	1			1	2	1
6	Household No. 6	1	1			2		
7	Household No. 7	2	3	1		1	3	
8	Household No. 8	1	4	2			3	
9	Household No. 9	1	4	1		1	3	
10	Household No. 10	1	1			2		
11	Household No. 11	2	2	1		1	2	
12	Household No. 12	3	3	2		1	3	
Makhalla "Yangiobod"								
13	Household No. 13	2	4	1		1	4	
14	Household No. 14	2	2	1			2	1
15	Household No. 15	1	2	1			2	
16	Household No. 16	3	1	1		1	2	
17	Household No. 17	2	1	1		1	1	
18	Household No. 18	2	2	1		1	2	
19	Household No. 19	1	2	1		1	1	
20	Household No. 20	3	2	1		1	3	
21	Household No. 21	2	2	1		1	2	
22	Household No. 22	2	2	1		1	1	1
23	Household No. 23 *	1	2	1		1	1	
"Illegal persons" from makhalla "Yangiobod"								
24	Household No. 24	1	7	2			4	2
25	Household No. 25	3	1	1		1	2	
26	Household No. 26	2	3	1		3	1	
27	Household No. 27	1	4	1		2	1	1
28	Household No. 28	3	3	1		1	2	2
29	Household No. 29	1	1	1			1	
30	Household No. 30	2	2			1	2	1
31	Household No. 31	1	3				2	2
32	Household No. 32	2	2	1			2	1
33	Household No. 33	2	2			1		3

* This household was included in the "legal" list after Decree of Hokim on 17 October 2012 was issued.

Education

34. The census showed that of all the adult household members aged 18+ (75 persons including "illegal households"), 61% had secondary education, 21% – college or technical school, 11% – higher or incomplete higher and 7% – less than 9 grades. All the children of school age attend secondary school. 88% of the households have children attending secondary schools or preschool facilities.

Employment

35. Of all the adult household members (18years old and over – 75 persons), 52% work somewhere, 23% are housewives, 11% are pensioners, and 12% are permanently or temporary unemployed. 23% of 39 all employed members work at the Navoi TPS, 26% of them work at 'Navoiazot' enterprise, 5% (2 persons) – outside Uzbekistan, 5% (2 persons) – self-employed, and 41% (17 persons) work at other enterprises (state and private).

36. 80% of all the employed household members' positions do not require specialized formal education (driver, watchman, worker, guard), and 20% – require such education (inspector, operator, foreman, engineer).

Household Income and Expenditures[7]

37. The average monthly income per households is 535,000 UZS ($277); that is 4,400 UZS ($2.28) per household member a day. This amount is somewhat higher than $2.15 (4,150 UZS) – the poverty level established by the World Bank and other international organizations in Uzbekistan as a required minimum per person a day for purchasing basic food items.

Table 6.Household Income from the Different Sources

Source of income	Per household		Per person		% of 22 HH
	1,000 UZS	*USD*	*1,000 UZS*	*USD*	
Wages or salary	377	195	92	48	70.4
Pensions received from government	62	32	15	8	11.6
Money earned from vegetables and fruits from own or lease land	22	12	5	3	4.2
Money earned from animal breeding and selling	17	9	4	2	3.1
Money earned from small trade or small business	14	7	3	2	2.5
Loan	9	5	2	1	1.7
Scholarships received by students	7	3	2	1	1.2
Other	28	15	7	4	5.3
TOTAL	535	277	131	68	100.0

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[7] The data were collected only for 22 households that really live in the replacement area.

Table 7. Household Average Expenditures by Different Items

Item	Per household		Per person		% of 22HH
	1,000 UZS	*USD*	*1,000 UZS*	*USD*	
Food	5,675	2,940	63	33	60.8
Clothes	955	494	11	5	10.2
Education	860	446	10	5	9.2
Health care/medicines	498	258	6	3	5.3
Utilities	487	252	5	3	5.2
Fuel	227	118	3	1	2.4
Recreation	205	106	2	1	2.2
Taxes	117	61	1	1	1.3
Other	312	162	3	2	3.3
TOTAL	9,336	4,836	104	54	100.0

38. The main share of average household expenses is for food (60.8%) and clothes (10.2%) (Table 7). 50% of the households (# 2, 3, 5, 9, 13, 14, 15, 17, 18, 19 and 20) are living below the poverty line, and will need certain allowances to be paid to them since they fall under the category of vulnerable groups.

39. One of the households is comprised of three different families (# 2, 4 and 6 in Table 5). A 75-year old pensioner, household NO.6 has the highest income and actually supports his eldest son's family in which neither the son himself nor his wife work. Besides, one of household No.4's sons is disabled.

IV.4. Gender and Ethnic Minority Issues

40. A single woman with two small children (aged 9 and 10) lives in household #15. She is disabled (is lame in one leg), however, she still works because disability pension is somewhat less than the salary she is being paid at the Navoi TPS. That is why she does not apply for a pension (the Law does not allow to work and get disability pension at the same time).

41. Apart from this case, the census did not reveal any gender or ethnic minority problems.

IV.5. The "Illegal Persons" (IP)

42. In this paragraph it will be described the situation with the 10 households in makhalla "Yangiobod". Karmana District Cadastre refused to register the 10 households. The uninhabited houses are determined to be illegal at the court, but the expense for the completed houses will be paid by the Navoi TPS as a support activity.

IV.6. Inventory of Loss (IOL)

43. The loss for land, buildings and trees is shown in Table 8-10.

Table 8. Land Required for the Project

No	Household No.	Land (ha)		
		Total	**Acquired**	**%**
Makhalla “Uyrot”				
1	Household No. 1	0.07	0.07	100%
2	Household No. 2	0.33	0.33	100%
3	Household No. 3	0.06	0.06	100%
4	Household No. 4	0.13	0.13	100%
5	Household No. 5	0.03	0.03	100%
6	Household No. 6	0.28	0.28	100%
7	Household No. 7	0.08	0.08	100%
8	Household No. 8	0.18	0.18	100%
9	Household No. 9	0.07	0.07	100%
10	Household No. 10	0.06	0.06	100%
11	Household No. 11	0.17	0.17	100%
12	Household No. 12	0.24	0.24	100%
	Total for makhalla “Uyrot”	**1.70**	**1.70**	**100%**
Makhalla “Yangiobod”				
13	Household No. 13	0.02	0.02	100%
14	Household No. 14	0.14	0.14	100%
15	Household No. 15	0.01	0.01	100%
16	Household No. 16	0.02	0.02	100%
17	Household No. 17	0.06	0.06	100%
18	Household No. 18	0.07	0.07	100%
19	Household No. 19	0.05	0.05	100%
20	Household No. 20	0.07	0.07	100%
21	Household No. 21	0.05	0.05	100%
22	Household No. 22	0.06	0.06	100%
23	Household No. 23	0.08	0.08	100%
	Total for makhalla “Yangiobod”	**0.63**	**0.63**	**100%**
	Total for both makhallas	**2.33**	**233**	**100%**
“Illegal persons” from makhalla “Yangiobod”				
24	Household No. 24	0.06	0.06	100%
25	Household No. 25	0.08	0.08	100%
26	Household No. 26	0.08	0.08	100%
27	Household No. 27	0.08	0.08	100%
28	Household No. 28	0.12	0.12	100%
29	Household No. 29	0.08	0.08	100%
30	Household No. 30	0.08	0.08	100%
31	Household No. 31	0.08	0.08	100%
32	Household No. 32	0.06	0.06	100%
33	Household No. 33	0.06	0.06	100%
	Total for “Illegal persons”	**0.78**	**0.78**	**100%**

Table 9. Loss of Structures			
No	**Household Number**	**Type of structure**	**Affected area (m^2)**
Makhalla "Uyrot"			
1	Household No. 1	Housing and household outbuildings	405.0
2	Household No. 2	Housing and household outbuildings	1,460.3
3	Household No. 3	Housing and household outbuildings	258.3
4	Household No. 4	Housing and household outbuildings	524.2
5	Household No. 5	Housing and household outbuildings	385.4
6	Household No. 6	Housing and household outbuildings	323.2
7	Household No. 7	Housing and household outbuildings	158.4
8	Household No. 8	Housing and household outbuildings	310.9
9	Household No. 9	Housing and household outbuildings	167.8
10	Household No. 10	Housing and household outbuildings	227.2
11	Household No. 11	Housing and household outbuildings	177.1
12	Household No. 12	Housing and household outbuildings	348.1
	Total for makhalla "Uyrot"		**4,745.9**
Makhalla "Yangiobod"			
13	Household No. 13	Housing and household outbuildings	275.0
14	Household No. 14	Housing and household outbuildings	158.9
15	Household No. 15	Housing and household outbuildings	47.5
16	Household No. 16	Housing and household outbuildings	168.6
17	Household No. 17	Housing and household outbuildings	108.2
18	Household No. 18	Housing and household outbuildings	219.5
19	Household No. 19	Housing and household outbuildings	173.0
20	Household No. 20	Housing and household outbuildings	215.2
21	Household No. 21	Housing and household outbuildings	160.7
22	Household No. 22	Housing and household outbuildings	192.1
23	Household No. 23	Housing and household outbuildings	293.5
	Total for makhalla "Yangiobod"		**2,012.2**
"Illegal persons" from makhalla "Yangiobod"			
24	Household No. 24	basis	54
25	Household No. 25	basis	180
26	Household No. 26	basis	192
27	Household No. 27	basis	178
28	Household No. 28	basis	200
29	Household No. 29	basis	108
30	Household No. 30	basis	76
31	Household No. 31	basis	92
32	Household No. 32	basis	45
33	Household No. 33	basis	103
	Total for "Illegal persons"		**1,228.0**

Table 10 Loss of Trees

No	Household Number	Type of structure	Affected trees
Makhalla "Uyrot"			
1	Household No. 1	Trees	35
2	Household No. 2	Trees	6
3	Household No. 3	Trees	33
4	Household No. 4	Trees	39
5	Household No. 5	Trees	2
6	Household No. 6	Trees	98
7	Household No. 7	Trees	23
8	Household No. 8	Trees	161
9	Household No. 9	Trees	21
10	Household No. 10	Trees	77
11	Household No. 11	Trees	28
12	Household No. 12	Trees	129
	Total for makhalla "Uyrot"		652
Makhalla "Yangiobod"			
13	Household No. 13	Trees	78
14	Household No. 14	Trees	13
15	Household No. 15	Trees	
16	Household No. 16	Trees	
17	Household No. 17	Trees	
18	Household No. 18	Trees	
19	Household No. 19	Trees	23
20	Household No. 20	Trees	
21	Household No. 21	Trees	
22	Household No. 22	Trees	
23	Household No. 23	Trees	
	Total for makhalla "Yangiobod"		114

V. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

44. This section outlines the consultation and participation processes that have already been undertaken to prepare the LARAP and those that are required during its update and implementation.

V.1. Project Stakeholders

45. The project consists of a number of stakeholders, all of whom will have some involvement in the RP process and mitigation of impacts. These were identified early in the RP process and targeted through a series of consultations. They include:

- Displaced Persons.
- Local officials from Karmana District Hokimiyat and include cadastral, road, environment, medical, economic and rural committee members.
- Land and resettlement Committee Members (LARC).
- Representative of Citizen’s Gathering from “Yangi Aryk” Village, “Uyrot” Makhalla and “Yangiobod” Makhalla.

V.2. Summary of Project Consultations

- **Public consultation**

46. Summary of Project Consultations are shown the below.

Table 11: Summary of Project Consultations

1st

Date and Time	December 20th, 2012
Language	Uzbek
Attendance	Representatives of Makhalla Representatives of District Managing Director of Navoi HES 31 affected households (The other 2 households did not attend this meeting. These households are about to start constructing houses, not residing at this moment.)
Agenda	Project Description Land Acquisition and resettlement
Remarks	

2nd

Date and Time	February, 2012
Language	Uzbek
Attendance	Navoi State Governor Representatives of Makhalla Representatives of District Managing Director of Navoi HES 33 affected households
Agenda	Compensation to the affected households
Remarks	- Navoi State Governor explained to the affected households that 33 households were not entitled to receive compensation since they are illegal residents. - Navoi State Governor, however, decided to provide compensation to the affected households because of the complaints from the residents.

3rd

Date and Time	May, 2012
Language	Uzbek
Attendance	Navoi State Governor Representatives of Makhalla

	Representatives of District Managing Director of Navoi HES 33 affected households
Agenda	Compensation to the affected households
Remarks	- Resolution was issued, and only residents that are actually residing in the affected properties are entitled to receive compensation. - Uzbekenergo hired an independent agency for evaluating replacement cost of buildings, and the cost survey started in July.

4th

Date and Time	August 29th, 2012
Language	Uzbek
Attendance	Representatives of Makhalla Staff of Navoi HES TEPSCO members Special Commission on determining the amount of the compensation and type of compensation for the citizen Chairman of local resettlement, Uyrot Village Citizen's Gathering, Chariman of local residential area "Yangiobod", Chairman of local residential area "Uyrot", Deputy of Navoi HEP
Agenda	Explanation of JICA project Progress of resettlement
Remarks	- Real estate agency has been conducting asset inventory survey at each affected household. The survey on 12 households to be relocated in Uyrot village has already been finished, and approval signatures on the survey result have been acquired. The survey on the remaining 11 households in Yangiobod village will be completed by September 10th. - The resettlement site will be prepared at about 2km away from the power plant site. - One household receives 600m2 of land at the resettlement site, totaling 4.4ha of land been prepared. - The procedure of the resettlement is as follows: 1) notifying the residents, 2) conducting social survey, 3) acquiring residents' approvals on asset inventory survey and the survey result, 4) calculating compensation cost, 5) paying compensation, 6) preparing land by local government, 7) constructing houses by residents, 8) relocating to the new site. - Consultation to the residents has been conducted since NO.16-68 was issued on December 27th, 2011. - Compensation will be paid based on the market price. - The alternative site located at north of the existing power plant has about 400 of summer houses (temporary residential houses) and about 200 of permanent residential houses.

5th

Date and Time	October 30th, 2012
Language	Uzbek
Attendance	Resettled residents Navoi TPS Director Navoi TPS Deputy Director Navoi TPS Assistant Director Navoi TPS Chairman of a union Navoi TPS of PIU Navoi TPS Chief of information Navoi TPS Secretary Navoi region, Karmana District, Hokim Karmana District, Makhalla "Yangiobod", Posbon Karmana District, Rural Citizen Assembly "Yangiobod", Chairman Karmana District, Makhalla "Uirot", Chairman Karmana District, Makhalla "Yangiobod", Chairman Karmana District, Makhalla "Yangiobod", Female Issues Consultant Karmana District, Makhalla "Yangiobod", Secretary Karmana District, Chief of Land and Assets Cadaster Karmana District, Deputy Chief of Architecture and Construction Department Residents and representatives of JICA and TEPSCO

Agenda	Opening remarks, project description Presentation of the project Speech by Governor of Karmana district Questions and Answers, Discussion with residents to be resettled
Remarks	- Residents have no objection to the new project. - Governor Ismatov proposed the residents to begin construction on new allocated sites today at their own expense. Compensation money will be paid in spring, so that they could start construction the main building. - According to the law, monetary compensation cannot be made by cash.

•Stake holder meeting.

47. The main goals of these consultations are: (a) to identify DPs' concerns and needs related to the development and implementation of the RP; (b) to define DPs' preferences as to the type and form of compensation to be provided to them; (c) to minimize DPs' concerns and assure them of transparency of all the actions related to the RP; (d) to help avoid unnecessary delays in the progress and implementation of the Project.

48. This Project triggered the discussion among the general public and stakeholders. In particular, there were conducted several meetings during the second visit of TEPSCO to Navoi (27-31 October 2012) both with households falling under the RP and with different official representatives of local authorities (Karmana District Hokim, Makhalla committee chairman, etc.).

49. During the meetings with DPs (presentation of the draft version of the LARAP, 30 October 2012), JICA's guideline, compensation policy and entitlement, grievance redress mechanism and resettlement schedule were explained. Participants did not voice any doubts that representatives of local authorities were trying to make people say something that was not actually true. All the participated in this meeting DPs know that their households will be relocated as a result of the Project implementation and expansion of Navoi TPS (the list of the participants in this meeting see in the Annex3). Ten households who were considered as illegal households did not attend this meeting.

50. Representatives of local authorities (Karmana District hokim and chairman of makhalla committee who is also in charge of "Uyrot" and "Yangiobod" makhallas to be resettled) showed their willingness to do their best so that the DPs did not suffer any damage as a result of the resettlement.

51. At the same time, after the meeting the TEPSCO Team was met by the few people who complained that Navoi Province Hokim refused them in compensation for their destroyed assets as the result of the expansion of Navoi TPS.

52. As it turned out these people have the land plots at Makhalla "Yangiobod" but don't have the legal papers for ones. Some years ago these people have purchased the land plots from the certain local farmer who doesn't live now in Karmana District. The permission for this deal was received from previous Karmana Hokim but it was the illegal deal because a land cannot be a subject of purchase and sale according to Uzbek Law (Land Code, Articles 16, 17). So, the new Karmana Hokim said that he cannot offend against law.

53. Of course, such answer could not satisfy the "illegal persons" as we name of these people from Makhalla "Yangiobod". They are complaining for the current situation and requiring satisfy their requirements about the providing of the new land plots.

54. The list of the "illegal persons" (10 persons – households' heads) as the following:

Household No.24	– land plot 0.06 ha and 2 non-built houses (only foundation),
Household No.25	– land plot 0.08 ha and 2 non-built houses (1 – only foundation and 1 – without roof),
Household No.26	– land plot 0.08 ha and 4 non-built rooms (only walls),

Household No.27 – land plot 0.08 ha and 4 built living rooms and toilet room (but they didn’t live there),

Household No.28 – land plot 0.12 ha and 4 non-built living rooms (only foundation),

Household No.29 – land plot 0.08 ha and 3 non-built rooms (only walls),

Household No.30 – land plot 0.08 ha and non-built house (only walls),

Household No.31 – land plot 0.08 ha and non-built house (without roof),

Household No.32 – land plot 0.06 ha and non-built house (only foundation),

Household No.33 – land plot 0.06 ha and non-built house (only foundation)

V.3. Further Information Disclosure

55. Further information disclosure will occur once approval of the RP has been obtained by the UE and JICA.

56. The full RP (translated into Uzbek) will be distributed to each makhalla for display and reference by all APs. An index sheets outlining each DP, maps of the new land plots, assets and entitlements will also be on available for review. All DPs have been informed of this, and understand that they will be able to provide comments or grievances through the normal channels.

57. Details of the updated implementation timeline, procedures and activities; entitlement matrix; and, grievance procedures will be provided at that time to each DP. The updated LARAP (in English) will be disclosed, and prior to any resettlement activities.

VI. GRIEVANCE REDRESS MECHANISM

58. This section describes mechanisms to receive and facilitate the resolution of affected persons' concerns and grievances.

VI.1. General Principles

59. JICA's Guideline requires that a grievance redress mechanism is established and maintained. It should be designed to efficiently receive and facilitate the resolution of affected peoples' concerns and grievances about project levels social and environmental issues. The grievance redress mechanism should be scaled to the risks and impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people.

VI.2. Grievance Coordination

60. The contact details:
Mr. Sh.Ismatov (Governor of Karama District)
Address: Karamana District, SSG Yangi-Ariq, MSG Talqoq

Mr. G. Mamatov (Chairman of Makhalla Yangiobod)
Address: Uyrot ishogi QFY Makhalla Yangiobod
Tel: +998 79 436-603-71-83

Mr. N.Ergashev (Chairman of Makhalla Uyrot)
Address: Karamana District Uyrot QFY, Makhalla Uyrot,

61. GFP is an organization handling all the complaints from the local inhabitants, and is established within Makhalla which is an organization of the inhabitants, and within districts which is an administrative organization.

62. The GFP will be assisted and supported by members of the District Land and Resettlement Committee (LARC) who will maintain a register of complaints, keep track of their status and report to the PIU's Head. They will regularly track complaints received, actions taken and the status of resolution. Complaint forms will be distributed to the heads of local makhalla's and the District GFP to facilitate recording of complaints.

VI.3. Grievance Procedures

63. The APs should be informed in prepared brochures on all contacts and contacts persons (GFP) responsible for the realization of the resettlement project. They will be able to call or submit personally any complaints to these persons. There should also be envisaged a possibility of a GFP's visit directly to a place of resettlement.

64. The duration for redressing all the complaints or requests submitted by the APs is one week. If there is no reaction to the APs' complaints within this period, APs should be able to turn to District GFP (e.g. in writing a complaint, faxing it, etc.) if necessary.

65. The District GFP will have one week from the day of submission of a complaint to provide a well-reasoned reply to APs and take an appropriate decision. The written complaint and attempts will be registered to be solved it. If complaint is not resolved in one week, it is passed by the GFP to the District LARC for resolution.

66. In the event that a satisfactory answer cannot be provided, the written complaint and attempts with the AP will be registered in the Land Acquisition and Resettlement Committee (LARC) the District Hokimiya to be resolved it. If a solution is not reached within two weeks, the LARC refers it to UE PIU.

67. UE PIU will assist the activities of the GFP and LARC to resolve the complaints and makes a decision within two weeks. If the District is not able to resolve the dispute within the elapsed time, the UE PIU will have further two weeks to resolve the issue. If the decision is still unacceptable to the AP, the APs can take it to the District Court although all court costs (preparation and representation) will be paid for by the project – no matter the outcome.

68. The District Court will make a final decision. The decision will bind on all parties. Table 12 shows the summary of grievance procedure.

Table 12. Summary of Grievance Procedure

Step	Stage in Response Handling	Required Activities
1	Makhalla Head or Makhalla GFP	Verbally responds to questions and/or complaints. If no response within one week, or response is unsatisfactory, AP prepares a grievance in writing (utilize standard forms where possible).
2	District GFP	Registers the written complaint and attempts to solve it. If complaint is not resolved in one week, it is passed by the GFP to the District LARC for resolution.
3	District Land Acquisition and Resettlement Committee (LARC)	Registers the written complaint and attempts to resolve it with the AP within two weeks. If a solution is not reached, the LARC refers it to UE PIU.
4	Uzbekenergo PIU	Assists in the activities of the GFP and LARC in the resolution of complaints. Makes a decision within two weeks. In the event that the District is not able to resolve the dispute within the elapsed time, the UE PIU will have further two weeks to resolve the issue. If the decision is still unacceptable to the AP, they make take it before the District Court, with all costs paid for by the project.
5	District Court of Law	The District Court hears the case and makes a final decision that is binding on all parties.

VII. LEGAL FRAMEWORK

69. This section describes National and Local Laws and the gaps with JICA Policy.

VII.1. Relevant Provisions for Involuntary Resettlement in Uzbekistan

70. There are no laws or legislation in Uzbekistan that specifically address matters related to involuntary resettlement. Rather land acquisition is governed by the following laws and resolutions:

- **The Civil Code. –** This Code is enacted by Oliy Majlis of Uzbekistan No. 257-I of August 29, 1996. Amended according to different laws of Uzbekistan of 1996-2012.
- **The Land Code. –** This Code is approved by the Statute of Uzbekistan No. 598-I of April 30, 1998. Amended according to Division XIX of the Statute of Uzbekistan of August 30, 2003, item 41 of the Statute of Uzbekistan of December 3, 2004.
- **The State Land Cadastre. –** This Law is approved by the Statute of Uzbekistan No. 666-I of August 28, 1998. Amended according to different laws of Uzbekistan of 2002-2004.
- **The State Cadastre. –** This Law is approved by the Statute of Uzbekistan No. 171-II of December 15, 2000. Amended according to different laws of Uzbekistan of 2002-2011.
- **Cabinet of Ministers Resolution on "Order of realization into private property of objects of trade and public services together with land plots where they are located, and land plots into life inheritance tenure". –** This Resolution No. 126 is adopted of April 11, 1995. Amended according to Resolution of CM No. 202 of April 30, 1999.
- **Cabinet of Ministers Resolution on "Order of compensation of citizens' and legal entities' losses due to land plots acquisition for state and public needs". –** This Resolution No. 97 is adopted of May 29, 2006. Amended according to Resolutions of CM No. 248 of November 9, 2010 and No. 146 of May 25, 2011.
- **Annex to Cabinet of Ministers Resolution No. 97. –** This Annex includes all prime rules and regulation that assign the order of compensation.

71. Collectively, these regulations provide a sound basis for acquiring land for public purposes and for compensating land users according to the registered use of the land.

VII.2. JICA's Policy on Involuntary Resettlement (IR)

72. JICA's main principle of involuntary resettlement is finding a way to avoid it if possible by analyzing all actual alternatives. The meetings with local authority's representatives and the analysis of the developed Project for construction of two new Units of Navoi TPS showed that there are no alternatives to involuntary resettlement within the frames of this Project.

73. That is why, all the APs should receive proper compensation and support so that they could improve, or at least restore, their customary way of life and earn incomes at the level existing prior to the realization of the Project. Compensation should be based on the cost of replacement in the maximum fullest extent. Compensation and other types of assistance should be provided prior to resettlement.

74. When developing the LARAP, JICA's policy towards IR is also being agreed with the World Bank Strategy specified in the OP (Operating Policy) 4.12 Involuntary Resettlement (December, 2001).

75. The Government of Uzbekistan will use the Project Resettlement Policy (the Project Policy) for the Navoi Thermal Power Station Modernization Project specifically because existing national laws and regulations have not been designed to address involuntary resettlement according to international practice, including JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitate themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs based on the type and degree of their losses. Where there are gaps between

the Uzbekistan legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.

76. Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.

77. Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.

78. Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:

- Standard of living adversely affected;
- Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;
- Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

79. All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

80. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.

81. People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition.

82. Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities.

83. The resettlement plans will be designed in accordance with Uzbekistan's Land law and JICA's Policy on Involuntary Resettlement.

84. The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups.

85. Payment for land and/or non-land assets will be based on the principle of replacement cost.

86. Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal land titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skill development, wage employment, or self-employment, including access to credit. Solely cash compensation will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project.

87. Replacement lands, if the preferred option of PAPs, should be within the immediate vicinity of the affected lands wherever possible and be of comparable productive capacity and potential. As a second option, sites should be identified that minimize the social disruption of those affected; such lands should also have access to services and facilities similar to those available in the lands affected.

88. Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.

89. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.

90. PAPs will be involved in the process of developing and implementing resettlement plans.

91. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.

92. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Government.

93. Displacement does not occur before provision of compensation and of other assistance required for relocation. Sufficient civic infrastructure must be provided in resettlement site prior to relocation. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases. (Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be ongoing activities.)

94. Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

95. Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified NGOs, research institutions or universities.

96. The cut-off-date of eligibility refers to the date prior to which the occupation or use of the project area makes residents/users of the same eligible to be categorized as PAPs and be eligible to Project entitlements. In the Project, the cut-off date is the first date of census survey including illegal households. The establishment of the eligibility cut-off date is intended to prevent the influx of ineligible non-residents who might take advantage of Project entitlements

97. Principle of Replacement Cost: All compensation for land and non-land assets owned by households/shop owners who meet the cut-off-date will be based on the principle of replacement cost.

Replacement cost is the amount calculated before displacement which is needed to replace an affected asset without depreciation and without deduction for taxes and/or costs of transaction.

VII.3. Comparison of Uzbek and JICA Guidelines, Regulations and Procedures

98. The main variations between Uzbekistan laws/regulation and JICA IR policy are outlined in Annex 1. Any key differences have been resolved in favor of JICA policy, particularly in areas where practices are less subject to independent oversight.

99. Comparison of the Uzbekistan LAR Policy with the JICA Involuntary Resettlement Policy indicates that key elements of the JICA Policy are present – particularly those related to valuation of immovable property. The JICA's principle of avoidance or minimization of resettlement is reflected in Uzbekistan Legislation.

100. The key policy difference regards DPs without title, or registration (businesses and structures). In order to remedy this, Uzbekistan has ensured that all land and structures will be registered prior to resettlement, at no cost to the DP, and then transferred or compensated under the relevant entitlement.

101. Overall, Uzbekistan's Country Safeguard System (CSS) is approaching that of JICA Guidelines for Environment and Social Consideration. The main area of concern is the application of laws in practice before and during construction – where differences have been noted in the field. This is mainly an issue of information dissemination to those responsible for implementation at the district level. This has been addressed in the information dissemination activities during preparation, and will be a core area for the monitoring activities during the LAR update and implementation.

VII.4. Actions Made to Address the Gaps

102. In this section, it will be necessary to mention measures taken to overcome the gaps in Uzbek legislation and JICA's policy towards involuntary resettlement. Please refer to the following table 13;

Table 13: Comparison of JICA and Uzbekistan Policy Pertaining to Land Acquisition and Resettlement

JICA Resettlement Policy	Uzbekistan Law	Remarks/Conclusions
DPs should be involved in meaningful consultation	DPs are involved in Province and Government officials	National legislation does not provide for public consultation This LARAP provides for meaningful consultation and information dissemination
Preference will be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based	Since the Land is owned by state, Land Code does not recognize individual ownership of land, but only permits use of land	Practice has to be in conformance
Lack of title should not be a bar to compensation or rehabilitation secured tenure to relocation land Untitled land owners are eligible for compensation for improvements to the land, at full replacement cost	People apply for registration for a particular land use Untitled land use is ineligible for compensation	Non-titled land user will receive either rehabilitation assistance equal to the land improvements they have undertaken after they register it accordingly at Project cost; or, Equivalent land titled similar to those with title
All houses/buildings are compensated for damage or demolition caused by a project irrespective of the status of formal title	All houses/buildings/shops which are registered under Land Code are valued at the respective regional/district level Unregistered buildings are not liable for compensation	All buildings compensated at current replacement cost (not market value) Unregistered buildings will be registered at project cost, prior to compensation
Prompt replacement of assets with better housing at resettlement sites with comparable access to employment and production opportunities Pay compensation and provide other resettlement entitlements before physical or economic displacement	Buildings are compensated at replacement value Payments are not made during construction	All buildings are compensated at current replacement cost (not market value) 100%of payments to be made prior to resettlement Resettlement to be completed prior to road construction beginning
Crop losses compensation to be provided to landowners and sharecroppers/lease tenants whether registered or not	Construction waits for harvest. If unable to wait then crops are compensated No compensation unless titled land	Titled and non-title downers will receive full compensation for all losses of trees and standing crops Untitled land will be registered at no cost to allow compensation to be paid
DPs should be compensated for all their losses at replacement cost	A commission will assess value of agricultural land; loss of crop/tree income; and market value for lands appropriated	All losses are at replacement cost –in the case of land, crops, trees etc. this is based on prevailing market rates
DPs should be timely compensated	Compensation will occur prior to construction of works	In compliance. All LAR activities, compensation, finalization of relocation, construction of replacement assets will occur prior to Construction

JICA Resettlement Policy	Uzbekistan Law	Remarks/Conclusions
DPs should be compensated and/or assisted, so that their economic or social future is generally as favorable as it would have been without the Project	RU law has social policies for all citizens. No specific policy directed at DPs	JICA Policy is followed using livelihood allowances and income/social restoration activities
Assess past and current involuntary resettlement risks	Only the current IR situation is assessed, whether legal or not	Where fees and taxes have been charged due to initial project preparation (such as title and registration charges), these will be repaid by the project following formal application to grievance committee
Pay particular attention to vulnerable groups especially those below the poverty line, the landless, the elderly, women and children, and indigenous peoples, and those without legal title to land	All DPs are treated equally under Uzbek Law	The LARP will include schemes and benefits targeted at vulnerable groups
Establish a grievance redress mechanism to receive and facilitate resolution of the affected persons' concerns	Resettlement has a standard mechanism to address grievances	Practice has to be in conformance
Provide DPs with transitional support and development assistance, such as land development, credit facilities, training, or employment opportunities	No specific policy. Covered under RU social policies	The JICA's policy will be followed where possible with activities contained in the GAP
Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards	RU policy relates to compensation only. Living standard improvement applies to all citizens. DPs are not specifically targeted	JICA's policy is to ensure that all DPs are brought up to minimum standards through the project. This relates to land, housing and livelihood
Develop procedures in a transparent, consistent, and equitable manner Ensure coercion or power differentials do not adversely impact DPs negotiations or grievances	RU policy ensures that all negotiations are conducted in an equitable and transparent manner	Practice has to be in conformance Monitoring will ensure that these policies are followed

103. The actions taken should be reflected in Minutes of Meeting prepared and signed by UE. This document should guarantee the following:

- Compensation will be provided for all relocated residential and household outbuildings at the market prices existing at the moment of resettlement.
- Those APs who do not have proprietary rights will be provided with means of existence for rehabilitation at the new place.
- APs from vulnerable groups will be provided with additional subsidies or assistance.
- All APs having land plots will be provided with similar land plots at the new place.

VII.5. Principles and Policies for the Project

104. The JICA's policy regarding involuntary resettlements lies in the fact that the valuation of DPs' property and assets should be at the replacement value. The JICA's practices also recognize this principle to ensure protection of interests and the well-being of the DPs.

105. The LARAP sets eligibility and entitlement provisions establishing compensation rates in accordance with guidelines from the Land Code of the Republic of Uzbekistan and JICA Guidelines for Environmental and Social Considerations.

106. The compensation policy is as follows;

Cut-off date

- According to Chapter V, the first public consultation was held on 20th December, 2011. On that day, the project outline, land acquisition and resettlement has been noticed to the affected 33 households. Therefore, 20th December, 2011 has been decided as Cut-off date for this project.

Compensation for Land

- 23 households are entitled to receive land compensation of 0.06 ha per each household.
- 23 households have been/will be registered by Land Cadastre so that they can hold the right to use the land. Then they will receive the compensation.
- In addition to the 0.06 ha of land compensation, the legal households (23 HHs), that own more than 0.06 ha of their building area, are entitled to receive monetary compensation.

Compensation for Buildings, Tree

- Monetary compensation for buildings, trees, crops, etc. are provided based on the replacement cost researched by the survey which is been conducted by an independent evaluation consultant/agency that "Uzbekenergo" hires.
- 23 households which are not engaged in agriculture will not be compensated for crops since they do not earn their living with crops.
- The expense for the houses of 10 uninhabited illegal households will be paid by Navoi TPS as an support activity. Karamana District has discussed with each household and 10 households have decided amount of expenses by themselves. Karamana District has requested UE to pay the expenses.

Responsibility

- All the compensation cost will be paid by "Uzbekenergo".
- As for land compensation, it is Karmana District that will receive budget from Navoi TPS for land compensation and provide the land (0.06 ha per household) to the affected households.

- As for monetary compensation for other assets including insufficient land, trees, it is “Uzbekenergo” that will pay the compensation directly to the affected households.

107. The following principles for the compensation/rehabilitation of families affected by the Project were explained to the DPs and stakeholders during consultations:

- There will be some permanent acquisition of land and buildings. Identification compensation and assistance will be provided prior to any construction commencing.
- All affected persons (APs) (identified before the cut-off date) will receive compensation even if they are without title or formal recognition. This includes any temporary residential structures, informal agricultural activities or temporary business use.
- All construction through agricultural land will be timed to minimize any impacts on the income and activities of adjoining land parcels.
- A defined grievance procedure has been established. When a land owner or user does not agree with a decision regarding compensation or change of the ownership or land use (lease), it may not be exercised before the dispute is resolved judicially. In addition, any person who feels that they are in any way worse off can take their grievance to the highest level, at the cost of the project.
- Those people who face significant impacts (more than 10% of their land being affected and/or physically displaced from housing) will receive additional support, assistance and compensation.
- Vulnerable groups, including female-headed households, the poor, disabled, or families with significant numbers of elderly members will receive additional support, assistance and compensation to ensure that they are not severely affected.
- DPs may use and exercise their rights to a land plot and make necessary expenditures in compliance with its purpose after notification on acquisition for public needs until compensation is agreed. However, there will be no entitlement to additional compensation based on these improvements.

VIII. ENTITLEMENTS, ASSISTANCE, AND BENEFITS

108. This section outlines DP's entitlements and eligibility and describes all resettlement assistance measures including an entitlement matrix. It also specifies all assistance to vulnerable groups, including women, and other special groups; and outlines opportunities for affected persons to derive appropriate development benefits from the project.

VIII.1. Entitlements for Compensation

109. The following groups of affected persons (APs) are included in the LAR and also will be addressed in this Land Acquisition and Resettlement Action Plan (LARAP) for the Project:

- all DPs losing land either with legal title, lease holding land rights or without legal status,
- owners of buildings, crops, plants, or other objects attached to the land (registered and unregistered).

VIII.2. Formalization of Title/Registration

110. To enable the Project to compensate unregistered land users under Uzbekistan laws, representatives from the District Cadastral Offices have advised affected land users to register or update the registration of their lands and structures. Under the LARAP those who have unregistered land or structures will be registered free of charge prior to compensation. This will be facilitated by the UE.

111. The assets/structures on the affected plots of land users without titles shall be evaluated by exactly the same criteria as those with titles.

VIII.3. Calculation of Compensation and support

112. This section will outline how compensation has been calculated for each component of the RP, and a summary of that calculation.

1. Land

113. Compensation for the land will be on a "land for land" basis, with land being provided to owners by the District Hokimiyat following assessment by LARC. Such land will be of equal value/productivity in a nearby location and with comparable associated services/ facilities, or compensation to provide such services. Transaction cost, registration fees, if any, will be borne by the Project.

114. For DPs using land without a formal lease, their land will be formalized without any cost to the DP. The land will then proceed under normal process.

115. A total of 3.11 hectare of land is required for the Project. All DPs will lose 100% of their land. Table 13 shows a summary of the land required.

Table 14. Land Required for the Project				
No	**Household No.**	**Land (ha)**		
		Total	**Acquired**	**%**
Makhalla "Uyrot"				
1	Household No. 1	0.07	0.07	100%
2	Household No. 2	0.33	0.33	100%
3	Household No. 3	0.06	0.06	100%
4	Household No. 4	0.13	0.13	100%
5	Household No. 5	0.03	0.03	100%
6	Household No. 6	0.28	0.28	100%
7	Household No. 7	0.08	0.08	100%
8	Household No. 8	0.18	0.18	100%
9	Household No. 9	0.07	0.07	100%
10	Household No. 10	0.06	0.06	100%
11	Household No. 11	0.17	0.17	100%
12	Household No. 12	0.24	0.24	100%
	Total for makhalla "Uyrot"	**1.70**	**1.70**	**100%**
Makhalla "Yangiobod"				
13	Household No. 13	0.02	0.02	100%
14	Household No. 14	0.14	0.14	100%
15	Household No. 15	0.01	0.01	100%
16	Household No. 16	0.02	0.02	100%
17	Household No. 17	0.06	0.06	100%
18	Household No. 18	0.07	0.07	100%
19	Household No. 19	0.05	0.05	100%
20	Household No. 20	0.07	0.07	100%
21	Household No. 21	0.05	0.05	100%
22	Household No. 22	0.06	0.06	100%
23	Household No. 23	0.08	0.08	100%
	Total for makhalla "Yangiobod"	**0.63**	**0.63**	**100%**
	Total for both makhallas	**2.33**	**233**	**100%**
"Illegal persons" from makhalla "Yangiobod"				
24	Household No. 24	0.06	0.06	100%
25	Household No. 25	0.08	0.08	100%
26	Household No. 26	0.08	0.08	100%
27	Household No. 27	0.08	0.08	100%
28	Household No. 28	0.12	0.12	100%
29	Household No. 29	0.08	0.08	100%
30	Household No. 30	0.08	0.08	100%
31	Household No. 31	0.08	0.08	100%
32	Household No. 32	0.06	0.06	100%
33	Household No. 33	0.06	0.06	100%
	Total for "Illegal persons"	**0.78**	**0.78**	**100%**

2. Land Preparation

116. Land development will be implemented using the machines and manpower of Navoi TPS and the expense is not included in the budget.

117. The expense for land preparation will be paid to Karamana District by UE. The expense is shown in Table 15.

Table 15. Land Preparation Costs

Item	Units	'000 UZS	USD
Payment to Karamana District	23	20,000	10,361
TOTAL	23	**20,000**	**10,361**

3. Structures and Trees

118. All registered assets were valued by independent evaluation agency[8] through calculating the real replacement cost based on cost of materials, type of construction, labor, transport and other construction costs.

119. Table16 shows the compensation for all buildings based on assessment of local cadastral services and the independent agency[9]. Total buildings replacement cost for 23 legal DPs is 1,233,656,000UZS ($641,501).

120. Monetary support for 10 illegal DPs by UE is 39,400,000UZS ($20,488).

121. Table 17 shows the compensation for all types of trees based on assessment of local cadastral services and the independent agency. Total trees replacement cost for 23 legal DPs is 7,831,000UZS ($4,072).

4. Crop

122. The resettled households are not engaged in agriculture and will not be compensated for crops

5. Businesses

123. There are no any operating businesses (neither registered nor unregistered) in the resettlement area. So, no need to pay any compensation for businesses or employed workers.

6. Community Assets

124. The public infrastructure will not be damaged by the resettlement.

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[8] This is "Navoiy Baxolashva Konsalting Markazi", LTD. The address: 210100, Navoi city, P. Ochilov Street, 24. Tel/Fax: 224-9221. The valuation report was registered by number No. 327 of 28 September 2012. Director of the company – N. M. Abdullaev.

[9] See Annex 9.

Table 16. Compensation and support for Structures				
No	**Household Number**	**Type of structure**	**Affected area (m^2)**	**Calculation of compensation (‘000 UZS)**
Makhalla “Uyrot”				
1	Household No. 1	Housing and household outbuildings	405.0	54,775
2	Household No. 2	Housing and household outbuildings	1,460.3	333,143
3	Household No. 3	Housing and household outbuildings	258.3	38,771
4	Household No. 4	Housing and household outbuildings	524.2	77,062
5	Household No. 5	Housing and household outbuildings	385.4	72,133
6	Household No. 6	Housing and household outbuildings	323.2	56,347
7	Household No. 7	Housing and household outbuildings	158.4	30,729
8	Household No. 8	Housing and household outbuildings	310.9	73,982
9	Household No. 9	Housing and household outbuildings	167.8	27,507
10	Household No. 10	Housing and household outbuildings	227.2	29,035
11	Household No. 11	Housing and household outbuildings	177.1	45,399
12	Household No. 12	Housing and household outbuildings	348.1	60,040
	Total for makhalla “Uyrot”		**4,745.9**	**898,923**
Makhalla “Yangiobod”				
13	Household No. 13	Housing and household outbuildings	275.0	55,879
14	Household No. 14	Housing and household outbuildings	158.9	18,506
15	Household No. 15	Housing and household outbuildings	47.5	9,680
16	Household No. 16	Housing and household outbuildings	168.6	18,389
17	Household No. 17	Housing and household outbuildings	108.2	14,276
18	Household No. 18	Housing and household outbuildings	219.5	35,610
19	Household No. 19	Housing and household outbuildings	173.0	27,742
20	Household No. 20	Housing and household outbuildings	215.2	35,861
21	Household No. 21	Housing and household outbuildings	160.7	30,140
22	Household No. 22	Housing and household outbuildings	192.1	36,074
23	Household No. 23	Housing and household outbuildings	293.5	52,578
	Total for makhalla “Yangiobod”		**2,012.2**	**334,733**
	Total for both makhallas (000’ UZS)			**1,233,656**
	Total for both makhallas (USD)			**641,501**
“Illegal persons” from makhalla “Yangiobod”				
24	Household No. 24	basis	54	4,500
25	Household No. 25	basis	180	4,300
26	Household No. 26	basis	192	2,300
27	Household No. 27	basis	178	5,500
28	Household No. 28	basis	200	4,000
29	Household No. 29	basis	108	5,000
30	Household No. 30	basis	76	5,500
31	Household No. 31	basis	92	2,500
32	Household No. 32	basis	45	2,300
33	Household No. 33	basis	103	3,500
	Total for “Illegal persons”		**1,228.0**	**39,400**
	Total for “Illegal persons” (000’ UZS)			**39,400**
	Total for “Illegal persons” (USD)			**20,488**

Table 17. Compensation for Trees				
No	**Household Number**	**Type of structure**	**Affected trees**	**Calculation of compensation (‘000 UZS)**
Makhalla “Uyrot”				
1	Household No. 1	Trees	35	333
2	Household No. 2	Trees	6	70
3	Household No. 3	Trees	33	242
4	Household No. 4	Trees	39	127
5	Household No. 5	Trees	2	34
6	Household No. 6	Trees	98	1,675
7	Household No. 7	Trees	23	223
8	Household No. 8	Trees	161	1,555
9	Household No. 9	Trees	21	240
10	Household No. 10	Trees	77	799
11	Household No. 11	Trees	28	336
12	Household No. 12	Trees	129	1,434
	Total for makhalla “Uyrot”		652	7,068
Makhalla “Yangiobod”				
13	Household No. 13	Trees	78	623
14	Household No. 14	Trees	13	23
15	Household No. 15	Trees		
16	Household No. 16	Trees		
17	Household No. 17	Trees		
18	Household No. 18	Trees		
19	Household No. 19	Trees	23	117
20	Household No. 20	Trees		
21	Household No. 21	Trees		
22	Household No. 22	Trees		
23	Household No. 23	Trees		
	Total for makhalla “Yangiobod”		114	763
	Total for both makhallas (000’ UZS)			**7,831**
	Total for both makhallas (USD)			**4,072**

VIII.4. Valuation Process

125. **Asset Valuation. –** Initial asset (buildings) valuation shall be undertaken by an independent valuation firm based on replacement cost. Then, it will be verified and certified first by the UE Social and Land Acquisition sub-Unit and then by the District LARC. If the DP agrees with the valuation, then this will be used as the basis of negotiation between the owners and the local authorities. If the DP disagrees with the valuation, Uzbek Law (Cabinet of Ministers Resolution No. 97 dated of May 29, 2006) allows utilizing an independent valuation firm at their own cost. In conformity with JICA requirements, this cost will be paid by the UE. It is possible also to recourse to the grievance committee if agreement cannot be reached.

126. **Land for Land. –** The District LARC decides on the assignment of alternative land plots. Given the lack of complexity in this project and the large extent of land available (according to Karmana District Hokim), the households are going to be relocated within the same settlement, at a distance of, approximately, 2-3 kilometers from their current location. Please see paragraph 129 and 130 as well.

VIII.5. Entitlement Matrix

127. Table 18 outlines the complete entitlement matrix for the project.

Table 18: Entitlement Matrix

Loss Item 1: Residential Land			
Unit of entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
1. Legal owner(s) as identified by Karamana District in the process of payment	1. Land compensation of 0.06 ha per each household.	1. Karmana District will receive budget from Navoi TPS for land compensation and provide the land (0.06 ha per household) to the affected households.	1. Legal owners will be assisted by UE to organize legal documents in support of their ownership. 2. The households which own more than 0.06 ha of their building area, are entitled to receive monetary compensation or land compensation for the additional land (per ha).
Loss Item 2: Housing and structures			
Unit of entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
1. Legal owner(s) as identified by Karamana District in the process of payment	1. Replacement Value of Housing and structures	1. Replacement Value will be recommended by the independent agency. 2. Project owner will pay cash compensation under law for the land to APs. 3. If Replacement value is higher than law, the difference will be paid by project owner.	1. Legal owners will be assisted by UE to organize legal documents in support of their ownership. 2. Regarding the 10 uninhabited illegal houses, the expense for the houses will be paid by the Navoi TPS as a support activity.
Loss Item 3: Standing Trees			
Unit of entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
1. Legal owner(s) as identified by Karamana District in the process of payment	1. Replacement Value of Standing Trees	1. Replacement Value will be recommended by the independent agency. 2. Project owner will pay cash compensation under law for the land to APs. 3. If Replacement value is higher than law, the difference will be paid by project owner.	
Livelihood Restoration			
Unit of entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
PAPs whose livelihood level are lowered after the relocation	1.Job training 2.Preferential hiring for works in Navoi Thermal Power Plant	1.Identifying PAPs whose livelihood levels are lowered after the relocation. 2.Uzbekenergo will provide job trainings. 3.Navoi Thermal Power Plant will hire	

		some of them if necessary.	
Support for Vulnerable Groups			
Unit of entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
Households who are regarded as vulnerable	1.Support for receiving public assistance. 2.Providing assistances such as training, job-opportunities, and allowances	1.Identifying the number of PAPs who are categorized in vulnerable groups. 2.Uzbekenergo will assist the application process for the public assistance. 3.Uzbekenergo will provide assistances such as training, job-opportunities, and allowances following the established order in accordance with the regulations of Uzbekistan.	

128. The Table 18 was made based on JICA's Guidelines for Environmental and Social Considerations and The World Bank's Operational Policy (OP 4.12 – Involuntary Resettlement).

VIII.6. Relocation Land

129. Relocation lands are located to the makhallas named "Honchorbog" and "Ayronchi" with total areal size 2.2 ha. The lands are belonged to the District. It is just a few km away from the Navoi TPS. The residents can use the school, hospital, drugstore, public bathhouse conveniently. The new land plots are in the living center of "Yangi-Aryk" village and this area is provided by power line, gas pipeline and central cold water supply. The lands are near the existing roads and the bus line is on the road. In the surrounding area, there are houses and agricultural lands, but no industrial plants. Figure 2 shows the location of current residential area and new land plots.

130. There are photos of the relocation land plots (see Annex 8). As is clear from these photos the land plots unusable for the construction today. It is required the grubbing, land forming and laying out of the plots by parcels. The lands will be ready for building the houses by Feb 2014.

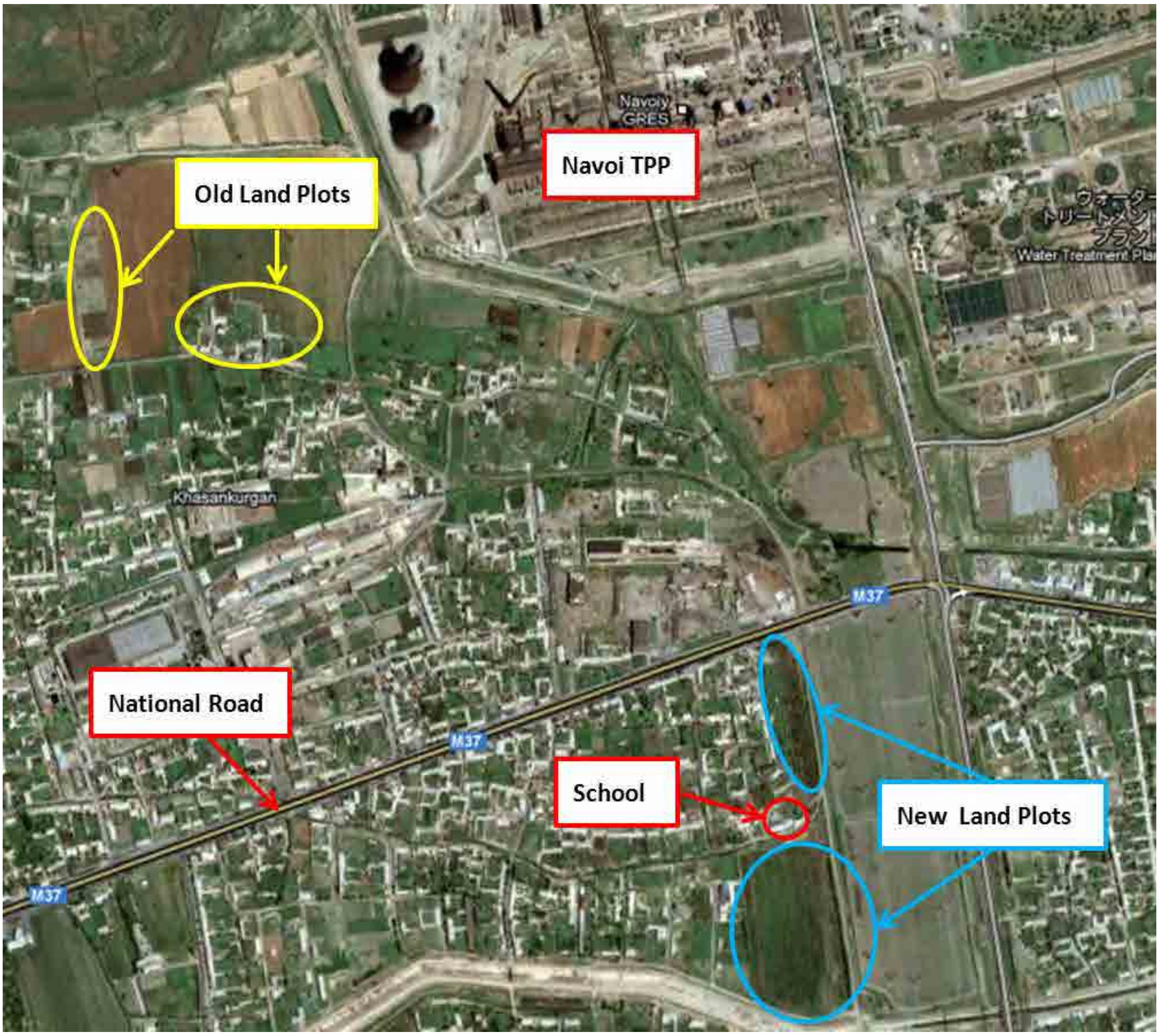

Figure 2: Location of Old and New Land Plots

IX. RELOCATION OF HOUSING AND SETTLEMENTS

131. This section describes the options for relocating housing and the activities that will be conducted to assist the process.

132. The District LARC assesses options for relocation of affected 23 households. It is expected that in all cases they will be reallocated land close to their current plots.

133. The Karmana District Hokimiyat has to approve that affected 23 households will be provided with appropriate lands in the same area. Decrees of District Hokimiyat regarding ownership of corresponding lands will be also issued, in which a particular new land will be indicated. This will be done prior the construction of civil work.

134. Regarding relocation places, please refer to the paragraph 129 and 130.

X. INCOME RESTORATION AND REHABILITATION

135. This section briefly describes programs for restoring and enhancing income of vulnerable groups, particularly women and the disabled.

136. Since relocation place is better environmental circumstance than the current place. And infrastructure such as supply of tap water, gas and electricity is in place. Therefore, it is not considered that it is necessary to support restoring and enhancing income of vulnerable groups, particularly women and the disabled.

X.1. Opportunities to Derive Development Benefits

137. **Priority Work Placement.** –All DPs and project stakeholders will receive priority entitlement to work in construction crews and for rehabilitation efforts (such as tree replanting).The standards will be incorporated in construction contracts and details included in progress reports.

X.2. Other Costs

138. Other costs to be provided under the LARAP include cost of resettlement consultants. Table 19 outlines the cost of providing these services and the agency responsible for payment. However Resettlement consultant is to be estimated later because TOR of Resettlement consultant is not determined yet.

Table 19. Other Costs (‘000 UZS)

Item	Amount	Responsible Agency
Resettlement Consultants under PIU	to be estimated later	State Joint Stock Company “Uzbekenergo”
Total (‘000 UZS)	to be estimated later	
Total (USD)	to be estimated later	

139. The tasks of resettlement consultant will include but not be limited to the following:

- Manage and coordinate the preparation, updating, implementation and monitoring the approved Land Acquisition and Resettlement Action Plan (LARAP).
- Set up internal monitoring system on the project’ s social and resettlement issues and requirements.
- Select and review an External Monitoring Agency (EMA) to be approved by the Program's Director.
- Project Information Management and Development.
- Assess and prepare capacity building program on social issues.
- Conduct internal and external coordination with relevant parties in social/resettlement activities according to requirements of the project.
- Set up redress and grievance mechanism for project activities.
- Report preparation and submission.

- Provide advice/recommendation to the Director, PIU on social safeguard/resettlement problems/ requirements.
- Redress or follow up actions based on findings and requirements of EMA reports.
- Provide independent monitoring on the contractors' compliance to (a) core labor standards, labor laws and incorporate applicable workplace occupational safety norms; (b) no differentiation of payment between men and women for work of equal value; (c) no child labor in the construction and maintenance activities; (d) no forced or compulsory labor; (e) discrimination in respect of employment; (f) freedom of association; (g) to the extent possible, maximize employment of local poor and disadvantaged persons for project construction purposes, provided that the requirements for job and efficiency are adequately met; and (h) land acquisition and resettlement framework and plans.
- Engage with relevant civil society organizations interested in the project implementation.
- Update the livelihood assistance program and support implementing the livelihood assistance program.
- Survey of full replacement cost.
- Support to make monitoring report which will be submitted to JICA.

XI. RESETTLEMENT BUDGET AND FINANCIAL PLAN

140. This section provides an itemized budget for all resettlement activities, including for the resettlement unit, staff training, monitoring and evaluation, and preparation of resettlement plans during loan implementation.

XI.1. Responsibilities

141. In order to ensure that sufficient funds are available for LAR tasks, "Uzbekenergo" will have to allocate 100% of the cost of compensation at replacement cost and expected allowances estimated in each LARAP plus contingencies before LARAP implementation. Uzbekenergo will be responsible for timely allocating the funds to implement the LARAP. Allocations will be reviewed bi-annually based on budget requirements indicated in the LARAP/RP.

142. The UE will be responsible for including LAR funds for project activities in each fiscal years government budget. The budget for LARAP/RP will be disbursed by UE via the District LAR Committee (LARC) which will in turn distribute the compensation to DPs.

143. The UE is responsible to establish Safeguard Team to conduct their tasks and responsibilities during the Program's activities. This will be funded via the Procurement and Safeguard Support package.

XI.2. Budget Summary

The complete budget for LAR activities on the Project is shown in Table 20. The budget for LAR will come from "Uzbekenergo" as counterpart fund. A total budget is 1,430,976UZS ($744,064).

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Table 20. LAR Budget Summary

	'000 UZS	**$US**
Compensation for land		
Land Preparation Costs*	20,000	10,361
Compensation		
Housing and Structures	1,233,656	641,501
Trees	7,831	4,072
Support and Assistance		
Structures for illegal	39,400	20,488
Other Costs		
Resettlement Consultant under PIU**	to be estimated later	to be estimated later
Sub-Total	**1,300,887**	**676,422**
Contingency (10%)	130,089	67,642
TOTAL	**1,430,976**	**744,064**

*"Land Preparation Costs" may be increased because 20 mil sum is cost of independent company who estimate cost of land and houses only. Other land preparation cost such as land registration cost is not estimated yet.

** Resettlement consultant is to be estimated later because TOR of Resettlement consultant is not determined yet.

XII. INSTITUTIONAL ARRANGEMENTS

144. The main institutions that will be involved in LAR activities are the State Joint Stock Company “Uzbekenergo” as executing agency, PIU (Project Implementation Unit), Design Institute (DI), Project Consultants (PC), Provincial (Province) and District (District) and municipal town authorities, State Unitary Enterprise Land and Immovable Cadastre Service (SUELICS) at district level.

XII.1. State Joint-Stock Company “Uzbekenergo” (SJSC Uzbekenergo)

145. The Uzbekenergo will have overall responsibility for all aspects of the project. The Project Implementation Unit (PIU) within Uzbekenergo will be responsible for the day to day management of the Project including cross-agency coordination for LARAP implementation and monitoring the compensation and disbursement.

146. The PIU will be directly involved in all LAR related planning, implementation, inter-agency coordination, monitoring and reporting.

XII.2. Project Implementation Unit (PIU)

147. The Project Implementation Unit (PIU) will be in charge of elaborating the design and construction documents for the project. It will work to:

- Look for measures and alternatives to avoid and minimize land acquisition and resettlement impacts.
- Assemble all documents required for compensation.
- Carry out topographic surveys of the expropriated land and replacement lands.
- Elaborate layouts indicating the location of the worksites and the permanent infrastructures and the perimeter of the required surfaces differentiating the land use patterns in the areas being occupied to serve as a base for the selection of compensation land.
- Conduct land marking and pegging of the land assigned for temporary use and permanent occupation of acquired land.
- Conduct the internal monitoring according to LARAP.
- Select the independent valuation agencies and independent monitoring agencies for external monitoring.

XII.3. District SUELICS

148. This is a permanent committee at District level. However it plays an enhanced role throughout implementation. It is responsible for:

- Identifying land losses incurred by land owners and land users plus agricultural output losses.
- Determining the need for protective sanitary and water protection zones around constructions.
- Preparing proposals on allocation of land plots of equal value under land for land.
- Approving the Implementation Act and the attached plan.
- Amending government edicts on land use and land ownership as well as other cadaster documents.

XII.4. District Government

149. Local district government involved in the LARAP review and implementation. It will form a district land acquisition and resettlement committee (LARC) which will undertake the following:

- Outline locations of constructions and structures affected by the project.
- Select land for construction sites.

- Prepare and approve legislation for the right (title) to use land plots.
- Approve the Act for the right to use the land plot.

150. In addition to permanent members, the Committee may include representatives of Uzbekenergo, as well as affected legal entities and individuals (DPs).

151. The LARC will also estimate losses of land owners and land users in accordance with JICA specifications in addition to losses resulting from land acquisition based on data provided by the independent valuation agency. The Committee will prepare Acts for the right to specific plots of land specifying the acquired land area and losses and allowances as determined under the LARAP entitlement matrix.

152. It is proposing that LARC will compose of the following members:

- Uzbekenergo PIU.
- District Department of SUELICS.
- District Department of Agriculture and Water Resources.
- District Department of Environmental Protection.
- Makhallas' leaders.
- Representatives of the affected people.

153. All affected legal parties and individual persons (or their legal representatives) will have representation on the committee. Besides state organizations and structures and makhalla authorities will be involved in resettlement activities to ensure the legal rights and interests of land users who are subject to land acquisition and resettlement.

XII.5. District Grievance Redress Committee (GRC)

154. This is a permanent committee at District level based at GFP (see Chapter VI.2) that has to function during all period of the resettlement process. It is responsible for:

- Reception and reviewing questions and/or complaints on the part of DPs.
- Informing for the District SUELICS on the questions/complaints for resolution.

XII.6. Supervision Consultants (Internal Monitoring)

155. The Supervision Consultants should be selected by PIU. They are responsible for:

- Supervision and information exchange with District SUELICS regarding to the resettlement process.
- Monthly reporting to the PIU regarding to the resettlement process.

XII.7. External Monitoring Agency (EMA)

156. The External Monitoring Agency (EMA) should be selected by PIU and approved by JICA. It is responsible for:

- Monitoring of the activities of District Grievance Redress Committee.
- Monitoring of the activities of District SUELICS.
- Monitoring of the activities of Supervision Consultants.
- Monthly reporting to JICA regarding to the resettlement process and activities of all institutions involved to the resettlement process.

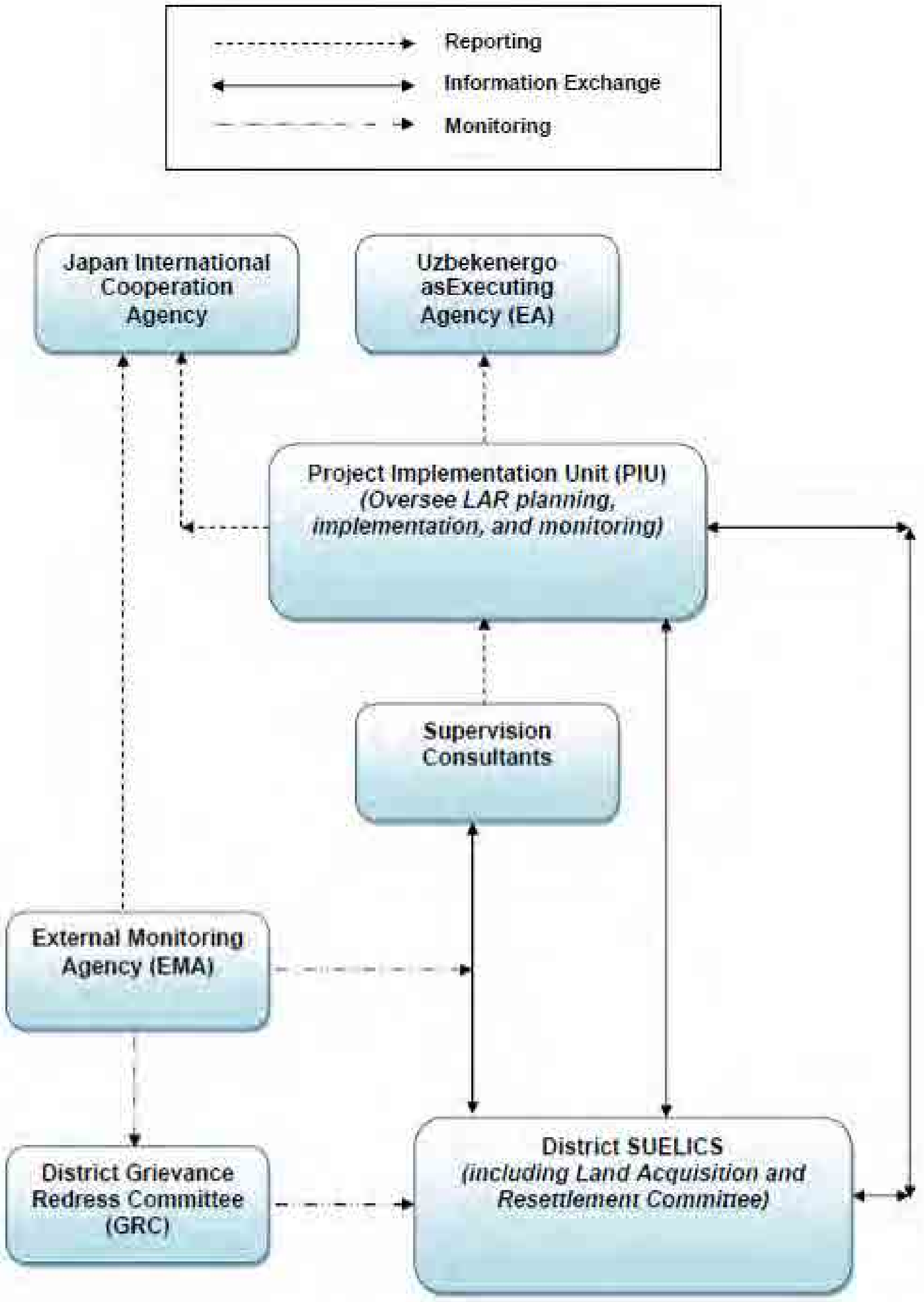


Figure 3.Project Implementation Diagram

XIII. IMPLEMENTATION SCHEDULE

157. This section includes a detailed, time bound, implementation schedule for all key resettlement and rehabilitation activities synchronized with the project schedule of civil works construction.

XIII.1. Pre-Resettlement Activities

158. The UE will undertake a brief verification of the RP based on the alignment finalized by the detailed design. Any modifications to the RP will be made, and verified with the UE and the JICA prior to any LAR activities commencing.

159. The RP has to include the full details of all land and resettlement arrangements, including verification of asset viability by the DPs. It is expected that this can take place prior to loan approval by JICA.

160. The Project Implementation Unit (PIU) will be responsible to:

- Assemble all required documents.
- Carry out topographic surveys of the expropriated and compensation lands.
- Elaborate layouts indicating the location of the worksites and the permanent infrastructures and the perimeter of the required surfaces.
- Establish layouts of the lands proposed as option for compensation.
- Conduct the land marking and the pegging of the lands assigned for temporary use and permanent occupation and of the compensation lands.

161. The DPs will sign a document signifying their satisfaction on the compliance of UE on the agreement. The PIU Social/Resettlement Specialist will guide the UE in preparing a pro-forma document to be used for the settlement of obligation in the purchase of affected land and/or materials for all structures.

162. Disbursement of cash will follow the approval of budgets for cash compensation. The PIU will inform the DPs of the schedule of fund release. They will also advise the APs to produce acceptable legal documents pertaining to their identification for claiming the compensation. It is the main responsibility of UE to ensure that all the compensations and entitlements have been paid to and settled with DPs prior to their resettlement.

163. All resettlement activities will be completed prior to clearing the construction sites. The UE will initiate the following steps in releasing the cash compensation and entitlements to DPs:

- The PIU’s Resettlement Team will advise the DPs of the fund release schedules.
- The District SUELICS shall then advise the DPs to produce the necessary legal documents for their identification in claiming the compensation and entitlements due to them.
- The Resettlement Team will arrange for receipt of the resettlement compensation and disburse it directly to DPs on presentation of identification.
- The Resettlement Team will arrange for district Hokimiyat to issue new title directly to DPs on presentation of identification.
- The Resettlement Team will require the DPs to sign a document indicating the receipt of their compensation and entitlements.
- The DPs will then begin their process of rebuilding and relocation.
- The Resettlement Team will require the DPs to sign a document indicating completion of their LAR activities, indicating that they have no further claims.
- These activities will be summarized by the UE and forwarded to JICA.

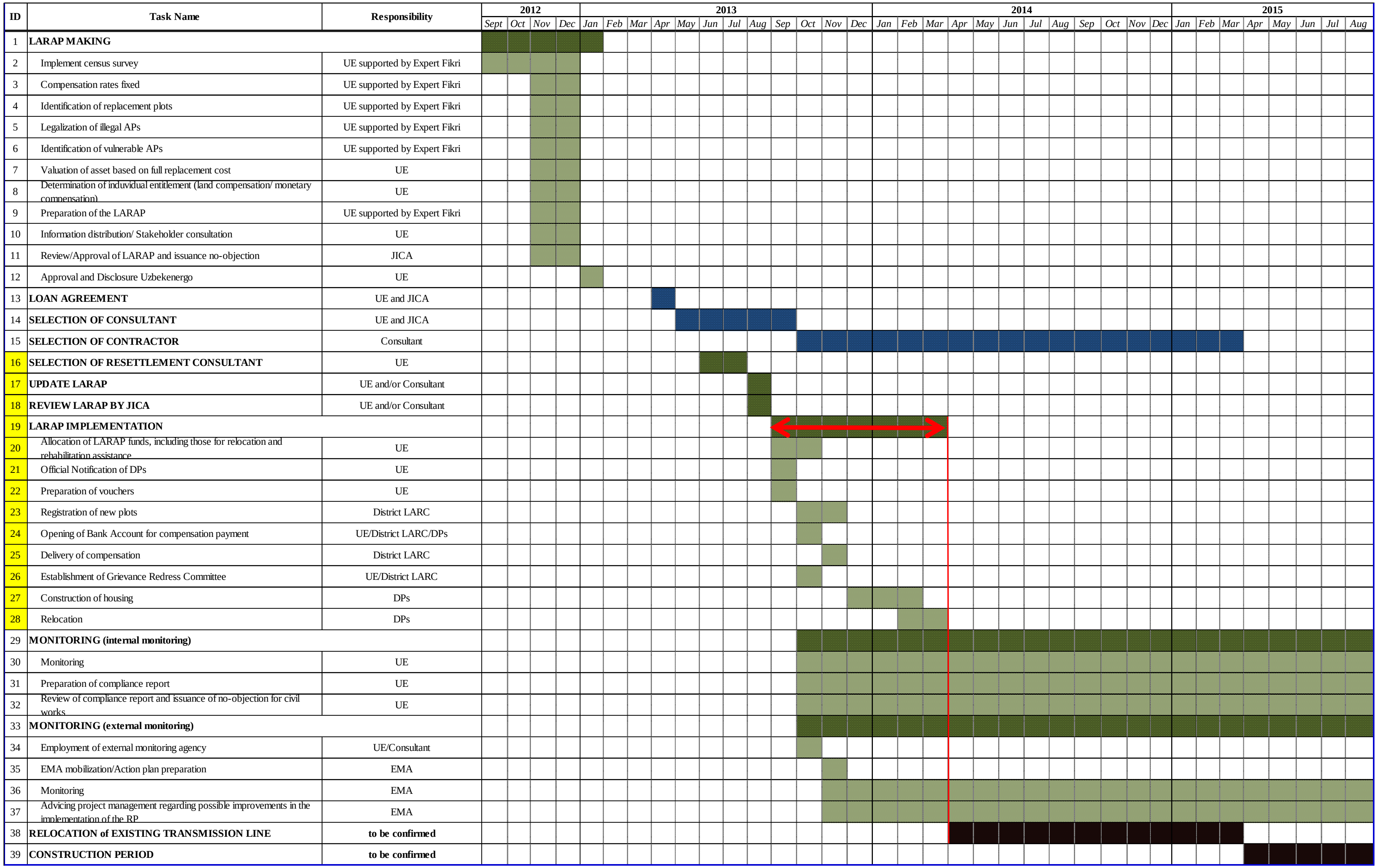
- As a condition to approve the civil works contract award both the RP in English and in Russian/Uzbek will be updated by the Consultant employed by UE of the contractor, re-approved by JICA and re-disclosed to the affected communities.

XIII.2. Implementation Phase

164. The project loan is expected to be approved in April 2013. Construction is set to start at April 2015. A schedule for implementation is presented in Figure 4.

XIII.3. Post-Resettlement Implementation Phase

165. Monitoring of resettlement activities and the compliance of the project policies by PIU of UE, as set out in this framework, are the items for this phase. This is because the internal monitoring which is the responsibility of the Project Implementation Unit (PIU) will be the basis for UE requesting from JICA its "no objection" for the mobilization of construction contractors.



ID	Task Name	Responsibility	2012				2013												2014												2015							
			Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1	**LARAP MAKING**		🟩	🟩	🟩	🟩	🟩																															
2	Implement census survey	UE supported by Expert Fikri	🟩	🟩	🟩	🟩																																
3	Compensation rates fixed	UE supported by Expert Fikri			🟩	🟩																																
4	Identification of replacement plots	UE supported by Expert Fikri			🟩	🟩																																
5	Legalization of illegal APs	UE supported by Expert Fikri			🟩	🟩																																
6	Identification of vulnerable APs	UE supported by Expert Fikri			🟩	🟩																																
7	Valuation of asset based on full replacement cost	UE			🟩	🟩																																
8	Determination of induvidual entitlement (land compensation/ monetary compensation)	UE			🟩	🟩																																
9	Preparation of the LARAP	UE supported by Expert Fikri			🟩	🟩																																
10	Information distribution/ Stakeholder consultation	UE			🟩	🟩																																
11	Review/Approval of LARAP and issuance no-objection	JICA			🟩	🟩																																
12	Approval and Disclosure Uzbekenergo	UE					🟩																															
13	**LOAN AGREEMENT**	UE and JICA								🟦																												
14	**SELECTION OF CONSULTANT**	UE and JICA									🟦	🟦	🟦	🟦	🟦																							
15	**SELECTION OF CONTRACTOR**	Consultant														🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦					
16	**SELECTION OF RESETTLEMENT CONSULTANT**	UE										🟩	🟩																									
17	**UPDATE LARAP**	UE and/or Consultant												🟩																								
18	**REVIEW LARAP BY JICA**	UE and/or Consultant												🟩																								
19	**LARAP IMPLEMENTATION**														🟩	🟩	🟩	🟩	🟩	🟩	🟩																	
20	Allocation of LARAP funds, including those for relocation and rehabilitation assistance	UE													🟩	🟩																						
21	Official Notification of DPs	UE													🟩																							
22	Preparation of vouchers	UE													🟩																							
23	Registration of new plots	District LARC														🟩	🟩																					
24	Opening of Bank Account for compensation payment	UE/District LARC/DPs														🟩																						
25	Delivery of compensation	District LARC															🟩																					
26	Establishment of Grievance Redress Committee	UE/District LARC														🟩																						
27	Construction of housing	DPs																🟩	🟩	🟩																		
28	Relocation	DPs																		🟩	🟩																	
29	**MONITORING (internal monitoring)**															🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
30	Monitoring	UE														🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
31	Preparation of compliance report	UE														🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
32	Review of compliance report and issuance of no-objection for civil works	UE														🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
33	**MONITORING (external monitoring)**															🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
34	Employment of external monitoring agency	UE/Consultant														🟩																						
35	EMA mobilization/Action plan preparation	EMA															🟩																					
36	Monitoring	EMA															🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
37	Advicing project management regarding possible improvements in the implementation of the RP	EMA															🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
38	**RELOCATION of EXISTING TRANSMISSION LINE**	**to be confirmed**																			⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛					
39	**CONSTRUCTION PERIOD**	**to be confirmed**																															⬛	⬛	⬛	⬛	⬛

Figure 4: Schedule for Implementation monitoring and reporting

XIV. MONITORING AND REPORTING

166. This section describes the mechanisms and benchmarks appropriate to the project for monitoring and evaluating the implementation of the resettlement plan. It specifies arrangements for participation of affected persons in the monitoring process. This section will also describe reporting procedures.

167. The primary objective of monitoring is to identify as early as possible the activities achieved and the cause(s) of constraints so that the arrangements in the LARAP implementation can be adjusted. Monitoring is important because LARAP implementation is often the critical path for any project where civil works is involved, due to issues on land acquisition, compensation and resettlement that may cause delay in civil works. The early identification of the causes of delay will enable the UE (with support from the supervision consultants), to prepare the mitigating measures during LARAP implementation.

168. LAR tasks will be monitored internally. Internal monitoring (IM) will be carried out by the PIU in conjunction with District Hokimiyat.

XIV.1. Internal Monitoring

169. All activities in LAR are time bounded. Internal monitoring (IM) will be carried out by the PIU and the LARC in the District Hokimiyat. Process indicators will relate to implementation outputs and deliverables. These will be collected directly from the field, and will be reported monthly to the PIU to assess the LARAP implementation progress and adjust the work plan if necessary. These reports will be quarterly consolidated and submitted to JICA.

170. Specific IM benchmarks will be:

- Information campaign and consultation with APs.
- Status of land acquisition and payments on land compensation.
- Compensation for affected structures and other assets.
- Relocation of APs.
- Payments for loss of income.
- Selection and distribution of replacement land areas.
- Income restoration activities.
- Ensure the gender mitigation measures are adhered to during the internal monitoring and reporting process.

171. Upon the completion of resettlement, the PIU will prepare a post-LARAP implementation evaluation report that will assess both the permanent and temporary land acquisition activities and impacts of the Project focusing on the restoration of impacted lands and conditions of DPs especially those who were identified as vulnerable.

172. In addition, the PIU will update the LARAP and particularly the JICA’s policy matrix, with a view to aligning Uzbekistan’s CSS and reducing LARAP reporting requirements. Internal monitoring and reporting will continue for two years since the all affected households finish relocating to the new place.

XIV.2. External Monitoring Agency (EMA)

173. The External Monitoring Agency (EMA) should be selected by PIU and approved by JICA. It is responsible for:

- Monitoring of the activities of District Grievance Redress Committee.
- Monitoring of the activities of District SUELICS.
- Monitoring of the activities of Supervision Consultants.
- Monthly reporting to JICA regarding to the resettlement process and activities of all institutions involved to the resettlement process.

XV. ANNEX

XV.1. Annex 1. JICA’s and Uzbekistan’s Resettlement Policies

174. This Annex describes the main principles of JICA’s Resettlement Policy, relevant laws and Governmental documents of the Republic of Uzbekistan, and the detailed comparison between these packages of documents.

JICA’s Resettlement Policy[10]

Objectives

175. The objectives of the Resettlement Policy are:

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

Impacts Covered

176. This policy covers direct economic and social impacts that both result from JICA-assisted investment projects, and are caused by

- the involuntary taking of land resulting in
    - relocation or loss of shelter;
    - loss of assets or access to assets; or
    - loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or
- the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

177. This policy applies to all components of the project that result in involuntary resettlement, regardless of the source of financing.

178. Requests for guidance on the application and scope of this policy should be addressed to the Resettlement Committee.

Required Measures

179. To address the impacts the borrower prepares a resettlement plan that covers the following:

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[10] This Section is based on the JICA’s Guidelines for Environmental and Social Considerations and the World Bank Operational Policy – OP 4.01, Annex B. – See:http://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/guideline100326.pdf and http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTOPMANUAL/0,,contentMDK:20064610~menuPK:64701637~pagePK:64709096~piPK:64709108~theSitePK:502184,00.html

- The resettlement plan includes measures to ensure that the displaced persons are
  - informed about their options and rights pertaining to resettlement;
  - consulted on, offered choices among, and provided with technically and economically feasible resettlement alternatives; and
  - provided prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project.
- If the impacts include physical relocation, the resettlement plan includes measures to ensure that the displaced persons are
  - provided assistance (such as moving allowances) during relocation; and
  - provided with residential housing, or housing sites, or, as required, agricultural sites for which a combination of productive potential, location advantages, and other factors is at least equivalent to the advantages of the old site.
- Where necessary to achieve the objectives of the policy, the resettlement plan or resettlement policy framework also include measures to ensure that displaced persons are
  - offered support after displacement, for a transition period, based on a reasonable estimate of the time likely to be needed to restore their livelihood and standards of living; and
  - provided with development assistance in addition to compensation measure such as land preparation, credit facilities, training, or job opportunities.

180. The process framework also includes a description of the arrangements for implementing and monitoring the process.

181. To achieve the objectives of this policy, particular attention is paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.

182. The implementation of resettlement activities is linked to the implementation of the investment component of the project to ensure that displacement or restriction of access does not occur before necessary measures for resettlement are in place. It means that these measures include provision of compensation and of other assistance required for relocation, prior to displacement, and preparation and provision of resettlement sites with adequate facilities, where required, also to assist the displaced persons are implemented in accordance with the plan of action as part of the project.

183. Payment of cash compensation for lost assets may be appropriate where livelihoods are not land-based. Cash compensation levels should be sufficient to replace the lost land and other assets at full replacement cost in local markets.

184. This JICA’s policy also requires the following:

- Displaced persons and their communities, and any host communities receiving them, are provided timely and relevant information, consulted on resettlement options, and offered opportunities to participate in planning, implementing, and monitoring resettlement. Appropriate and accessible grievance mechanisms are established for these groups.
- In new resettlement sites or host communities, infrastructure and public services are provided as necessary to improve, restore, or maintain accessibility and levels of service for the displaced persons and host communities. Alternative or similar resources are provided to compensate for the loss of access to community resources (such as fishing areas, grazing areas, fuel, or fodder).
- Patterns of community organization appropriate to the new circumstances are based on choices made by the displaced persons. To the extent possible, the existing social and cultural institutions of resettlers and any host communities are preserved and resettlers' preferences with respect to relocating in preexisting communities and groups are honored.

Eligibility for Benefits

185. Upon identification of the need for involuntary resettlement in a project, the borrower carries out a census to identify the persons who will be affected by the project, to determine who will be eligible to assistance, and to discourage inflow of people ineligible for assistance. The borrower also develops a procedure, satisfactory to the JICA, for establishing the criteria by which displaced persons will be deemed eligible for compensation and other resettlement assistance. The procedure includes provisions for meaningful consultations with affected persons and communities, local authorities, and, as appropriate, nongovernmental organizations (NGOs), and it specifies grievance mechanisms.

186. *Criteria for Eligibility.* Displaced persons may be classified in one of the following three groups:

- those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country);
- those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets--provided that such claims are recognized under the laws of the country or become recognized through a process identified in the resettlement plan; and
- those who have no recognizable legal right or claim to the land they are occupying.

Resettlement Planning, Implementation, and Monitoring

187. The borrower is responsible for preparing, implementing, and monitoring a resettlement plan, a resettlement policy framework, or a process framework (the "resettlement instruments"), as appropriate, that conform to this policy. The resettlement instrument presents a strategy for achieving the objectives of the policy and covers all aspects of the proposed resettlement. Borrower commitment to, and capacity for, undertaking successful resettlement is a key determinant of Bank involvement in a project.

188. The full costs of resettlement activities necessary to achieve the objectives of the project are included in the total costs of the project. The costs of resettlement, like the costs of other project activities, are treated as a charge against the economic benefits of the project; and any net benefits to resettlers (as compared to the "without-project" circumstances) are added to the benefits stream of the project.

189. The borrower is responsible for adequate monitoring and evaluation of the activities set forth in the resettlement instrument. The JICA regularly supervises resettlement implementation to determine compliance with the resettlement instrument. Upon completion of the project, the borrower undertakes an assessment to determine whether the objectives of the resettlement instrument have been achieved. The assessment takes into account the baseline conditions and the results of resettlement monitoring. If the assessment reveals that these objectives may not be realized, the borrower should propose follow-up measures that may serve as the basis for continued JICA supervision, as JICA deems appropriate.

Uzbekistan’s Relevant Legal Instruments

Land Code of the Republic of Uzbekistan

190. This Code is approved by the Statute of Uzbekistan No. 598-I of April 30, 1998. Amended according to Division XIX of the Statute of Uzbekistan of August 30, 2003, item 41 of the Statute of Uzbekistan of December 3, 2004.

Article 16. Property for land in the Republic of Uzbekistan

191. Land is a state property, national wealth, is subject to rational use, protected by the state and is not subject to purchase and sale, barter, gift, pledge, with the exception of cases established by legal acts of the Republic of Uzbekistan.

Article 17. Rights of legal and physical persons for land parcels

192. The legal persons may have land parcels for the right of permanent possession, permanent use, and urgent (short time) use, lease and ownership in accordance with the present Code and other acts of legislation.

193. The legal persons may have land parcels for the right of lifetime inheritable possession, permanent use, urgent (short time) use, lease and ownership in accordance with the present Code and other acts of legislation.

Article 23. Granting (realization) of land parcels for possession and use

194. Granting (realization) of land parcels into possession, use, lease and ownership shall be made by the procedure of allotment.

195. The allotment of land parcels shall be made by the Cabinet Ministers of the Republic of Uzbekistan, khokims of oblasts, Tashkent city, areas, and cities by the procedure established by legislation.

196. Granting (realization) of a land parcel being into possession, use, lease and ownership shall be made only after bite (redemption) of the present land parcel by the procedure established.

197. Lands of non-agricultural designation or non-suitable for agriculture or agricultural lands of worse quality shall be granted (realized) for building of industrial enterprises, railway and motor roads, lines of communication and power lines, trunk pipelines, and also for other non-agricultural needs. Granting (realization) of land parcels from areas of the forest fund for indicated purposes shall be conducted mainly at the expenses non-covered areas by a forest or areas occupied by bushes and not valuable plants. It is prohibited to start possessing and using of a land parcel granting (realized) before establishment of respective boundaries of this land parcel in nature (on an area) by land surveying services and issue of documents certifying the right for a land parcel.

198. The procedure on granting (realization) of land parcels for possession, use, lease and ownership shall be established by legislation.

Article 35. State registration of rights on land parcels

199. Rights of legal and physical persons for land parcels are the subject of state registration.

200. The state registration of rights on land parcels shall be conducted at a place of location of land parcels. The following is included into the public register:

- information about a person who has received the right for a land parcel;
- description of a land parcel (a type of areas, a purpose of use, types of grounds, squares, share of joint possession or use, boundaries, cadastre number and other characteristics);
- information about conditions of the contract on granting of a land parcel, burdening and servitudes;
- decisions of empowered bodies on including of a land parcel in an area of alienation for state and public needs;
- other information established by legislation.

201. The official registration of rights of legal and physical persons for land parcels shall be conducted by corresponding empowered body within ten time period from the day of receipt of application with enclosure of necessary documents on rights for land parcels, with the exception of cases provided by legislation.

202. The grounds for refusal in state registration of rights for a land parcel are the following:

- presence of documents certifying on presence of a dispute about belonging of present land parcel in a body of state registration;
- presence of information about withdrawal of the present land parcel in a body of state registration established by legal procedure.

203. The grounds for refusal in state registration of rights for a land parcel are the following:

- absence of necessary documents on the right for a land parcel;
- absence of information provided by Part 3 of the present;
- changes of based purposed designation of a land parcel with violation of rules established;
- violation of established norms of a common square of a land parcel in the result of a transaction;
- presence in a body of the state registration of documents certifying about presence of a dispute on belonging to the present land parcel;
- presence in a body of the state registration of decision of a court on confiscation of objects of trade and services sector, dwelling houses, other buildings and constructions;
- absence of documents on payment of registration tax unless otherwise provided by legislation;
- decision on withdrawal of land parcels for state and public needs accepted by the established procedure.

204. The procedure of state registration of rights for land parcels shall be established by legislation.

Article 37. Withdrawal, buy-out of a land parcel for state and public needs

205. Withdrawal of a land parcel or its part for state and public needs shall be made with the consent of a landowner or with agreement with a land user and a farmer by decision accordingly of a khokim of an area, a city, an oblast or by decision of the Cabinet Ministers of the Republic of Uzbekistan.

206. In case of disagreement of a landowner, land user and farmer with a decision accordingly of a khokim of an area, a city, an oblast or a decision of the Cabinet Ministers of the Republic of Uzbekistan on taking off a land parcel, this decision may be appealed against in a court.

207. Enterprises, institutions and organizations which are interested in taking off a land parcels for building of enterprises, buildings, constructions shall be liable before the beginning of designing previously to come to an agreement with landowners, land users and farmers and also accordingly with a khokim of an area, a city, an oblast or the Cabinet Ministers of the Republic of Uzbekistan about a place of an object, a model size of a land parcel and conditions of its allotment taking into consideration of integrated development of an area. Financing of design works up to indicated preliminary agreement shall not be admitted.

208. Withdrawal of a land parcel for state and public needs and preliminary coordination of a place of location of an object and also registration of allotment of lands shall be made by a procedure established by legislation.

209. Buyout of a land parcel which is in ownership of legal and physical persons including of foreign persons together with an object of trade and services sector or living quarters and other building or a part of building for state and public needs shall be made by a decision of a khokim of an area, a city, an oblast or a decision of the Cabinet Ministers of the Republic of Uzbekistan with provision of guarantees provided by Article 41 of the present Code.

Article 41. Guarantee of rights for land parcels

210. Interference in the activity of landowners, land users, farmers and owners of land parcels from the direction of state, economic and other bodies, and organizations or also their public officers shall be prohibited, with the exception of cases provided by legislation.

211. Violated rights of landowners, land users, farmers and owners of land parcels are the subject to compensation by the procedure provided by legislation.

212. Losses caused by violation of rights of landowners, land users, farmers and owners of land parcels (including in lost profit) are the subject to compensation in full amount.

213. The taking of land parcels given to physical persons for state or municipal needs may be made after giving an equal land parcel by their wishes by a decision of a khokim of an area, a city, an oblast, building of living, industrial and other structures at a new place by enterprises, institutions and organizations for which a land parcel is allotted, in exchange for parcel taken and compensation all other losses in full amount (including in lost profit) according to Article 86 of the present Code.

214. The taking of lands of agricultural and forestry enterprises, agricultural research-and-development institutions, experimental and educational units for state or municipal needs may be made under the condition of building by their request living, manufacturing and other buildings in exchange for parcel taken off and compensation in full amount of all other losses (including of lost profit) according to Article 86 of the present Code.

215. Buyout of an object of trade and services sector or also living quarters and other buildings or a part of a building together with a land parcel on which they are located, being in ownership of legal and physical persons for state and municipal needs and also their confiscation shall be made by a procedure established by legislation.

Article 80. Ecological requirements to disposition, designing, construction and operation of objects, structures and constructions

216. The ecological requirements to disposition, designing, construction and operation of objects, structures and constructions shall be established by legislation on preservation of the environment.

217. The events on protection of lands shall be provided and shall be conducted which are negatively influencing on a condition of the grounds in case of disposition, designing, construction and putting into operation of new and reconstructed objects, structures and constructions, and also introduction of the new technologies.

218. Negative influence evaluation of input object or introducing technology on a condition of the grounds and efficiency stipulated by events on use and protection of the lands shall be conducted on the basis of ecological examination.

219. Putting into operation of objects and using of technologies which are not provided by measures of protection of lands from degradation or violation and the positive conclusion of ecological examination shall be prohibited.

220. Disposition of the objects influencing on a condition of the lands shall be agreed with land surviving, nature protection and others bodies by the procedure determined by legislation.

Article 86. Compensation of losses to land owners, land users, farmers and owners of land parcels

221. The losses caused to land owners, land users, farmers and owners of land parcels are the subject to compensation in full (including the missed benefit) in the following cases:

- withdrawal, buy out or temporary withdrawal of lands;
- restriction of their rights in connection with establishment of water protection zones, zones of sanitary protection of water objects, zones of formation of surface and underground waters, zones of resort natural territories, zones of state biosphere reserves, protective zones around state

preserves, reserves, state monuments of nature, objects of material cultural heritage, disposals, roads, pipelines, communication lines, power lines; (Paragraph 3 is stated in edition of point 9) of Article 9 of the Law of the RUz No. ZRU-278 dated 04.01.2011);

- deterioration of the lands as a result of the influence caused by construction and operation of reservoirs, channels, collectors and other objects allocating harmful substance for agricultural crops and plantings and other actions of legal and physical persons leading to reduction in a crop and deterioration agricultural production.

222. The compensation of losses shall be made by enterprises, institutions and organizations for which the withdrawn land parcels are allocated and also enterprises, institutions and organizations which activity attracts restriction of the rights of land owners, land users, farmers and owners of the land parcels or deterioration of nearby grounds by the procedure established by legislation.

Article 91. Return of unauthorized occupied lands

223. The land parcels occupied without permission shall be returned on their belonging without compensation of the expenses made in time of illegal possession and using.

224. Restoring to serviceability of the land parcels for use of condition including of housebreaking shall be made at the expense of persons who have occupied these land parcels without permission.

225. Returning of a land parcel occupied without permission to a land owner, land user, farmer or to an owner of the land parcel shall be made under a decision a khokim of a respective area, city, and region or under a decision of a court.

Civil Code of the Republic of Uzbekistan

226. This Code is enacted by Oliy Majlis of Uzbekistan No. 257-I of August 29, 1996. Amended according to different laws of Uzbekistan of 1996-2012.

Article 187. Acquisitive prescription

227. A person who is not the owner of property but who has in good faith, openly, and uninterruptedly possessed as his own immovable property for fifteen years or other property for five years, shall acquire ownership of this property (acquisitive prescription).

228. The right of ownership of an immovable and of other property subject to state registration shall arise for a person who has acquired this property by virtue of acquisitive prescription from the time of such registration.

229. Until the acquiring of the right of ownership to the property by virtue of acquisitive prescription, a person possessing property as his own has the right to protection of his possession against third persons who are neither owners of the property nor have the right of possession by virtue of another basis provided by a Law or the contract.

230. A person relying on prescription by possession may join to the time of such possession all the time during which the property was possessed by the one to whom this person is a legal successor.

231. The running of the period of acquisitive prescription with respect to things located with a person from whose possession they could be taken in accordance with Articles 228, 229, 230 and 232 of the present Code starts not sooner than the expiration of the period of limitation of actions for the respective claims.

Article 199. Taking of property from an owner

232. The taking of property from an owner shall be allowed only by the levying of execution on its property for obligations of the owner in cases and by the procedure provided by legislative acts, and also by the procedure of nationalization, requisition and confiscation.

233. If property has come into ownership by a person to whom by virtue of a Law the property may not belong to him, the right of ownership for this property shall be terminated by the procedure of a court with compensation the value of taking of property to the person.

Article 206. Termination of the right of ownership not directed for taking of property from an owner

234. Termination of the right of ownership in connection with a decision of state body non- directed to the taking of property from an owner including with a decision on the taking of land parcel on which there are a house of the owner, other buildings, structures or plantations, shall be allowed only in cases and by the procedure established by legislative acts with provision to the owner equal property and compensation to him in full of value of losses caused by termination of the right of ownership

235. In case of disagreement of an owner with a decision entailing termination of the right of ownership, it may not be made before the rendering of a decision in the dispute by a court. All problems on compensation to an owner losses caused shall also be solved under consideration of dispute.

Article 212. Unauthorized building

236. An unauthorized building is a dwelling house, other structure, construction, or other immovable property made on a land parcel not allocated for these purposes by the procedure established by legislation and also made without receipt of the necessary permissions thereto or with substantial violation of architectural and construction norms and rules

237. A person who has made an unauthorized building does not acquire the right of ownership to it. He does not have the right to dispose of the building, to sell, give, lease out, or make other transactions.

238. An unauthorized building by a suit of a person whose rights have been violated or the respective state body must be torn down by a decision of a court by the person who made it or at this person's expense except for cases provided by Paragraph 4 and 5 of the present Article.

239. The right of ownership to an unauthorized building may be recognized by a court for the person who made the building on a land parcel not belonging to him on the condition that the given parcel shall be granted to this person by the established procedure for the building that was made. (Amended by item 1 of Section IX of the Law of RU No. 671-II of August 27, 2004.).

240. The right of ownership to an unauthorized building may be recognized by a court for the person in whose ownership, lifetime inheritable possession, and permanent use is the land parcel where the building was made. In this case the person for whom the right of ownership to the building is recognized shall compensate the person who made it for the building expenses in an amount determined by the court.

241. The right of ownership to an unauthorized building may be recognized for these persons if the keeping of the building violates the rights and interests protected by a Law of other persons or creates a threat to the life and health of citizens.

Directions on the procedure for official registration of the rights to land plots in the Republic of Uzbekistan

242. These Directions are registered by Ministry of Justice of the Republic of Uzbekistan No. 736 of May 27, 1999.

Article 4.Procedure for official registration of the rights to land plots

243. Documents required for registration, which serve to establish the emergence of the rights to land plots, as well as their discontinuation, transfer and introduction of burdens and changes, should be notarised in cases expressly stated in the law.

244. Properly notarized documents relating to operations in land plots are not subject to any additional verification when undergoing the registration procedure.

245. The rights to land plots are registered on the basis of the following documents:

- when there emerges the right of ownership of the land plot – on the basis of the official warrant to the right of ownership, purchase-and-sale contracts and other documents specified under the law;
- when there emerges the right of possession and use of the land plot – on the basis of a decision to allocate a land plot taken by an appropriate authority (an official);
- when there emerges the right of lease – on the basis of a decision to grant a land plot on lease and a lease contract;
- when transferring the right of possession or use of the land plot – on the basis of the contract for the purchase and sale, change, granting or rent: a certificate of the right of inheritance of buildings and structures or an appropriate decision taken by the land plot's owner or a body (an official) authorized by the latter to do so;
- when there are servitudes – on the basis of an appropriate contract or court adjudgement;
- when there are burdens – on the basis of decisions taken by appropriate authorities.

246. Registration of the rights to land plots is carried out in the following succession:

- reception of the application;
- verification of the application and documents and materials enclosed;
- registration of the application in a special application registry;
- registration of the rights to the land plot;
- provision of the subject of the right with a certificate of registration of its rights to the land plot.

247. Registration of the rights to land plots is accomplished within 10 days from the date the registration authority has accepted the application for consideration.

248. In cases where (i) the documents submitted fail to meet the established criteria, with a defect seeming to be so insignificant that it could be eliminated at once, (ii) any additional information is required, or (iii) the documents submitted have to be examined, the registration authority may put off the final decision for two weeks from the date a decision on adjournment is taken. If the applicant fails to put his documents in order within this period, his application for registration may be rejected, with the former being informed of the fact in writing. Registration fees are not refundable.

249. Registration is valid from the date when the documents required for registration have been submitted. This should be reflected in a registry. The right's priority is established on the basis of the date the application has been entered on the registry.

250. The registration procedure having been finalized, the registration authority certifies the fact either by issuing a certificate of the registered right or by marking the document submitted for registration with an appropriate notice.

Cabinet of Ministers Resolution on “Order of compensation of citizens’ and legal entities’ losses due to land plots acquisition for state and public needs”

251. This Resolution No. 97 is adopted of May 29, 2006. Amended according to Resolutions of CM No. 248 of November 9, 2010 and No. 146 of May 25, 2011.

Point 2

252. Land or it's part is resumed for the state and public needs only by the consent of or agreement with the land owner, tenant by the decision of district or city mayor, Council of Ministers of the Republic of Karakalpakistan, regional mayor offices and Cabinet of Ministers of the Republic of Uzbekistan and Tashkent city mayor.

Point 6

253. Illegally constructed houses, buildings and structures are not subject to compensation.

Point 7

254. In case of land allotment of the resumed land to enterprises, organizations and entities the payment of compensation, provision of houses (flats) and provision of temporary houses as well as full coverage of relocation costs are done by these entities, organizations and enterprises.

Point 9

255. District mayor office creates commission which defines the amount and type of compensation for demolished houses (flats), buildings, structures and plantations. The commission is headed by the district deputy mayor and consists of the following members: representative of financial and other departments of the mayor office, state inspector on monitoring over land usage and protection, representatives of makhalla committees, land owner (land user, tenant) whose land is resumed, representatives of the entities, organizations and enterprises whom the land plot is allotted and other representatives at mayor offices discretion.

Point 10

256. Technical status valuation of houses, buildings and structures and definition of plantations value on the resumed land is done by the district department on land resources and state cadastre at the expense of applicant. At landowners discontent with cadastre's valuations he/she can apply to independent licensed valuers. The independent valuer's service payment is done by the applicant.

Point 12

257. All construction materials left after demolishing of houses, buildings and structures (except unauthorized ones) on the resumed land plot will go to constructor or landowner paying full compensation for the owner.

In separate cases the construction materials can be given to the owner of the demolished houses, buildings and structures at his/her will and by the decision of relevant district (city) mayor. In this case the commission must define the value of the construction materials at market prices taking into consideration depreciation.

Point 13

258. Exact dates and order of compensation payment is defined by the decision of the Council of Ministers of the Republic of Karakalpakstan, regional and Tashkent city mayors with payment of compensation prior to demolishing.

XV.2. Annex 2. Pictures at Resettlement Area

Picture 1. Mkhalla "Yangiobod" (overall view)

Picture 2. The courtyard of Azamat Salimov's household in Makhalla "Uyrot" (view on the Navoi Thermal Power Plant)

Picture 3. Unfinished houses in Makhalla "Yangiobod" (overall view)

Picture 4. Well-to-do households in Makhalla "Uyrot"

Picture 5. The census (Makhalla “Uyrot”)

Picture 6. The field with clover and corn (Makhalla “Yangiobod”)

XV.3. Annex 3. Meeting Minutes and the list of participants on the meeting of 30 October 2012

Meeting of residents and representatives of JICA and TEPSCO

October 30, 2012 (09.20-11.20)

PROTOCOL

Place of meeting: Recreation Room in Navoi CCCGP No.1's camp site

Method of notification to residential people: informing neighboring residents through their representatives

1. Opening remarks, the project description - Ganiev K. Director of Navoi TPP (09.20).

2. Presentation of the project - Norihiko Fukazawa, Yoko Hamada (09.40).

3. Speech by Governor of Karmana district - Ismatov R. (10.45).

4. Questions and answers. Discussion with residents to be resettled. (11.00).

The first speech (Saifi Obloberdyev, pensioner from makhalla "Uyrot").

Supports modernization of Navoi TPP because it will give new energy to the development of the economy of Navoi region and the country as a whole. (Applause)

Project Owner: We appreciate your support.

The second speech (representative of the residents, did not introduce him/herself.)

Residents have no objection to the new project. Expressed dissatisfaction with the fact that the evaluation of their homes was made with earlier date of construction, which makes the value of their homes lower than it should be.

Other residents, attending the meeting, supported him. Governor Ismatov reassured (calming down the speaker): "The problem can be solved."

Next, Governor Ismatov said that compensation money for resettled residents can be paid "even today". But then, the residents will have to relocate in the cold season. So he proposed them to begin construction on new allocated sites today at their own expense. Compensation money will be paid in spring, so that they could start construction the main building.

Residents: We prefer to get monetary compensation by cash rather than by bank remittance.

Project owner: According to the law, we cannot provide monetary compensation by cash.

5. End of meeting. Residents and representatives of JICA, TEPSCO and local authorities break up.

THE MEETING WITH RESETTLED RESIDENTS AND OFFICIALS

(30 October 2012, 09.20-11.45, Navoi TPS)

No.	Name	Gender	Status
1	KuvondikBerdiev	male	Resettled resident
2	KorholBerdieva	female	Resettled resident
3	ShakhloKosimova	female	Resettled resident
4	SevdiyorBerdiev	male	Resettled resident
5	MukaddasBerdieva	female	Resettled resident
6	AlisherNurmatov	male	Resettled resident
7	ShakhloAshurova	female	Resettled resident
8	TuimurodRamazanov	male	Resettled resident
9	SevdiyorAshurov	male	Resettled resident
10	HusniddinAkhmedov	male	Resettled resident
11	ShafzodToshev	male	Resettled resident
12	IskandarHamroev	male	Resettled resident
13	IkhtiyorBerdiev	male	Resettled resident
14	ShukhratObloberdiev	male	Resettled resident
15	HudaiberdiObloberdiev	male	Resettled resident
16	UmidObloberdiev	male	Resettled resident
17	Aziz Berdiev	male	Resettled resident
18	KobilKayumov	male	Resettled resident
19	RaimObloev	male	Resettled resident
20	RustamShamsiev	male	Resettled resident
21	ShoiraObloberdieva	female	Resettled resident
22	SanobarKlycheva	female	Resettled resident
23	KomilSamatov	male	Resettled resident
24	AbrorHokimov	male	Resettled resident
25	SunnatErgashev	male	Resettled resident
26	RavshanTuraev	male	Resettled resident
27	IkhtiyorKamolov	male	Resettled resident
28	SirodjHodjiev	male	Resettled resident
29	MuborakHodjieva	female	Resettled resident
30	MuborakNosirova	female	Resettled resident
31	KadriyaIslomova	female	Resettled resident
32	GulomMamatov	male	Resettled resident
33	NurulloErgashev	male	Resettled resident
34	KobilInoyatov	male	Resettled resident
35	KakhramonGaniev	male	Navoi TPS, Director
36	NajmiddinBabakandov	male	Navoi TPS, Deputy Director
37	IbrokhimNorov	male	Navoi TPS, Assistant Director
38	MuzaffarYarashov	male	Navoi TPS, Chairman of a union

39	ShukhratDostov	male	Navoi TPS, Member of PIU (Project Implementation Unit)
40	UtkirHamraev	male	Photographer
No.	**Name**	**Gender**	**Status**
41	IstamHamraev	male	Navoi TPS, Chief of information
42	NazokatSafarova	female	Navoi TPS, Secretary
43	YulduzAdylova	female	Navoi TPS, Member of PIU (Project Implementation Unit)
44	SharofiddinIsmatov	male	Navoi Region, Karmana District, Hokim (Major)
45	KomilSamatov	male	Karmana District, Makhalla “Yangiobod”, Posbon (Commissary)
46	KobilInoyatov	male	Karmana District, Rural Citizen Assembly “Yangiobod”, Chairman
47	NurulloErgashev	male	Karmana District, Makhalla “Uirot”, Chairman
48	GulomMamatov	male	Karmana District, Makhalla “Yangiobod”, Chairman
49	MuborakNosirova	female	Karmana District, Makhalla “Yangiobod”, Female Issues Consultant
50	KadriyaIslomova	female	Karmana District, Makhalla “Yangiobod”, Secretary
51	AlisherNumatov	male	Karmana District, Chief of Land and Assets Cadaster
52	Hakim Akhmedov	male	Karmana District, Deputy Chief of Architecture and Construction Department

XV.4. Annex 4. Resolution of the Karmana District Hokim No. 605-K

Resolution of the Khokim (Governor) of the Karmana District of the Navoi Region Republic of Uzbekistan Karmana district, Yangi-Aryk Village Citzens' Gathering, Talkok Makhalla Citizens' Gathering

Date: 11 July 2012

Ref. No. 605-K

On approving the membership of the Special Commission on seizure of the housing land plots owned by the natural persons with their consent for the public needs

For the purpose of ensuring the execution of the Decree of the President of the Republic of Uzbekistan No. UP-1668 dated December 27th 2011 and in accordance with the Article 41 of the Land Code of the Republic of Uzbekistan in order to ensure conducting inventory of the housing of the citizens to be demolished and provision of the housing for the re-settled families and paying the compensation for the citizen, which house shall be demolished in connection with the new construction of the road section with the length of 3.4 km, located between the 159.4 km of the Road M-37 to the intersection of the streets Nizomiy and Navoi of the Navoi city as well as with the construction of the Second 450 MWt capacity Gas and Steam Combined Unit of the Navoi Thermal Power Plant

I HAVE RESOLVED AS FOLLOWS:

1. Approve the membership of the Special Commission in accordance with the Annexes 1 and 2, which will determine the amount of the compensation and type of compensation for the citizen, whose housing will be demolished in connection with the capital repair of the road section with the length of 3.4 km, located between the 159.4 km of the Road M-37 to the intersection of the streets Nizomiy and Navoi of the Navoi city where section for the enlargement of the road is located at the area of the YangiArik village gathering of citizen Makhallas Argun, Yangi Arik, Talkok as well as with the construction of the Second 450 MWt capacity Gas and Steam Combined Unit of the Navoi Thermal Power Plant located at the area of Uyrot village citizen gathering Makhallas Uyrot and Yangiobod.

2. Special Commission (headed by Sh. Ismatov) shall perform its activity on determining the amount of compensation and type of compensation for the citizen, whose housing shall be demolished in connection with the seizure of the land plots for the state and public needs, on the basis of the Resolution No. 97 of the Cabinet of Ministers of the Republic of Uzbekistan "On Approval of the Regulation On the Order of Compensation of the Loss, Inflicted to the Citizens and Legal Entities in Relation with the Seizure of the Lands for the State and Public Purposes" dated May 29th 2006 and Article 41 of the Land Code of the Republic of Uzbekistan. Special commission shall formalize in appropriate manner minutes on the progress of implemented works till 30 July of the current year.

3. Control over the execution of the present Resolution shall be assigned upon the Acting First Deputy of District Khokim (Governor) Mr. Sh. Ismatov.

District Khokim (Governor)Ch. Kanoatov

Annex 1 to the Resolution of the Karmana District Khokim (Governor) Ref. No. 605-K, dated July 11, 2012

MEMBERSHIP

of the Special Commission on

determining the amount of the compensation and type of compensation for the citizen, whose housing will be demolished due to the seizure of the land plots for state and public needs for the enlargement of the road in connection with the capital repair of the road section with the length of 3.4 km, located between the 159.4 km of the Road M-37 to the intersection of the streets Nizomiy and Navoi of the Navoi city.

Mr. Sh. Ismatov	First Deputy of District Khokim (Governor), Chairman of the Special Commission
Mr. V. Urinov	Director of Navoi AutoYul (Navoi branch of Road Agency)
Ms. M. Akhmedova	Head of the District Department of Finance
Mr.A. Nurmatov	Chief of State Unitary Enterprise District Land and Immovable Cadastre Service
Mr. Mukhammatkuov	Head of the District Architecture and Construction Department
Mr. A. Ernazarov	Director of the Branch of Karmana District Gas Agency
Mr. B. Islamov	Head of the District Electric Power networks
------------------	Head of the Anti-Fire Department of Interior
Mr. R. Rajabov	Chief Doctor of the District State Sanitary Epidemiology Agency
Mr. I. Radjabov	Head of the District Nature Protection Department
Mr. B. Toshev	Acting Director of the Karmana Drinking water production Liability Limited Company
Mr. S. Kurbonov	Chairman of the District Makhalla Charity Public Foundation
Mr. I. Yodgorov	YangiArik Village Citizen’s Gathering
Mr. Kh. Jurayev	ArgunMakhalla Citizen’s Gathering
Mr. D. Akramov	YangiArikMakhalla Citizen’s Gathering
Mr. U. Kurbonov	TalkokMakhalla Citizen’s Gathering
---------------------	Citizen, whose housing is being demolished for the state and public needs

Chief Specialist

of the District Khokimiyat (Governor’s Office)

on the issues of capital construction, communications,

public utilities and municipal improvements

______________________ Mr. F. Ismoilov

Annex 2 to the Resolution of the Karmana District Khokim (Governor) Ref. No. 605-K, dated July 11, 2012

MEMBERSHIP

of the Special Commission on

determining the amount of the compensation and type of compensation for the citizen, whose housing will be demolished due to the seizure of the land plots for state and public needs in connection with the construction of the Second 450 MWt capacity Gas and Steam Combined Unit of the Navoi Thermal Power Plant.

Mr. Sh. Ismatov	First Deputy of District Khokim (Governor), Chairman of the Special Commission
Mr. K. Ganiev	Director of the Open Joint Stock Company Navoi Thermal Power Plant
Ms. M. Akhmedova	Head of the District Department of Finance
Mr.A. Nurmatov	Chief of State Unitary Enterprise District Land and Immovable Cadastre Service
Mr. Mukhammatkuov	Head of the District Architecture and Construction Department
Mr. A. Ernazarov	Director of the Branch of Karmana District Gas Agency
Mr. B. Islamov	Head of the District Electric Power networks
-------------------	Head of the Anti-Fire Department of Interior
Mr. R. Rajabov	Chief Doctor of the District State Sanitary Epidemiology Agency
Mr. I. Radjabov	Head of the District Nature Protection Department
Mr. B. Toshev	Acting Director of the Karmana Drinking water production Liability Limited Company
Mr. S. Kurbonov	Chairman of the District Makhalla Charity Public Foundation
Mr. K. Inoyatov	Uyrot Village Citizen's Gathering
Mr. N. Ergashev	Uyrot Makhalla Citizen's Gathering
Mr. G. Mamatov	Yangiobod Makhalla Citizen's Gathering
---------------------	Citizen, whose housing is being demolished for the state and public needs

Chief Specialist

of the District Khokimiyat (Governor's Office) on the issues of capital construction, communications, public utilities and municipal improvements

______________________ Mr. F. Ismoilov

XV.5. Annex 5. Resolution of the Karmana District Hokim No. 612-K

Resolution of the Khokim (Governor) of the Karmana District of the Navoi Region Republic of Uzbekistan Karmana district, Yangi-Aryk Village Citzens' Gathering, TalkokMakhalla Citizens' Gathering

Date: 12 July 2012

Ref. No. 612-K

On seizure of the housing land plots owned by the Natural persons with their consent for the public needs

For the purpose of ensuring the execution of the Decree of the President of the Republic of Uzbekistan No. UP-1668 dated December 27th 2011 and in accordance with the Article 41 of the Land Code of the Republic of Uzbekistan District Khokim (Governor) has issued Decree No. 605-K, dated July 11th, 2012 On Setting up Working Group, which shall perform activities on conducting inventory of the housing of the citizens to be demolished and provision of the land plots for the families to be re-settled in connection with the new construction of the road section with the length of 3.4 km, located between the 159.4 km of the Road M-37 to the intersection of the streets Nizomiy and Navoi of the Navoi city as well as with the construction of the Second 450 MWt capacity Gas and Steam Combined Unit of the Navoi Thermal Power Plant. After examining the Minutes of the Working Group

I HAVE RESOLVED AS FOLLOWS:

1. In accordance with the District Khokim (Governor) Decree No. 605-K, dated July 11th, 2012 the list of citizens, whose housing shall be demolished in relation with the new construction of the road section with the length of 3.4 km, located between the 159.4 km of the Road M-37 to the intersection of the streets Nizomiy and Navoi of the Navoi city, shall be confirmed in accordance with the Annexes 1 and 2.

2.District Department of the Land Resources and State Cadastre (Mr. Gaffarov A.) shall be assigned with the task of drafting and submission for the approval by the District Khokim (Governor) the proposals on allocation of the land plots, in the sizes, determined in the Article 41 of the Land Code of the Republic of Uzbekistan and Resolution No. 97 of the Cabinet of Ministers of the Republic of Uzbekistan "On Approval of the Regulation On the Order of Compensation of the Loss, Inflicted to the Citizens and Legal Entities in Relation with the Seizure of the Lands for the State and Public Purposes" dated May 29th 2006.

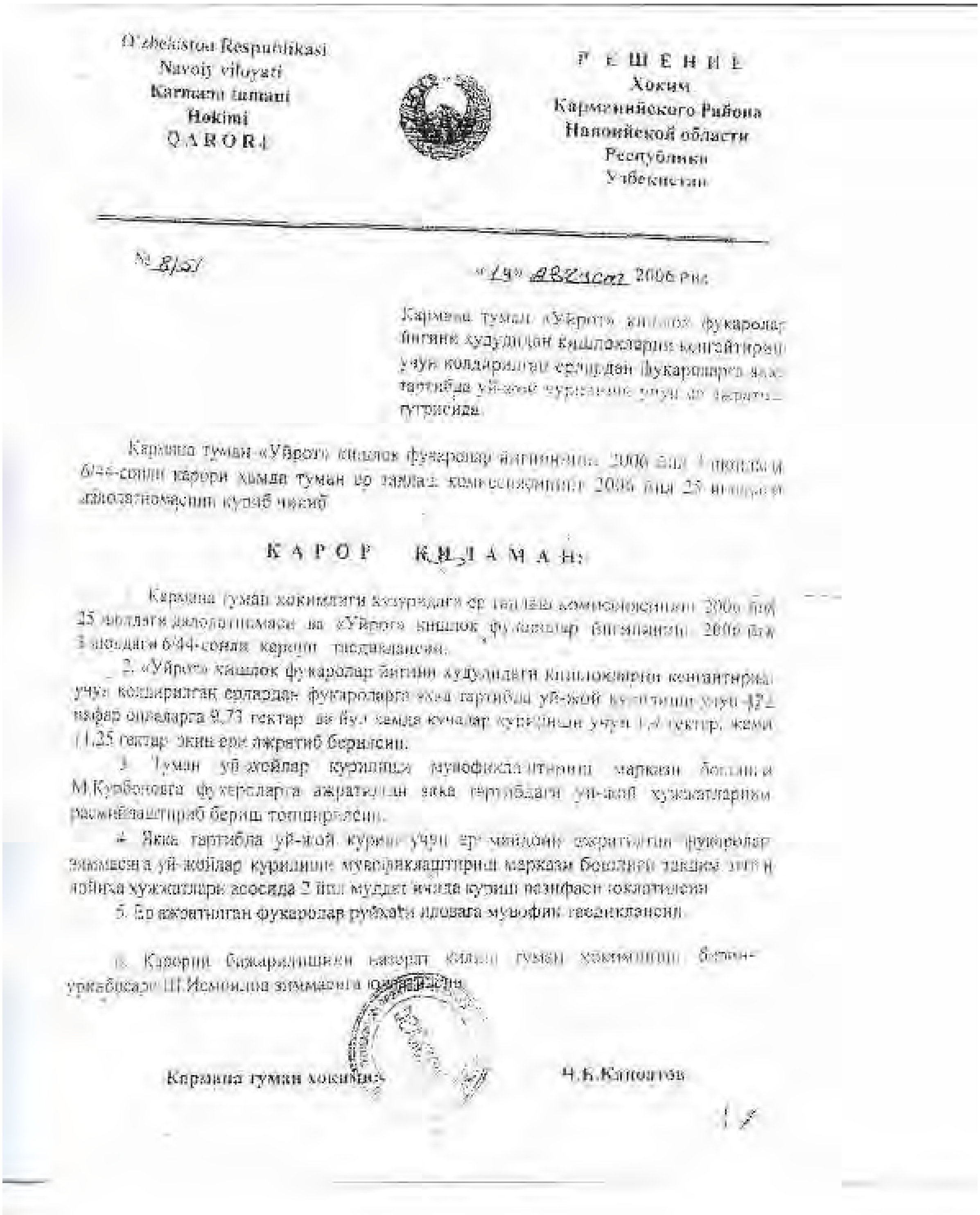
3. Chief Officials, responsible for the construction of the present road and 450 MWt capacity steam and gas combined unit shall carry out payment of the compensations, allocation of the lands and provision of the housing to the owners of the housing to be demolished due to the road construction in accordance with the requirements of the Resolution No. 97 of the Cabinet of Ministers of the Republic of Uzbekistan "On Approval of the Regulation On the Order of Compensation of the Loss, Inflicted to the Citizens and Legal Entities in Relation with the Seizure of the Lands for the State and Public Purposes" dated May 29th 2006, Land Code of the Republic of Uzbekistan, Citizen's Code of the Republic of Uzbekistan and Housing Code of the Republic of Uzbekistan.

4. Control over the execution of the present Resolution shall be assigned upon the Acting First Deputy of District Khokim (Governor) Mr. Sh. Ismatov and Deputy of District Khokim (Governor) Mr. Kh. Jurayev.

District Khokim (Governor)Ch.Kanoatov

Round Stamp

XV.6. Annex 6. Resolution of the Karmana District Hokim No.8/61 dated on August 14, 2006



O'zbekiston Respublikasi
Navoiy viloyati
Karmana tumani
Hokimi
QARORI

РЕШЕНИЕ
Хокима
Карманинского Района
Навоийской области
Республики
Узбекистан

№ 8/61

«14» август 2006 йил

Кармана туман «Уйрот» кишлок фукаролар йигини худудидан кишлокларни кенгайтириш учун колдирилган ерлардан фукароларга якка тартибда уй-жой куриш учун ер ажратиш тугрисида.

Кармана туман «Уйрот» кишлок фукаролар йигинининг 2006 йил 3 июлдаги 6/44-сонли карори хамда туман ер танлаш комиссиясининг 2006 йил 25 июлдаги хулосатномасини куриб чикиб

К А Р О Р   К И Л А М А Н:

1. Кармана туман хокимлиги хузуридаги ер танлаш комиссиясининг 2006 йил 25 июлдаги хулосатномаси ва «Уйрот» кишлок фукаролар йигинининг 2006 йил 3 июлдаги 6/44-сонли карори тасдиклансин.

2. «Уйрот» кишлок фукаролар йигини худудидаги кишлокларни кенгайтириш учун колдирилган ерлардан фукароларга якка тартибда уй-жой куриш учун 472 нафар оилаларга 9,73 гектар ва йул хамда кучалар куриш учун 1,4 гектар, жами 11,25 гектар экин ери ажратиб берилсин.

3. Туман уй-жойлар курилишини мувофиклаштириш маркази бошлиги М.Курбоновага фукароларга ажратилган якка тартибдаги уй-жой хужжатларини расмийлаштириб бериш топширилсин.

4. Якка тартибда уй-жой куриш учун ер майдони ажратилган фукаролар зиммасига уй-жойлар курилишини мувофиклаштириш маркази бошлиги тавсия этган лойиха хужжатлари асосида 2 йил муддат ичида куриш вазифаси юклатилсин.

5. Ер ажратилган фукаролар руйхати иловага мувофик тасдиклансин.

6. Карорни бажарилишини назорат килиш туман хокимининг биринчи уринбосари Ш.Исмоилов зиммасига юклатилсин.

Кармана туман хокими — Ч.Б.Каноатов

August 14, 2006

About assignment of lands to citizens for house building
on an individual basis from the lands that were kept for
enlargement of villages at the village community
assembly «Uyrot» of Karmana District

After consideration of Decision No. 6/44 on June 3, 2006 awarded by the village community assembly «Uyrot» of Karmana District and the information of District Cadastre on July 25, 2006,

I HEREBY RESOLVE:

1. To confirm the information of District Cadastre on July 25, 2006 and the Decision No. 6/44 on June 3, 2006 awarded by the village community assembly «Uyrot» of Karmana District.

2. To set aside and provide the land plots of the size of 9.73 ha from the lands that were kept for enlargement of villages at the village community assembly «Uyrot» of Karmana District for 122 families on an individual basis, and и 1.4 ha for road construction, total of 11.25 ha of the cultivated area.

3. To lay under an obligation the District Coordination Center for House Building Head Mr. M. Kurbanov to give the perfect individual housing documentation.

4. The citizens who have received the lands for individual housing building must to build the housing during 2 years on the basis of construction documentation that will be provided by the District Coordination Center for House Building Head.

5. To confirm the list of citizens who have received the lands on the basis of the Annex.

6. To impose control for execution this Decision on the First Deputy Hokim Mr. Sh. Ismoilov.

Karmana District HokimMr. Ch. B. Kanoatov

XV.7. Annex 7. The list of resettled households with the names of household heads

No.	Household's No.	Name of Household Head
"Uyrot" makhalla		
1	Household No. 1	SevdiyerBerdiev
2	Household No. 2	HudoiberdiObloberdiev
3	Household No. 3	IkhtiyerBerdiev
4	Household No. 4	ShukhratObloberdiev
5	Household No. 5	GolibNarzillaev
6	Household No. 6	SaifiObloberdiev
7	Household No. 7	IskandarHamroev
8	Household No. 8	KamolYekubov
9	Household No. 9	Aziz Berdiev
10	Household No. 10	KuvondikBerdiev
11	Household No. 11	UmidObloderdiev
12	Household No. 12	KobilKayumov
"Yangiobod" makhalla		
13	Household No. 13	SevdiyerAshurov
14	Household No. 14	SherzodToshev
15	Household No. 15	ShakhloKosimova
16	Household No. 16	HusniddinAkhmedov
17	Household No. 17	Rashid Madatov
18	Household No. 18	TuymurodRamazanov
19	Household No. 19	AzamatSalimov
20	Household No. 20	KakhramonUlashov
21	Household No. 21	RustamShamsiev
22	Household No. 22	TulkinOchilov
23	Household No. 23	NigoraKodirova
24	Household No. 24	Aziz Kudratov
25	Household No. 25	OlimMustafoev
26	Household No. 26	SafiyaMamatova
27	Household No. 27	ShoiraJabborova
28	Household No. 28	DilmurodTilovov
29	Household No. 29	GulchehraMamatova
30	Household No. 30	MadinaPakhmatova
31	Household No. 31	MadinaMamatova
32	Household No. 32	HamzaEshkobilov
33	Household No. 33	Yusuf Jabborov

XV.8. Annex 8. The photos of the relocation places

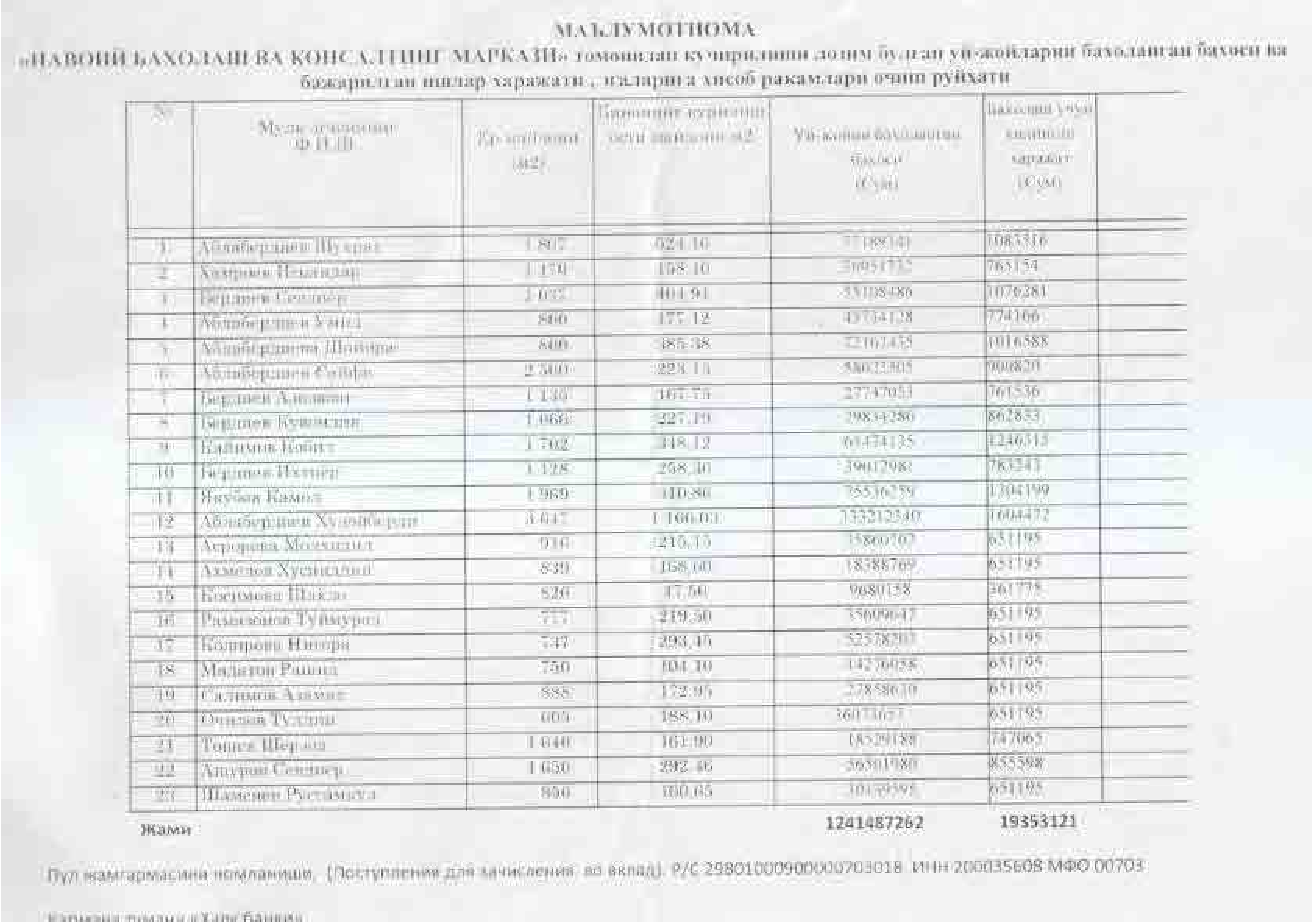
Picture 7.The relocation land plot No. 1

Picture 8.The relocation land plot No. 2

Picture 9.The relocation land plot No. 2

Picture 10.The relocation land plot No. 2

XV.9. Annex 9. The valuation report (No. 327 of 28 September 2012) made by “Navoi Baxolashva Konsalting Markazi”, LTD.



МАЪЛУМОТНОМА

«НАВОИЙ БАХОЛАШ ВА КОНСАЛТИНГ МАРКАЗИ» томонидан кучирилиши лозим булган уй-жойларни бахоланган бахоси ва бажарилган ишлар харажати , эгаларига хисоб ракамлари очиш руйхати

№	Мулк эгасининг Ф.И.Ш.	Ер майдони (м2)	Бинонинг курилиш ости майдони м2	Уй-жойни бахоланган бахоси (Сўм)	Бахолаш учун кетилган харажат (Сўм)
1	Абдибердиев Шухрат	1 807	624.10	77188040	1083316
2	Хазраев Искандар	1 150	158.10	30951732	763154
3	Бердиев Севинчр	1 032	404.91	53108486	1076281
4	Абдибердиев Улиё	800	177.12	43734128	774166
5	Абдибердиева Шохира	800	385.38	72167435	1016588
6	Абдибердиев Сайфи	2 500	223.11	58633805	909820
7	Бердиев Алишер	1 130	167.75	27747053	761536
8	Бердиев Кувондик	1 068	227.19	29834286	862853
9	Кайимов Кобит	1 702	348.12	60474135	1246513
10	Бердиев Ихтиёр	1 128	258,30	39012983	783243
11	Якубов Камол	1 969	110.80	75536259	1304199
12	Абдибердиев Худойберди	3 647	1 166.03	133212340	1604472
13	Ахророва Мохинисо	916	216,15	15860707	651195
14	Ахмедов Хусниддин	839	158,00	18388769	651195
15	Косимова Шахло	826	47,50	9680138	361778
16	Рахмонова Туймурод	777	219,50	35609647	651195
17	Кодирова Нигора	747	293,45	52578203	651195
18	Мадатов Рашид	750	104.10	14276058	651195
19	Салимов Ахмад	888	172.95	27858610	651195
20	Оннаев Тухтаи	605	188,10	36073677	651195
21	Тошев Шерали	1 640	161.90	18529188	747065
22	Ашуров Севинчр	1 650	292.46	36301980	855598
23	Шамсиев Рустамжон	850	100.65	10159595	651195
Жами				1241487262	19353121

Пул жамгармасина номланиши. (Поступления для зачисления во вклад). Р/С 29801000900000703018 ИНН 200035608 МФО 00703

Chapter 9 Project Cost and Economic and Financial Analysis

9.1 Operational Condition of the Navoi CCCGP No.2

The output and thermal efficiency of the power plant must be assumed for economic and financial analysis. There is a slight difference according to the supplier of the power plant. Purchase of the power plant is commonly carried out based on the EPC contract and the EPC contractor is selected through the international competitive bidding. In this case, the bid price is evaluated with consideration given to the difference in the proposed specifications, and the difference in performances including output and thermal efficiency. Accordingly, the bidder of the lowest price does not always win the contract.
Table 9.1-1 shows the technical assumption under the site condition of Navoi CCCGP No.2.

Table 9.1-1 Technical Assumption of Navoi CCCGP No.2

Rated Gross Power Output	431,000 kW
Rated Heat Output	200 Gcal/hr
Shaft Configuration	Multi shaft type with bypass stack
Gross Energy Efficiency	72.3%
Plant Availability Factor	91.3%
Plant Load Factor	86.8 %
Project Period	30 years
Construction to Start	2014
Commercial Operation to Start	2017

(Source: JICA Study Team)

9.2 Project Cost

The total cost of this project is comprised of the cost of construction of the plant and the interest during the construction (IDC). The cost of construction of the plant is comprised of the cost of equipment (facility design and production, equipment procurement, transportation, installation, civil engineering and the construction work, commissioning, spare parts), and such cost for preparation of operation as consulting services and contingency.
The total project cost has not been calculated individually based on a detailed design, but rather been estimated from the costs of similar electric power generation plants constructed in the past.

9.2.1 Assumptions for Calculation of Initial Investment

(1) Project formation
Equipment costs for this project are on the basis of a full turnkey contract with a single contractor.

(2) Financing plan
It is assumed that 85% of the project costs are covered by the loan and remaining 15% of plant construction costs and Interest During Construction will be self financed.

(3) Items to be excluded from project cost
Following items are excluded on the estimation of the project cost.

- Costs for purchasing the land for new plant and compensations for residents of resettlement
- Costs for demolition and relocation of the existing transmission lines.
- Costs for obtaining necessary approvals and licenses for construction of new plant.
- Cost of development of on-site access roads into the construction yard
- Power and water required during construction of new plant
- Fuel and Power during commissioning

(4) Exchange rates
The applicable currency will be the US dollar, and the exchange rates used are as follows:

US$1.00 = JP Yen 78.9 (November 19, 2012)

US$1.00 = Soum 1,960.0 (November 19, 2012)

(5) Escalation rate
The initial investment calculated as of November 2012 has been adjusted taking into consideration the inflation rate assuming that the project will begin in April 2013 and that the construction contract for the project will be signed in January 2014.
Foreign currency: 2.1% per year
Local currency: 4.9% per year

(6) Taxes
Import tax and Value Added Tax: Assumed to be exempt.
Corporate income tax: 15% of taxable income.

9.2.2 Project Cost

(1) Construction cost
a. Project cost
Breakdown of plant project costs are provided in Table 9.2.2-1.

Table 9.2.2-1 Breakdown of new plant project cost

Item		Amount (thousand US$)
Land Preparation Cost		744
Cost of design, manufacturing, test, erection and commissioning for mechanical, electric and I&C equipment	Main equipment (Gas turbine, steam turbine, generators, HRSG and their auxiliaries)	279,029
	BOP	31,824
	Spare Parts for 2 years Operation	18,750
	Engineering & Home Office Fees	25.065
Turbine and boiler buildings, and miscellaneous buildings		59,877
Cost of transport		50,000
Transmission line (New line) and Substation		4,186
Relocation of the Existing Transmission lines		3,250
Total (as of the time of the cost estimate)		472,727

(Source: JICA Study Team)

b. Preparation cost

Breakdown of preparation cost are provided in Table 9.2.2-2.

Table 9.2.2-2 Breakdown of preparation cost

Item	Amount (thousand US$)
Consulting service fee	18,750
Physical Contingency	24,574
Total (as of the time of the cost estimate)	43,324

(Source: JICA Study Team)

(2) Interest during construction

a. Construction capital investment plan

A disbursement plan for the project is provided in Table 9.2.2-3

Table 9.2.2-3 Disbursement plan

Unit: Thousand US$

Fiscal year	F/C	L/C	Total
Year 1	16,674	7,900	24,574
Year 2	33,347	15,801	49,148
Year 3	100,041	47,402	147,443
Year 4	116,715	55,302	172,017
Year 5	66,694	31,601	98,295
Total	333,471	158,006	491,477

(Source: JICA Study Team)

b. Interest during construction

Interest during construction is provided in Table 9.2.2-4, utilizing interest rate on loans of 1.40% per year.

Table 9.2.2-4 Interest During Construction

Unit: Thousand US$

Fiscal year	Loan
Year 1	344
Year 2	688
Year 3	2,064
Year 4	2,408
Year 5	1,376
Total	6,881

(Source: JICA Study Team)

(3) Initial investment

The initial investment is comprised of the total of the cost of equipment construction, cost of preparation for the commencement of operation and interest during construction and is as shown in Table 9.2.2-5.

Table 9.2.2-5 Initial investment

Unit: Thousand US $

Item	Cost
Cost of equipment construction	472,727
Cost of preparation for the commencement of operation	43,324
Interest during construction	6,881
Total	522,982

(Source: JICA Study Team)

9.3 The Basis of Economic and Financial Analysis

Table 9.3-1 Summery of Basic Conditions and Assumptions

Item	Conditions and Assumptions
a. Power and Heat Production	Rated Gross Power Output: 431.0MW Annual Operating Hours:8,000 hours Plant Load Factor: 86.8% Annual Gross Power Output Energy: 3,276 GWh Annual Auxiliary Power Consumption: 112 GWh Transmission and Distribution Loss: 13.0% Rated Heat Output: 200 Gcal Annual Heat Output Energy: 1,520 Tcal/year
b. Construction Period	5 years
c. Project life	30 years after commissioning
d. Funding	Internal Fund: 11% Debt: 89% - ODA Loan: 74% - Reconstruction and Development Fund: 15%
e. Debt Amortization	ODA sub-loan 30 years including grace period of 10 year Domestic loan 15 years
f. Interest Rate	ODA sub-loan 1.40%

	Domestic loan 3.90%
g. Depreciation	Strait-line, 30 years, Salvage value 10% of original value
h. Tariff	Electricity: the same value for the entire project life Heat: Same as above
i. Physical Contingency	5% of base cost
j. Price Contingency	2.1 % per annum for foreign portion 4.9 % per annum for local portion
k. Exchange rate	1USD=78.9, 1USD = 1960 Sum, 1Sum=JPY 0.04

(Source: JICA Study Team)

a. Power Production

The annual gross power output energy is expected to be 3,276GWh with the assumptions of rated gross power output of 431MW, annual operating hours of 8,000 hours and plant load factor of 86.8%. Based on annual auxiliary power consumption of 112 GWh, annual net power output energy is expected to be 3,164GWh (=3,276GWh-112GWh). Annual heat output energy is 1,520Tcal/year with the assumptions of rated heat output of 200Gcal, annual operating hours of 8,000 hours and plant load factor of 86.8%.

b. Construction Period

The construction is planned to be commenced in 2013 and to be completed in 2017. It is planned to take 5 years for project implementation.

c. Project Life

The assumed project life is 30 years after commissioning.

d. Funding

It is assumed that the total project cost is to be financed by both internal fund and debt. Internal fund is expected to be 11% of the project cost. Debt from the Reconstruction and Development Fund of the Republic of Uzbekistan is expected to be 15% of the project cost. The ODA loan provisioned by JICA is expected to be 74% of the project cost. It is assumed that the ODA loan is borrowed by the Republic of Uzbekistan and is to be sub-loaned to SJSC Uzbekenergo.

e. Debt Amortization

The general terms of ODA Loans for the Low-Middle-Income Countries are applied to the project. Repayment period for the sub-loan of the ODA Loan is 30 years with grace period of 10 years. The principal payment of the sub-loan starts after the grace period. Both interest and principal payment of the domestic loan will be made for 15 years. The payment of the domestic loan is refinanced with the same terms and conditions until commissioning.

f. Interest Rate

The general terms of ODA Loans for the Low-Middle-Income Countries are applied to the project. Interest rate of the ODA Loan is 1.40% per annum. As no premium is expected to be added on the sub-loan for SJSC Uzbekenergo, interest rate of the sub-loan is 1.40%. For the domestic loan from Reconstruction and Development Fund, interest rate is expected to be 3.90%.

g. Depreciation

It is assumed that depreciation employs a straight line method for the estimated economic lives of equipment. The estimated economic life of equipment is 30 years. Salvage value is

10% of the capital cost.

h. Tariff

Major sources of income are electricity sales and heat sales. The assumptions for tariff pricing of both types of energy are following:

Electricity tariff: Given small cross-subsidy and frequent review of pricing, the price of electricity is assumed to absorb inflation and maintain its value in real terms during the life of the project. This assumption is more conservative than an actual tariff revision for the period of 2004-2010 when electricity tariff increased in real term.

Heat tariff: Price of heat remains the same in real terms during the life of the project.

i. Contingency

The physical contingency is assumed at 5% of base cost adjusted by inflation. The assumptions for price contingency are 2.1 % per annum for foreign portion and 4.9% per annum for local portion.

j. Exchange Rate

The Central Bank of the Republic of Uzbekistan employs an adjustable peg system and adjust exchange rate once a week in consideration of several factors such as inflation, money supply and balance of payments. The assumptions of the exchange rate are 1USD=78.9, 1USD = 1960 Sum, and 1Sum=JPY 0.04

9.4 Financial Evaluation

9.4.1 Method of Evaluation and the Basic Parameters

The purpose of the financial evaluation is to assess the financial viability of the project. In this section, the analysis of the financial viability is based mainly on the FIRR, which estimates financial benefit and financial cost derived from the project and calculate return on capital investment. In the case that the result of the FIRR is higher than WACC, the project generates positive cash flow, contributes to the financial health of the entity and can be considered financially viable.

9.4.2 Financial Cost

a. Project Cost

For financial evaluation, the project cost is consisted of EPC contract, consulting service, physical contingency and taxes. Price contingency and interest during construction (IDC) are not included for the financial evaluation. VAT and duty are not levied on imported equipment. In total, VAT and corporate income tax is 25% of local portion of the project cost. In the financial evaluation, the project cost is estimated at USD 571.5 million.

b. Operation and Maintenance Cost - Fuel Cost

The estimation of annual fuel cost is based on the assumptions that the annual gas consumption is 792.5 million m3N and the unit price of natural gas is 116,100sum (equivalent of USD 59.23) per thousand cubic meters. The unit price of natural gas is based on actual unit price. The domestic price of natural gas is assumed to stay at the same level for the project life.

c. Operation and Maintenance Cost – Other Costs

Other costs can be classified into variable costs and fixed costs. Variable costs are consisted of spare parts (USD 2.48/MWh), consumables and tap water (987.54 sum /MWh). Fixed costs include insurance (0.03% of equipment), administrative cost (686 million sum annually) and others (1,418 million sum annually). For this project, the cost projections are based on these for a gas-fired combined cycle power generating unit to be installed by Tashkent Thermal Power Plant Modernization Project. The cost projections are adjusted with inflation rates in both the United States and Uzbekistan.

d. Tax

In addition to taxes included in the project cost, VAT (20%), property tax (3.5% of the total fixed assets excluding equipment for the first five years), corporate income tax for Uzbekenergo (12% on net income), and infrastructure development tax (8% of net income) are levied on the project.

9.4.3 Financial Benefit

a. Electricity Sales Revenue

As of October 2012, the tariffs of electricity were 52.2-110 sum/kWh including VAT (20%) depending on the category of customer. In most categories, consumers are charged 104.4 sum / kWh. The electricity tariff (95.3 sum/kWh or USD 0.049/kWh) is calculated based on the weighted average electricity tariff. With the transmission and distribution loss of 13.0% (an average of 2008-2010), SJSC Uzbekenergo is expected to supply 2,752GWh (=3164GWh x (100.0%-13.0%)) to end users.

Table 9.4.3-1 Weighted Average of Electricity Tariff (October 2012)

Type of user	Consumption 2011(GWh)	Electricity Tariff Sum/kWh
Industry-large	16,350	81.9
Industry-small	2,476	104.4
Industrial Agriculture	8,858	104.4
Commerce	1,174	106.5
Non-industrial	1,184	104.4
Residential	10,286	104.4
Others	177	-
Total /Weighted Average	40,505	95.3

Source: SJSC Uzbekenergo

b. Heat Sales Revenue

Navoi TPP provides heat to chemical plants and, via a mining company, residents in the Navoi area. As of October 2012, the tariffs of heat were 16,961-30,838 sum/Gcal including VAT (20%). Billing of hot water and steam are Gcal-basis. Customers except whole sellers and greenhouses accounted for a major part of heat revenue. For 2012, the heat tariff was based on the weight average of heat tariff (27,312 sum/Gcal or USD 13.93/Gcal). Heat is expected to be sold at 1,520 Tcal per year with the assumption that heat is gauged at Navoi TPP.

Table 9.4.3-2 Weighted Average of Heat Tariff (2012)

Type of user	Forecasted Consumption Mix 2012 (Gcal)	Heat Tariff Sum/Gcal
Consumers except whole sellers and greenhouses	71.7%	30,838
Whole sellers and greenhouses	4.8%	26,349
Uzbekenergo system	0.01%	23,248
Residents	23.5%	16,691
Weighted Average	-	27,312

Source: Navoi Thermal Power Station

9.4.4 Weighted Average Cost of Capital

For the financial analysis, WACC of the project is employed as a hurdle rate. The general terms of ODA Loans for the Low-Middle-Income Countries are applied to the project. The interest rate of the sub-loan for SJSC Uzbekenergo is 1.40% per annum. The interest rate of domestic loan is assumed to be 3.90%. Cost of equity (14.10%) is based on SJSC Uzbekenergo's ROE for the period of 2009-2011. ROE implies how much return SJSC Uzbekenergo expects for its equity investment.

WACC = (OL/OL+DL+IF)xIOx(1-T)+(DL/OL+DL+IF)xIDx(1-T)+(RE/OL+DL+IF) x CE
= 2.82%

OL: ODA Loan - 74% of total project cost
DL: Domestic Loan - 15% of total project cost
IF: Internal Fund - 11% of total project cost
IO: Interest rate of ODA loan - 1.40 %
ID: Interest rate of domestic loan - 3.90 %
CE: Cost of Equity - 14.10%
T: Corporate tax rate – 20.0%

9.4.5 Financial Analysis

a. FIRR

By using a financial model based on the aforementioned conditions and assumption, the FIRR of the project is computed. In the base case, FIRR is 5.73% and higher than WACC (2.82 %). This project is financially viable in the base case. Appropriate tariff setting ensures revenue enough to cover operational costs including both O&M costs and taxes. As electricity and heat tariffs are expected to remain the same during the project life, financial benefit is stable. Fluctuations in operational cost are due to changes in property tax.

Table 9.4.5-1 Summary of FIRR (Base Case)

(USD Million)

Fiscal Year	Financial Cost (A)			Financial Benefit (B)	(B) - (A)
	Capital	O&M+Tax	Total Cost		
Year 1	28.5		28.5		-28.5
Year 2	57.0		57.0		-57.0
Year 3	171.3		171.3		-171.3
Year 4	200.2		200.2		-200.2
Year 5	114.5		114.5		-114.5
Year 6		78.7	78.7	124.3	45.6
Year 7		78.2	78.2	124.3	46.2
Year 8		77.7	77.7	124.3	46.7
Year 9		77.1	77.1	124.3	47.2
Year 10		76.6	76.6	124.3	47.8
Year 11		86.5	86.5	124.3	37.8
Year 12		86.0	86.0	124.3	38.3
Year 13		85.6	85.6	124.3	38.8
Year 14		85.1	85.1	124.3	39.3
Year 15		84.6	84.6	124.3	39.7
Year 16		84.1	84.1	124.3	40.2
Year 17		83.6	83.6	124.3	40.8
Year 18		83.0	83.0	124.3	41.3
Year 19		82.5	82.5	124.3	41.9
Year 20		81.9	81.9	124.3	42.4
Year 21		81.4	81.4	124.3	42.9
Year 22		80.9	80.9	124.3	43.5
Year 23		80.3	80.3	124.3	44.0
Year 24		79.8	79.8	124.3	44.6
Year 25		79.2	79.2	124.3	45.1
Year 26		78.7	78.7	124.3	45.6
Year 27		78.2	78.2	124.3	46.2
Year 28		77.6	77.6	124.3	46.7
Year 29		77.1	77.1	124.3	47.3
Year 30		76.5	76.5	124.3	47.8
Year 31		76.0	76.0	124.3	48.4
Year 32		75.4	75.4	124.3	49.0
Year 33		74.8	74.8	124.3	49.6
Year 34		74.2	74.2	124.3	50.2
Year 35		73.6	73.6	124.3	50.8
Total	571.5	2,394.7	2,966.2	3,730.3	764.1
FIRR	**5.73%**				

(Source: JICA Study Team)

b. Cash Flow Analysis

The financial model for FIRR is also utilized for preparing a cash flow statement of the project. The cash-flow analysis can assess financial viability of the project in terms of (1) capacity of the project to cover the O&M cost and (2) solvency of the project to make principals and interest payments. For the project life after commissioning, total cash flow is expected to stay in the positive with a range of USD 0.8 million - USD 50.8 million. Total cash flow is the smallest in Year 11 when the payment of ODA loan and an increase in property tax starts and, then, total cash flow gradually increases until the end of project life.

After commissioning of the plant, the net-cash-flow-in from operating activities is expected to start from USD 26.1 million in Year 6 and increase to USD 50.8 million in Year 35. There are fluctuations caused by the payment of property tax. After commissioning, the net-cash-flow-out from financing activities ranges from USD 8.6 million to USD 29.7

million. The net-cash-flow-out from financing activities is the largest during the period of Year 11-15 when principal payments of domestic loan and ODA loan need to be made.

The project cost (USD 571.5 million) is expensed over five years from Year 1 to Year 5. From the view point of all financers, the project cost would be fully recovered in Year 19 with the cash flow before the payment of interest and principle. It is expected to take 14 years from the commencement of commercial operation until the full recovery of project cost. From the view point of equity investor, the equity investment (USD 62.9 million) would be fully recovered in Year 8 with the net cash flow after the payment of interest and principle. The recovery of equity investment could require three years after the commencement of commercial operation.

c. Financial Ratio Analysis

The financial model for FIRR also enables the estimation of financial ratios for the project. Debt Service Coverage Ratio (cash flow before debt service/debt service) is expected to be more than 1.0 after commissioning and this result suggests that cash flow from operating activities can cover debt service. However, it should be noted that the ratio is barely above 1.0 in Year 11 even with the assumption that dividend is not paid out. Both Current Ratio (current assets/current liabilities) and Quick Ratio ((current assets-inventory)/current liabilities) are expected to start from more than 0.7 time, the level which can be considered financially solid. As retained earning is accumulated, current assets also increases with the assumption that cash is not paid out as dividends. This results in continuous improvement of both ratios. Total Liabilities/Total Assets also improves after commissioning. In addition to the accumulation of retained earning, principal payment of debt contributes to the improvement of the ratio. Although cash flow from operating activities barely covers debt service in Year 11, a healthy balance sheet is likely to absorb unforeseeable adverse changes in cash flow.

Table 9.4.5-2 Financial Ratios on Financial Stability

Ratio	Unit	Year 6	Year 11	Year 16	Year 21	Year 26	Year 31	Terminal Year
Debt Service Coverage Ratio	Times	1.99	1.02	1.58	1.79	2.03	n.a.	n.a.
Current Ratio	Times	2.14	4.14	6.32	9.25	12.89	63.15	86.91
Quick Ratio	Times	2.09	4.11	6.29	9.22	12.86	63.04	86.80
Total Liabilities /Total Assets	%	86.1%	71.0%	53.4%	34.8%	15.7%	1.3%	1.1%

(Source: JICA Study Team)

9.4.6 Sensitivity Test

The sensitivity analysis is to illustrate the effects of changes in key variables on the project and, in particular, to test the financial viability of the project under adverse situations. In this analysis, three key variables (a. Construction Cost, b. Fuel Price, c. Electricity Tariff) are used for testing. The test result shows that the most critical variable is electricity tariff. If electricity tariff is lower than the projection by 20%, FIRR (2.18%) does not reach WACC (2.82 %). In other critical cases, FIRR is higher than WACC with a margin of 100 basis points or more.

Table 9.4.6-1 Results of Sensitivity Analysis (FIRR)

Key Variables	% Change	FIRR
a. Construction Cost	+20%	4.05%
	+10%	4.83%
	-10%	6.77%
	-20%	8.00%
b. Fuel Price	+20%	4.18%
	+10%	4.97%
	-10%	6.45%
	-20%	7.14%
c. Electricity Tariff	+20%	8.62%
	+10%	7.23%
	-10%	4.07%
	-20%	2.18%

(Source: JICA Study Team)

9.5 Economic Evaluation

9.5.1 Methodology of Evaluation and the Basic Assumptions

The purpose of the economic evaluation is to optimize resource allocation in the viewpoint of policy makers. The economic evaluation measures the effects of the project by the EIRR, which estimates economic benefits and economic cost, both of which are based on the comparison of a with-project case and a without-project case, and calculate return on capital investment. The positive return of EIRR suggests that the benefits of the project adequately cover opportunity cost of the capital investment.

9.5.2 Economic Cost

a. Project Cost

In principle, the economic evaluation is based on the project cost which is used for the financial evaluation but excluding tax. In the economic evaluation, the project cost is estimated at USD 518.8 million.

b. Operation and Maintenance Cost - Fuel Cost

The Uzbekistan government regulates the price of natural gas which is consistently lower than international price. In order to eliminate price distortion, the economic evaluation employs the average for 2009-2011 of natural gas spot price at Henry Hub (USD 4.54/million Btu). Compared with the current spot price (USD 2.95/ million Btu in July 2012[1]), this estimate is considered conservative. For the annual gas consumption, the same assumption of the financial evaluation is used.

c. Operation and Maintenance Cost - Other Costs

For the economic evaluation, O&M cost deducts tax from that for the financial evaluation.

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[1] Both the 2009-2011 average price and the spot price in July 2012 are obtained from the website of US Energy Information Administration (http://www.eia.gov/)

9.5.3 Economic Benefit

a. Electricity Production

Reliable data on WTP for electricity are unavailable in Uzbekistan. For this reason, power sector projects in Uzbekistan funded by ADB and WB employed LRMC per kWh instead of WTP. This analysis adopts the same approach. LRMC is calculated by using the following formulas:

LRMC= Project Cost x CRF + O&M Cost
CRF= $i\ (1+i)^n / (1+i)^n -1=12.4\%$
LRMC=USD 163.4 million
LRMC/kWh= USD 0.059/kWh
Project Cost: Project Cost for Power Generation Facility USD 420.2 million
O&M cost: O&M Cost USD 111.2 million / year
i: Discount Rate: 12%
n: Project Life: 30 years

Both the project cost and O&M cost (including both fuel cost and other costs) are divided into power production and heat production at the ratio of 81:19, respectively. This ratio is in accordance with actual cost allocation practice of Navoi TPP. The discount rate is 12%, which is based on refinancing rate of the Central Bank of the Republic of Uzbekistan. This interest rate is generally referred as a proxy rate of long-term capital in Uzbekistan. The power supply for end users is 2,752GWh annually assuming the same operational conditions of the financial evaluation.

For this project, LRMC is calculated at USD 0.059/kWh. This estimation of LRMC is almost at the mid-point between the projections made by ADB and WB. ADB computed LRMC at USD 0.075/kWh for Talimarjan Power Project with the estimated range of USD 0.065/kWh-0.085/kWh. WB used USD 0.035/kWh for Talimarjan Transmission Project.

b. Heat Production

WTP is unavailable for heat production as well. LRMC is employed for estimating the benefit of heat. The heat production is expected to be 1,520Tcal annually assuming the same operational conditions of the financial evaluation. The same assumptions and formulas for the LRMC of power production are utilized for that of heat production. For heat production, LRMC is USD 25.21 /Gcal.

LRMC= Project Cost x CRF + O&M Cost
CRF= $i\ (1+i)^n / (1+i)^n -1=12.4\%$
LRMC=USD 37.8 million
LRMC/Gcal= USD 25.21/Gcal
Project Cost: Project Cost for Heat Supply Facility USD 98.6 million
O&M cost: O&M Cost (including fuel cost) USD 26.1 million / year
i: Discount Rate: 12%
n: Project Life: 30 years

c. Energy Saving

The CCCGP No.2 is expected to consume less natural gas than the existing power sources. The difference of natural gas consumption between the new and the old equipment can be considered as an economic benefit. This estimation is based on the actual gas consumption and future operation plan of the Units 4,5,7,11,12 and CCCGP No.1 which are to be used in the foreseeable future. This estimation is regarded as proxy of the energy efficiency of the existing gas-fired power plants in Uzbekistan. The existing plants of Navoi TPP are expected to generate 8,504,000 MWh per annum with the natural gas consumption of 2,568.9 million m3N. On the other hand, the CCCGP No.2 is expected to generate 3,276GWh annually with that of 792.5 million m3N. The energy saving is 64.52 m3N/MWh.

d. CO2 Reduction
Incremental reduction of CO2 emission can be considered an economic benefit. The incremental reduction of CO2 is 0.133t/MWh. While the CO2 emission of the baseline power generation estimated by the UNDP project “Capacity Building for CDM in Uzbekistan” is 0.593 t/MWh, that of the CCCGP No.2 is 0.460 t/MWh with the emission factor CO2 1,900t/million m3N. The average of CER spot price traded at BlueNext was 9.97 euro/ton (equivalent of USD 13.67/ton) for the period of 2009-2011.

9.5.4 Economic Evaluation

The EIRR of the project is computed by using an economic model based on the conditions and assumption discussed above. In the base case, EIRR is 15.88% and higher than WACC (2.82 %) and social discount rate (conventionally 10-12%). This project can be considered beneficial from the view point of the national economy. EIRR is higher than FIRR for several reasons such as smaller capital cost and additional benefits. On the other hand, a notable increase in operational cost is mainly due to fuel cost which is based on international price instead of domestic price.

Table 9.5.4-1 Summary of EIRR (Base Case)

(USD Million)

Fiscal Year	Economic Cost (A)			Economic Benefit (B)	(B) - (A)
	Capital	O&M	Total Cost		
Year 1	25.8		25.8		-25.8
Year 2	51.8		51.8		-51.8
Year 3	155.5		155.5		-155.5
Year 4	181.7		181.7		-181.7
Year 5	104.0		104.0		-104.0
Year 6		136.7	136.7	241.3	104.5
Year 7		136.7	136.7	241.3	104.5
Year 8		136.7	136.7	241.3	104.5
Year 9		136.7	136.7	241.3	104.5
Year 10		136.7	136.7	241.3	104.5
Year 11		136.7	136.7	241.3	104.5
Year 12		136.7	136.7	241.3	104.5
Year 13		136.7	136.7	241.3	104.5
Year 14		136.7	136.7	241.3	104.5
Year 15		136.7	136.7	241.3	104.5
Year 16		136.7	136.7	241.3	104.5
Year 17		136.7	136.7	241.3	104.5
Year 18		136.7	136.7	241.3	104.5
Year 19		136.7	136.7	241.3	104.5
Year 20		136.7	136.7	241.3	104.5
Year 21		136.7	136.7	241.3	104.5
Year 22		136.7	136.7	241.3	104.5
Year 23		136.7	136.7	241.3	104.5
Year 24		136.7	136.7	241.3	104.5
Year 25		136.7	136.7	241.3	104.5
Year 26		136.7	136.7	241.3	104.5
Year 27		136.7	136.7	241.3	104.5
Year 28		136.7	136.7	241.3	104.5
Year 29		136.7	136.7	241.3	104.5
Year 30		136.7	136.7	241.3	104.5
Year 31		136.7	136.7	241.3	104.5
Year 32		136.7	136.7	241.3	104.5
Year 33		136.7	136.7	241.3	104.5
Year 34		136.7	136.7	241.3	104.5
Year 35		136.7	136.7	241.3	104.5
Total	518.8	4,101.3	4,620.1	7,237.6	2,617.5
EIRR	**15.88%**				

(Source: JICA Study Team)

9.5.5 Sensitivity Test

A sensitivity test assesses the robustness of the economic viability. For this analysis, three key variables (a. Construction Cost, b. Fuel Price, c. Economic Benefit of Electricity Production) are chosen for testing. The test result indicates that this project is sensitive to economic benefit of power production. In the case that economic benefit of power production decreased by 20%, EIRR also declines to 11.31% and touches social discount rate (10-12%). In other critical cases, EIRR is higher than social discount rate with a sizable margin.

Table 9.5.5-1 Results of Sensitivity Analysis (EIRR)

Key Variables	% Change	EIRR
a. Construction Cost	+20%	13.54%
	+10%	14.62%
	-10%	17.35%
	-20%	19.10%
b. Fuel Price	+20%	13.40%
	+10%	14.66%
	-10%	17.05%
	-20%	18.18%
c. Economic Benefit of Electricity Production	+20%	19.87%
	+10%	17.93%
	-10%	13.69%
	-20%	11.31%

(Source: JICA Study Team)

9.6 Key Performance Indicator

9.6.1 Operational and Effect Indicators

In order to monitor the power plant performance, give feedback to the management of operation and maintenance, confirm the effects of the CCCGP No. 2, it is recommend to employ the following operational and effect indicators:

(1) Operational Indicators
- a. Rated Gross Power Output
- b. Rated Heat Output
- c. Plant Capacity Factor
- d. Availability Factor
- e. Gross Energy Efficiency

(2) Effect Indicators
- a. Rated Gross Power Output
- b. Rated Heat Output
- c. Rated Annual Net Power Generation
- d. Rated Annual Heat Generation

The aforementioned indicators were selected mainly from “Operational and Effect Indicators Reference, 2nd Edition”, which was established by Japan Bank International Cooperation in October 2002. As the new plant also is planned to supply a substantial amount of heat, relevant indicators are added. The target of each indicator is set in consideration of international experience of the JICA team. These indicators are needed to be reviewed annually based on Table attached herewith.

Table 9.6.1-1 Operation and Effect Indicators

Indicator	Target	By when	Details
Operational Indicators			
a. Rated Gross Power Output	431.0 MW	Project Completion	
b. Rated Heat Output	200Gcal/hr	Project Completion	
c. Plant Capacity Factor	86.8%	Within two years after Project Completion	Definition: (Annual Gross Power Generation×0.86 + Annual Heat Generation)/ (Rated Gross Power Output × 0.86+ Rated Heat Output) x 24 x 365) x 100 Assumption: Annual Gross Power Generation = 3,276 GWh, Annual Heat Generation = 1,520 Tcal, Rated Gross Power Output= 431.0 MW, Rated Heat Output = 200 Gcal/hr
d. Availability Factor	91.3%	Within two years after Project Completion	Definition: Annual Operation Hours /(24x365) x 100 Assumption: Annual Operation Hours= 8,000 hours
e. Gross Energy Efficiency	72.3%	Within two years after Project Completion	Definition: (Annual Gross Power generation×0.86 + Annual Heat generation)/ (Annual Fuel Consumption x Fuel Lower Heat Value) x 100 Assumption: Annual Gross Power Generation = 3,276 GWh, Annual Heat Generation = 1,520 Tcal Fuel Lower Heat Value = 11,270 kcal/kg, Annual Fuel Consumption = 532,700 ton
Effect Indicators			
a. Rated Gross Power Output	431.0 MW	Project Completion	
b. Rated Heat Output	200Gcal/hr	Project Completion	
c. Rated Annual Net Power Generation	3,336 GWh*	Within two years after Project Completion	Definition: (Rated Gross Power Output – Auxiliary Power Consumption)×8,000 Assumption: Auxiliary Power Consumption= 14.0 MW
d. Rated Annual Heat Generation	1,600 Tcal	Within two years after Project Completion	Definition: Rated Annual Heat Generation = Rated Heat Output (200)×Annual Operation Hours (8,000) = 1,600 Tcal

(Source: JICA Study Team)

* Preliminary target with the assumption of average outdoor temperature at 15 ℃

9.6.2 Qualitative Effects

The expected qualitative effects are following:

(1) Improvement of capabilities for operation and maintenance: In addition to CCCGP No. 1 (under construction now), CCCGP No. 2 is planned to be introduced into the Navoi Power Plant by this project. In Uzbekistan, the introduction of a modernized CCCGP has just been started and it is expected that advanced capabilities for operation and maintenance of power generation facilities could be obtained in training conducted at the time of installation of the facilities and one to be conducted later.

(2) Stable supply of electricity: This project planned to replace Nos. 3 and 8 of the existing Navoi Thermal Power Plant. Both units have been operated since the mid-1960s. The replacement of the obsolete facilities contributes to less frequent maintenance and stable supply of electricity.

Appendix 9-1 Financial Model

ATTACHMENT 9.1 MACRO ASSUMPTIONS (BASE CASE)

		-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9
Fiscal Year Ending at	**Unit**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021***
Inflation															
Local inflation(CPI)	% p.a.	7.2%	7.8%	7.6%	7.3%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%
US inflation (CPI)	% p.a.		-0.3%	1.6%	3.1%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Inflation differential between Uzbekistan & USA	% p.a.	7.2%	8.1%	6.0%	4.2%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%
Inflation in Japan (CPI)	% p.a.	1.4%	-1.4%	-0.7%	-0.3%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%
Inflation differential between Uzbekistan & Japan	% p.a.	5.8%	9.2%	8.3%	7.6%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%
Price index															
Local prices (2007=100)		107.2	115.6	124.3	133.4	133.5	133.6	133.7	133.8	133.9	134.0	134.1	134.2	134.3	134.4
US prices (2005=100)		110.2	109.9	111.7	115.2	115.2	115.2	115.3	115.3	115.3	115.3	115.3	115.3	115.4	115.4
Japanese prices (2010=100)		102.1	100.7	100.0	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.6	99.6	99.6	99.6
Exchange rate															
Sum/USD (year average)	Sum	1314.2	1458.8	1576.8	1717.8	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0
Change from previous year	% p.a.		11.00	8.09	0.09	14.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JPY/USD (year average)	Yen	101.70	100.30	99.60	79.84	78.90	78.90	78.90	78.90	78.90	78.90	78.90	78.90	78.90	78.90
Sum/JPY (year average)	Sum	12.92	14.54	15.83	21.52	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84
Change from previous year	% p.a.		12.55	8.85	35.90	15.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tariff and Economic Benefit															
% change of elecricity tariff from original fortecast	%					0.0%									
Electricity Tariff of Uzbekenergo	Sum/kWh					95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60
Heat Tariff of Navoi TPP	Sum/Gcal					27,312	27,312	27,312	27,312	27,312	27,312	27,312	27,312	27,312	27,312
% change of LRMC of electricity from original forecast	%					0.0%									
Long run marginal cost of elecricity	USD/kWh					0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
Long run marginal cost of heat	USD/Mcal					25.21	25.210	25.210	25.210	25.210	25.210	25.210	25.210	25.210	25.210
Spot CER at BlueNext	USD/CER					13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67
Fuel price-international															
% change of gatural gas from original fortecast	%					0.0%									
Natural Gas Spot Price at Henry Hub	US$/MM Btu		5.24	4.37	4.00	4.54	4.54	4.54	4.54	4.54	4.54	4.54	4.54	4.54	4.54
Fuel price-local															
% change of natural gas from original forecast	%					0.0%									
Natural gas in Uzbekistan(per 1000m3, 2012 price)	Sum/1000m3					116,100	116,100	116,100	116,100	116,100	116,100	116,100	116,100	116,100	116,100
Natural gas in Uzbekistan(per 1000m3, 2012 price)	USD/1000m3					59.23	59.23	59.23	59.23	59.23	59.23	59.23	59.23	59.23	59.23

Legend: 🟧 =Actuals and shall not be changed. 🟦 =Fields for input with assumptive data. 🟩 =Variables for sensitivity analysis

*The same macro assumptions is used for the period from 2022 to 2035

Conversion Factor

Conversion from m3N to m3(20 C, 1atm)	1 m3N=	1.0733	m3
Calorie of natural gas in Uzbekistan	1 m3N=	8800	kcal
Conversion from kcal to Btu	1kcal=	3.9676	Btu

ATTACHMENT 9.2 PROJECT PARAMETERS

Item		
Capital Investment		
Rated Gross Power Output	431	MW
Operating hour	8000	
Load Factor	95.0%	
Annual Gross Power Output Energy	3,276	GWh
Annual Gross Power Output Energy at base case	3,276	GWh at 792.5 m3N
Change in Annual Output	0%	
Auxiliary Power Consumption	14	MW
Net Units at Busbar	3,164	GWh
Rated Heat Output	200	Gcal/h
Annual Heat Output Energy	1,520,000	Gcal
Project Life	30	years
Construction to Start	2013	
Commercial Operation to Start	1	st/nd/th month in 2018
Energy Saving	64.52	m3N / MWh
Price of Fuel		Refer to Macro Assumption
Equipment and Infrastructure Cost		Refer to Project Capital Cost
CO2 Reduction	0.133	ton/MWh
Depreciation	30	years for total plant
Salvage Value	10.0%	of original cost
Transportation & Insurance		Included in project cost
Physical Contingencies	5.0%	of total EPC & LTSA Contract
Price Contingencies (Foreign)	2.1%	p.a. per year (Foreign). Price contingency is excluded from EIRR and FIRR calculation.
Price Contingency (Local)	4.9%	p.a. per year (Local). Price contingency is excluded from EIRR and FIRR calculation.
Finance		
Equity	11%	of total investment
Debt	89%	of total investment
ODA Loan	74%	of total investment
Domestic Loan	15%	of total investment
ODA Loan		
Grace Period	10	years
Repayment Period	30	years
Rate of Interest During Operation Period	1.40%	p.a.
Rate of Interest During Construction	1.40%	p.a.
Domestic Loan		
Grace Period	5	years (refinanced until commissioning)
Repayment Period	15	years
Rate of Interest During Operation Period	3.90%	p.a.
Rate of Interest During Construction	3.90%	p.a.
O&M-Fuel		
Natural Gas Consumption	792.5	million m3N at Base case
Transmisison and Distrubution Loss	13.00%	
O&M-Others		
Annual tap water consumption		Included in Variable Cost (local)
LTSA Contract		LTSA will not be signed.
Initial Spare Parts (incl. Contingency)	0	Sparpart is included in capital cost
Maintenance under LTSA (inc. Conti.)	0	LTSA will not be signed.
Normal Maintenance		
Fixed Cost	2,104	million sum per year
Variable Cost (Local)	987.54	sum per MWh
Variable Cost (Foreign)	2.48	USD/MWh
Insurance on equipment	0.88	million USD per year
Working Capital		
Cash for O&M Expense	2	months of O&M expense
Materials & Supplies	1	month of O&M
Prepayments	0	month of sales
Account Receivable		
Account receivable	2	months of Sales
Account payable	2	months of Fuel Bill
Tax & Duties		
Corporate Income Tax	12%	Uzbekenergo 2009-2011 Average
Income Tax & VAT for EPC Contractor	25.0%	= (Local cost only) Income Tax 5% (33%x15%) + VAT 20%
Income Tax & VAT for Consultant	25.0%	= (Local cost only) Income Tax 5% (33%x15%) + VAT 20%
Property Tax	3.5%	total fixed asset excluding equipment for 5 years
Infrastructure Development Tax	8.0%	of net income before tax
VAT	20%	
Custom Duties & VAT for Imports	0%	= Custom Duty 0% + VAT 0%
Return on Equity		
Return on equity (after tax)	14.1%	2009-2011 Average
Return on equity (before tax)	17.2%	2009-2011 Average

ATTACHMENT 9.3 COST & BENEFIT (FIRR)

(USD Million)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
Fiscal Year Ending at Unit	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**
Annual Gross Power Output Energy (GWh)						3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276
Annual Power Sold (GWh)						2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752
Annual Heat Sold (Gcal)						1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000
Revenue						124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3
Electricity Sales (Net)						107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4
Heat Sales (Net)						16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9
Capital Expenditure (cumulative)	28.5	85.5	256.8	457.0	571.5																														
Foreign Currency	17.5	52.5	157.7	280.6	350.9																														
Local Currency	11.0	33.0	99.1	176.4	220.6																														
Fund Raising (Balance at Year End)																																			
Equity (Cumulative Investment)	3.1	9.4	28.2	50.3	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9
Loan Balance (Foreign)	21.1	63.3	190.0	338.2	422.9	422.9	422.9	422.9	422.9	422.9	401.8	380.6	359.5	338.3	317.2	296.0	274.9	253.7	232.6	211.5	190.3	169.2	148.0	126.9	105.7	84.6	63.4	42.3	21.1	0.0	0.0	0.0	0.0	0.0	0.0
Loan Balance (Local)	4.3	12.8	38.5	68.5	85.7	77.2	68.6	60.0	51.4	42.9	34.3	25.7	17.1	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Repayment of Loans																																			
Foreign Loan Repayment						0.0	0.0	0.0	0.0	0.0	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	0.0	0.0	0.0	0.0	0.0
Domestic Loan Repatment						8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fixed Cost (Foreign)																																			
LTSA																																			
Loan Interest (Foreign)						5.9	5.9	5.9	5.9	5.9	5.8	5.5	5.2	4.9	4.6	4.3	4.0	3.7	3.4	3.1	2.8	2.5	2.2	1.9	1.6	1.3	1.0	0.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0
Fixed Cost (Local)																																			
O & M (Fixed)						1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Custom Duties & VAT on O&M						0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Insurance						0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Depreciation						17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Return on Equity						10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Loan Interest (Local)						3.2	2.8	2.5	2.2	1.8	1.5	1.2	0.8	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Variable Cost (Foreign)																																			
O & M (Variable)						8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
O&M Adjustment during LTSA																																			
Net O&M (variable)						8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Variable Cost (Local)																																			
Fuel Cost (Natural Gas)						50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4
Other O & M (Variable)						1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Custom Duties & VAT on O&M (Foreign)						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VAT on O&M (Local)						0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Asset Value																																			
Cummurative Depreciation						17.1	34.3	51.4	68.6	85.7	102.9	120.0	137.2	154.3	171.5	188.6	205.7	222.9	240.0	257.2	274.3	291.5	308.6	325.8	342.9	360.0	377.2	394.3	411.5	428.6	445.8	462.9	480.1	497.2	514.4
Net Book Value at Year End						554.4	537.2	520.1	502.9	485.8	468.6	451.5	434.3	417.2	400.1	382.9	365.8	348.6	331.5	314.3	297.2	280.0	262.9	245.7	228.6	211.5	194.3	177.2	160.0	142.9	125.7	108.6	91.4	74.3	57.2
Salvage Value																																			57.2
Annual Costs						99.7	99.4	99.0	98.7	98.4	97.9	97.3	96.6	96.0	95.4	94.9	94.6	94.3	94.0	93.7	93.4	93.1	92.8	92.5	92.2	91.9	91.6	91.4	91.1	90.8	90.6	90.6	90.6	90.6	90.6
Total Fixed Costs						39.2	38.9	38.6	38.2	37.9	37.4	36.8	36.1	35.5	34.9	34.4	34.1	33.8	33.5	33.2	32.9	32.6	32.3	32.0	31.8	31.5	31.2	30.9	30.6	30.3	30.1	30.1	30.1	30.1	30.1
Total Variable Costs						60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5
Profit before Tax						35.4	35.8	36.1	36.4	36.8	37.3	37.9	38.5	39.2	39.8	40.3	40.5	40.8	41.1	41.4	41.7	42.0	42.3	42.6	42.9	43.2	43.5	43.8	44.1	44.4	44.5	44.5	44.5	44.5	44.5
Corporate Income Tax						4.3	4.3	4.3	4.4	4.4	4.5	4.5	4.6	4.7	4.8	4.8	4.9	4.9	4.9	5.0	5.0	5.0	5.1	5.1	5.1	5.2	5.2	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Property Tax						9.0	8.4	7.8	7.2	6.6	16.4	15.8	15.2	14.6	14.0	13.4	12.8	12.2	11.6	11.0	10.4	9.8	9.2	8.6	8.0	7.4	6.8	6.2	5.6	5.0	4.4	3.8	3.2	2.6	2.0
Tax on Infrastructure Development						2.8	2.9	2.9	2.9	2.9	3.0	3.0	3.1	3.1	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.4	3.4	3.4	3.4	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.6
Net Profit after Tax						19.4	20.2	21.1	22.0	22.8	13.4	14.5	15.6	16.7	17.8	18.8	19.6	20.5	21.3	22.1	23.0	23.8	24.7	25.5	26.3	27.2	28.0	28.8	29.7	30.5	31.2	31.8	32.4	33.0	33.6
Cumulative Retained Earnings						19.4	20.2	41.4	63.3	86.2	99.6	114.1	129.7	146.4	164.3	183.1	202.7	223.2	244.5	266.6	289.6	313.4	338.1	363.6	389.9	417.1	445.1	473.9	503.6	534.1	565.4	597.2	629.6	662.7	696.3
Financial Benefit						124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3	124.3
Capital Expenditure	28.5	57.0	171.3	200.2	114.5																														
Operation Cost + Taxes						78.7	78.2	77.7	77.1	76.6	86.5	86.0	85.6	85.1	84.6	84.1	83.6	83.0	82.5	81.9	81.4	80.9	80.3	79.8	79.2	78.7	78.2	77.6	77.1	76.5	76.0	75.4	74.8	74.2	73.6
Financial Benefit - Financial Cost	-28.5	-57.0	-171.3	-200.2	-114.5	45.6	46.2	46.7	47.2	47.8	37.8	38.3	38.8	39.3	39.7	40.2	40.8	41.3	41.9	42.4	42.9	43.5	44.0	44.6	45.1	45.6	46.2	46.7	47.3	47.8	48.4	49.0	49.6	50.2	50.8
FIRR	**5.73%**																																		

ATTACHMENT 9.4 COST & BENEFIT (EIRR)

(USD Million)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Fiscal Year Ending at	**Unit**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**
Annual Gross Power Output Energy (GWh)							3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276
Net Annual Energy Output (GWh)							2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752	2,752
Annual Energy Output (Gcal)							1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000
Benefit							241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3
Electricity Production							163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5	163.5
Heat Production							38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3
Energy Saving							33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5
CO2 Reduction							6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Capital Expenditure (cumulative)		25.8	77.6	233.1	414.8	518.8																														
Foreign Currency		17.5	52.5	157.7	280.6	350.9																														
Local Currency		8.3	25.1	75.3	134.2	167.9																														
Fund Raising (Balance at Year End)		25.8	77.6	233.1	414.8	518.8	511.0	503.2	495.4	487.6	479.9	452.9	425.9	398.9	372.0	345.0	325.8	306.6	287.4	268.2	249.0	229.8	210.6	191.4	172.2	153.0	133.8	114.6	95.5	76.3	57.1	57.1	57.1	57.1	57.1	57.1
Equity (Cumulative Investment)		2.8	8.5	25.6	45.6	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1
Loan Balance (foreign)		19.1	57.4	172.5	306.9	383.9	383.9	383.9	383.9	383.9	383.9	364.7	345.5	326.3	307.1	287.9	268.7	249.5	230.3	211.1	191.9	172.7	153.6	134.4	115.2	96.0	76.8	57.6	38.4	19.2	0.0	0.0	0.0	0.0	0.0	0.0
Loan Balance (local)		3.9	11.6	35.0	62.2	77.8	70.0	62.3	54.5	46.7	38.9	31.1	23.3	15.6	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Repayment of Loans																																				
Foreign Loan Repayment							0.0	0.0	0.0	0.0	0.0	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	0.0	0.0	0.0	0.0	0.0
Domestic Loan Repayment							7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fixed Cost (Foreign)																																				
LTSA (maintenance)																																				
Loan Interest (Foreign)							5.4	5.4	5.4	5.4	5.4	5.2	5.0	4.7	4.4	4.2	3.9	3.6	3.4	3.1	2.8	2.6	2.3	2.0	1.7	1.5	1.2	0.9	0.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0
Fixed Cost (Local)																																				
O & M (Fixed)							0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Insurance							0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Depreciation							15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Return on Equity							9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
Loan Interest (Local)							3.2	2.8	2.5	2.2	1.8	1.5	1.2	0.8	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Variable Cost (Foreign)																																				
O & M (Variable)							8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
O&M Adjustment during LTSA																																				
Net O&M (variable)							8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Variable Cost (Local)																																				
Fuel Cost							125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5	125.5
O & M (Variable)							1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Asset Value																																				
Cummurative Depreciation							15.6	31.1	46.7	62.3	77.8	93.4	108.9	124.5	140.1	155.6	171.2	186.8	202.3	217.9	233.4	249.0	264.6	280.1	295.7	311.3	326.8	342.4	357.9	373.5	389.1	404.6	420.2	435.8	451.3	466.9
Net Book Value							503.2	487.6	472.1	456.5	440.9	425.4	409.8	394.3	378.7	363.1	347.6	332.0	316.4	300.9	285.3	269.8	254.2	238.6	223.1	207.5	191.9	176.4	160.8	145.3	129.7	114.1	98.6	83.0	67.4	51.9
Salvage Value																																				51.9
Annual Costs							171	170	170	170	169	169	168	168	167	166	166	166	165	165	165	165	164	164	164	164	163	163	163	162	162	162	162	162	162	162
Total Fixed Costs							36	35	35	35	34	34	33	33	32	31	31	31	30	30	30	30	29	29	29	29	28	28	28	28	27	27	27	27	27	27
Total Variable Costs							135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135
Economic Benefit							241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3	241.3
Capital Cost		25.8	51.8	155.5	181.7	104.0																														
Operation Cost							136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7	136.7
Economic Benefit - Economic Cost		-25.8	-51.8	-155.5	-181.7	-104.0	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5	104.5
EIRR		**15.88%**																																		

Chapter 10 Proposal for Scope of Yen Loan Project

10.1 Scope of Yen Loan Project

This project is proposed to implement on the “Full Turn-key” basis to processed each works smoothly and communicate closely.
The scope of Yen Loan project is based on “Full Turn-key”.

10.1.1 Scope of Yen Loan Project

The following equipment and facilities, etc, are proposed to be scope of yen loan portion of Navoi CCCGP No.2 project.

(1) Gas turbine, steam turbine, generators and auxiliaries
(2) Heat recovery steam generator (HRSG) and auxiliaries
(3) HRSG supplementary firing equipment (duct burners, etc.)
(4) Gas turbine and steam turbine building including structural steel, siding, roofing, windows, doors and louvers
(5) Main stack and bypass stack including diverter flap dumper
(6) Fuel gas supply system including and pipings
    (a) Fuel gas compressors
    (b) Fuel gas pre-treatment
    (c) Fuel gas pipings
(7) Heat supply system
    (a) Industrial steam supply system
    (b) Hot water supply system
    (c) Hot water supply and return piping and valves
    (d) Water treatment system for hot water make-up water
(8) Waste water treatment system
(9) Fire protection system
(10) Drain recovery system
(11) Cooling tower system
(12) Closed cooling water system for cooling of lubricating oil and other cooling media
(13) Piling (if necessary) and foundations for equipment
(14) All civil works including foundations for supplied equipment and buildings and houses.
(15) Pipings and valves
(16) Generator step-up transformers
(17) Unit and auxiliary transformers
(18) Electrical equipment and materials
(19) Hydrogen supply system
(20) Emergency diesel generator
(21) Central Control Room with facilities for operators
(22) Control and instrumentation equipment and materials
(23) Service and instrument air supply system
(24) Continuous emission monitoring system
(25) 220kV Substation
(26) Finish painting of equipment and materials
(27) Temporary works and facilities for construction
(28) Spare parts for one major overhaul
(29) Standard and special tools

(30) Necessary temporary facilities on the downstream side from the connection points of utilities such as electric power, water and the like necessary for construction.

10.1.2 Scope of SJSC Uzbekenergo

The following equipment and facilities, etc, are proposed to be scope of SJSC Uzbekenergo of Navoi CCCGP No.2 project.

(1) Administration building
(2) Miscellaneous buildings and houses for supplied equipment
(3) Camp
(4) Site and building lighting
(5) Yard utility trenches/covers
(6) Roads within the new plant site
(7) Site drainage/Site sanitary
(8) Civil works including foundations for auxiliary equipment and miscellaneous buildings and houses.
(9) Fencing around the new plant Site, access road to equipment and drainages inside the new plant Site.
(10) Plumbing (toilets and showers)
(11) Finish painting of equipment and materials
(12) Fire pump house including structural steel, masonry block walls, roofing, doors and louvers
(13) Fire engine with all necessary equipment and minibus for administrative and technical staff
(14) Temporary works and facilities for construction
(15) Necessary temporary facilities on the downstream side from the connection points of utilities such as electric power, water and the like necessary for construction.

10.1.3 Works and Services to be provided by SJSC Uzbekenergo

The following works and services associated with the new plant shall be provided by SJSC Uzbekenergo and/or the Consultant employed by the SJSC Uzbekenergo.

(1) Drinking water, natural gas, electric power for use during construction.
(2) Electric power and auxiliary steam for start-up of the new plant
(3) Updated Environmental Impact Assessment (EIA) Report after commissioning
(4) Assistance for acquisition of all permits necessary for construction and operation of the new plant.
(5) Topography mapping/surveying
(6) Site soil investigation/borings
(7) Natural gas, electric power load, and heat export demand for commissioning and guarantee and reliability tests.
(8) Periodic provision of operation and maintenance record data and information during the Defect Liability Period of two (2) years to the Contractor and Consultant for evaluation of operation and maintenance conditions.
(9) Labors, facilities and tools available at the Site for the inspection at the end of Defect Liability Period.

10.2 Scope of Consulting Service

Terms of reference (TOR), required experts and man-month schedule for the consulting service for Navoi CCCGP No.2 are proposed hereunder.

TERMS OF REFERENCE (TOR)
OF
ENGINEERING CONSULTANCY SERVICES FOR NAVOI THERMAL POWER STATION MODERNIZATION PROJECT

A. PROJECT INFORMATION

a) Background Information

In Uzbekistan, as a result of satisfactory economical development since 2002, demand for electricity is increasing at the average yearly rate of approximately 2%. According to the power demand estimation by Uzbekistan in 2004, it is expected that demand for electricity will increase at the equivalent rate and the maximum demand will reach approximately 11,200 MW at least in 2014.

On the other hand, though the rated capacity of the total power generation in Uzbekistan is approximately 12,400 MW in 2009, the actual power generation capacity stays less than approximately 10,000 MW, since many power plants have been used for 40 to 50 years since they were constructed. Aging facilities have low power generation efficiency and cause such problems as more emission of greenhouse gas, NOx, etc. per generated electric energy.

With these backgrounds in mind, the SJSC “Uzbekenergo” of Uzbekistan, since it is urged not only to introduce high-efficiency power generation facilities out of regard for the environment by utilizing fuel efficiently but to increase the power generation capacity in preparation for future electricity shortage, is working to modernize the aging thermal power plants.

This project intends to modernize the existing Navoi Thermal Power Plant (1,250 MW) near the Navoi City, Uzbekistan, as a part of these activities. Near Navoi City, there is the largest-scale national metal mining complex in Uzbekistan, which is an important basis of economical development of Uzbekistan. A special industrial and economic free zone with an area of 564 ha was established near the Navoi Airport, which was constructed newly with President’s Decree in 2008, in order to call in overseas countries’ investments actively. The Navoi Power Plant is expected to be modernized to meet the demands for electric power and heat energy necessary for those investments.

b) Location of the project and information on the surrounding area

Navoi thermal power station (OJSC «Navoi HES») (postal address: Rural citizens assembly “Yangi-Arik”, Karman District, Navoi Region, 210600) is located 6 km north-west of Navoi city. Distance to the nearest dwelling building located to the west from HES boundaries comprises 650 m; this distance to housing decreased to 400 m after construction of 478 megawatt SGP.

HES boundaries are:

- agricultural lands and homestead plots from the north;
- united NGMK energy service, motorway Tashkent-Bukhara and dwelling estates of rural citizens assembly “Uyrot” from the south;
- homestead village “Michurin”, Zerafshan River and motorway Navoi-Uchkuduk from

the east;
- dwelling estate of rural citizens assembly “Yangiobod” and agricultural lands from the west.

The station occupies area of 100 hectares extending from north-north-west to south-south-east; altitude above sea level is 334.2 m.

A land plot for construction of a new power generating unit of 450 megawatt SGP is intended on the western side of the territory of Navoi HES and 478 megawatt SGP. Location of the site is made taking into consideration delivery of power capacity towards the existing ORU-220 kV of Navoi HES, approach of an access motor road and delivery of engineering communications (gas, water etc.). Configuration of the land plot represents 330x270 m rectangular shape.

Distance to the nearest dwelling building of the rural citizens assembly “Yangiobod” located to the west from boundary of the territory of the construction land plot of the Navoi CCCGP No.2 (450 MW) is 70 m and 112 m to the nearest dwelling building of the rural citizens assembly «Uyrot» located to the south.

c) Stage reached in the project preparation and summary of the findings of studies to date

Feasibility study has already been completed on March 2013 by Tokyo Electric Power Services Company Ltd in Co-operation with JICA, JAPAN.

d) Implementing Organization

State Joint Stock Company Uzbekenergo (SJSC Uzbekenergo)

B. OTHER RELEVANT INFORMATION

a) Technical Information

The capacity of the Plant will be 450 MW of electric power and more than 200 Gcal.hr (upto 350 Gcal/hr) of heat energy. It will consist of 2 (Two) units (One gas turbine unit and One steam turbine unit). In this project the technical standards to be followed will be JIS, IEC, ISO, ANSI, ASTM and DIN

b) Relevant laws and regulations

This Project will be guided by Laws of the land (Uzbekistan).

c) Related Projects.

Navoi CCCGP No.1 has been completed and put into operation in October 2012. Information and data related to this project are useful for Navoi CCCGP No.2 project.

I. INTRODUCTION

The Government of Republic of Uzbekistan (hereinafter called “GOU”) is going to receive financing (Credit) from Japan International Cooperation Agency (JICA) (hereinafter called “loan”) toward the cost of Navoi Thermal Power Plant Modernization Project (hereinafter called “the Project”) and intends to apply part of the proceeds of this credit to payments under the Consulting Services for the supervision of implementation of the Project. SJSC Uzbekenergo intends to employ a firm of consultants for the contract to manage and supervise the implementation of the Project, Navoi, Uzbekistan.

II. SCOPE OF WORKS UNDER THIS PROJECT

The scope of work (Including procurement & erection/ commissioning) for the project (under Turnkey contract) is as follows:-

1-1. Installation of Navoi Combined Cycle Co-generation Plant (CCCGP) No.2 and its auxiliaries.

1) Gas Turbine, Steam Turbine, Generators and auxiliaries
2) Heat Recovery Steam Generator (HRSG) and auxiliaries including duct burning equipment
3) Cooling Tower System
4) Closed cooling water system for cooling of lubricating oil and other cooling media
5) Drain Recovery system
6) Water treatment system
7) Waste water treatment system
8) Main stack and bypass stack including dumper
9) Fuel Gas supply system
10) Indirect type fuel gas heater (if necessary)
11) Emergency diesel generator
12) Auxiliary Power Supply System
13) Generator step-up transformers
14) Unit and auxiliary transformers
15) DC Power Supply System
16) Power Cables and control cables
17) Electrical equipment and materials.

1-2. System facilities for CCCGP

1) Protection, metering and control system
2) Continuous emission monitoring system
3) Service and instrument air supply system
4) Communication facilities
5) Public address system control and instrumentation equipment and materials

1-3. Buildings for CCCGP

1) Gas turbine and steam turbine building including structural steel, siding, roofing windows
2) Overhead crane and mobile crane
3) Other buildings and houses for supplied equipment
4) Administration building.
5) Camp
6) Ventilation and air conditioning
7) Site & building lighting
8) Architectural materials
9) Finish painting of equipment and materials
10) Fire pump house including structural steel, masonry block walls, roofing, doors and louvers

1-4. Installation and Improvement of Substations and Transmission facilities

1) 220 KV Substation

2) Existing 220 KV Substation (renovation and expansion)

1-5. Gas Facilities

1) Gas supply piping
2) Fuel gas compressor/booster
3) Fuel gas pre-treatment system

1-6. Civil Work

1) Site drainage/Site Sanitary
2) Piling (if necessary) and foundations for equipment.
3) All civil works including foundations for supplied equipment and buildings and houses.
4) Preparation, excavation and leveling works of site area including temporary storage area during construction and preparation of access road for carrying-in of heavy components.
5) Fencing around the new plant site and access road (including access road to equipment and drainages inside the new plant site)
6) Necessary temporary facilities on the downstream side from the connection points of utilities such as electric power, water and the like necessary for construction.
7) Temporary works and facilities for construction

1-7. Heat supply system

1) Industrial steam supply system
2) Hot water supply system
3) Hot water supply and return piping and valves
4) Water treatment system for hot water make-up water

1-8. Others

1) Spare parts for one Combustion Inspection (CI), one Hot Gas Path Inspection (HGPI), one Major Inspection (MI), which will be out of scope of LTSA spare parts supply and supply of consumable parts for warranty period.
2) Standard and special tools.

III. UNDERTAKING BY SJSC Uzbekenergo

For carrying out the engineering services of consultant, SJSC Uzbekenergo shall provide the following to the consultant without any cost:

1) All available documents, drawings, maps, statistics, data and information related to the project, and
2) Full time counterparts of SJSC Uzbekenergo project team to participate in the consultants activities, and
3) All necessary permits, recommendation and authorization for carrying out the construction work and
4) Working office required to be hired as near as possible to “Yangi-Arik”, Karman District, Navoi Region, 210600 during design phase. It will be shifted to Navoi thermal power station during construction phase.

IV. SCOPE OF SERVICE OF THE CONSULTANTS

The services of the consultant are to undertake the necessary conceptual study, design, engineering, project management and execution including supervision of construction, commissioning through the pre-construction stage, construction stage and warranty period of the Combined Cycle Co-generation Plant together with the associated auxiliaries and ancillary equipment to compete the project. The Consultant is required to offer a comprehensive proposal to include the following:

A. Review of feasibility study.
B. Design and engineering.
C. Assist SJSC Uzbekenergo in pre-qualification for Bidders.
D. Assist SJSC Uzbekenergo in international competitive biddings.
E. Project Management at all levels including periodic review of budget estimate and administration of project cash flows.
F. Inspection, testing and delivery control during manufacturing
G. Construction supervision.
H. Commissioning and acceptance tests.
I. Ensure the quality of transfer of knowledge and technology from manufacture to SJSC Uzbekenergo personnel.
J. Assist SJSC Uzbekenergo in operation and maintenance.
K. Assist SJSC Uzbekenergo for environmental and social aspects.
L. Prepare reports and documents.

A) Review of feasibility study and conceptual design

1) The Consultant also shall make provisions to undertake the following:
    a) Review and comment on all the existing documents including the Pre-Feasibility Study Report, JICA Feasibility Study Report, design parameters, etc. and recommend revision or modification, if necessary to achieve the successful completion of the project.
    b) Review and comment on the project cost estimates originally envisaged and recommend modification or adjustment, if necessary, so that all the works originally envisaged including consulting services are completed within the original cost estimates.
    c) Prepare updated project program, cost estimate and cash flow.
2) The scope of services would include response to client’s requirement after assessment of SJSC Uzbekenergo’s needs and analysis such as the selection of plant, especially the type and design parameters of the main equipment The study should include a value analysis of alternatives and recommend the type of plants & auxiliaries to be selected.

B) Design and Engineering

The consultant shall be responsible for but not be limited to:-

1) Prepare design calculations, basic plans, drawings, specification and schedules for Bidders and for contract documents. The design shall include but not limited to; calculations to determine size or capacity requirements; single line diagram with control and protection scheme; layout and arrangement of components, plant area layout, selection of equipment and materials including those related to environmental issues; models of testing equipments and materials and specialized research, if any required.
2) Review and update the above mentioned documents based on SJSC Uzbekenergo and JICA comments

C) Assist SJSC Uzbekenergo in Pre-qualification for Bidders

The consultant shall undertake the following works:

1) Select pre-qualification criteria including but not limited to, eligibility requirement; joint venture requirement; general experience requirement; specific experience requirement; financial capability; organizational capability and others.
2) Prepare Pre-qualification documents.
3) Check and review pre-qualification proposal from Bidders with due co-ordination of SJSC Uzbekenergo and guidelines of JICA.
4) Assist SJSC Uzbekenergo for pre-qualification advertising.
5) Evaluate all Bids in accordance with established SJSC Uzbekenergo and JICA approved criteria.
6) Review and update the draft report based on comments from SJSC Uzbekenergo and JICA.
7) Prepare draft evaluation reports to SJSC Uzbekenergo and assist SJSC Uzbekenergo in preparing final evaluation reports.

D) Assist SJSC Uzbekenergo in International Competitive Biddings

The consultant shall undertake the following works:

1) Prepare, check and review of Bid documents for the EPC contracts, including but not limited to, general and commercial terms and conditions for bidding purpose conditions of contract, technical specification and drawings for bidding purpose, schedule and forms for bidding purpose with due coordination of guidelines of SJSC Uzbekenergo and JICA. Suggestion for appropriate level of service, Bidding method to be provided.
2) Assist SJSC Uzbekenergo for pre-bid conference.
3) Assist SJSC Uzbekenergo in replying Bidders question and in issuing addenda to Bid documents
4) Examine and evaluate the technical Bids received (on qualification and technical aspects) in accordance with established SJSC Uzbekenergo and JICA approved criteria.
5) Prepare draft evaluation report of SJSC Uzbekenergo and assist SJSC Uzbekenergo in selecting technically responsible Bidders.
6) Evaluate and tabulate contents of all Bids for compliance with the Bid documents, reasonableness of price and proposed time for completion of the work and any other guidelines as required by SJSC Uzbekenergo and JICA.
7) Prepare final evaluation reports and recommend for award of contract taking into consideration comments of SJSC Uzbekenergo and JICA on draft evaluation report.
8) Prepare draft contract agreement issued by SJSC Uzbekenergo to successful Bidder.

E) Project management at all levels including periodic review of budget estimate and administration of project cash flows

The consultant shall establish a project management system acceptable to SJSC Uzbekenergo, which will be used to monitor, track and pin point problem.

The works involved will include but not be limited to the following:

1) Establish the basic overall project construction schedule, budget and cash disbursement schedule for both foreign and local portion;
2) Establish and implement a project management system and procedures to monitor and control the cost and time schedule to enable timely corrective measures.
3) Support, co-coordinate, supervise, and make decision and issue instruction for all design and engineering related to the construction activities to SJSC Uzbekenergo

from view point of ensuring the engineering standards, quality assurance and safety of the project

4) Set up a quality reporting system of project progress and status to SJSC Uzbekenergo.
5) Manage claims by and against the contractor properly and reasonably within reasonable time considering the best interest of SJSC Uzbekenergo.
6) Anticipate and identify potential difficulties or conflicts and their effect on the implementation schedule and recommended and agree steps to be taken by the contractor or recommending steps to be taken by SJSC Uzbekenergo to overcome the difficulties and to avoid delays.
7) Prepare and/or evaluate recommendations to SJSC Uzbekenergo regarding any change proposals, technical amendments and change in the scope of work, if any, the appropriateness of their pricing and if agreed by SJSC Uzbekenergo the timely issuance to the contractor of charged order, as per the conditions of the supply and installation contract.

F) Inspection, testing and delivery control during manufacturing

The consultant with SJSC Uzbekenergo participation shall undertake to implement the following:

1) Check and approve proposal on quality assurance, quality control plan and delivery schedule prepared by the contractor.
2) Regularly review production and delivery schedule submitted by contractor.
3) Check and approve factory testing procedures and factory test results submitted by the contractor.
4) Monitor manufacturing progress by testing regular inspections to ensure compliance to contract documents.
5) Witness factory test of major equipment and preparation of corresponding certificates (test items to be witnessed are to be agreed between SJSC Uzbekenergo and the contractor).
6) Check and review inspection report on each factory testing submitted by the contractor.

G) Construction Supervision

The consultant with SJSC Uzbekenergo participation shall undertake the following;

1) Ensure that the contractor sets up his site works appropriately and in accordance with the contract terms and with due consideration to aspects of environmental protection.
2) Act on behalf of SJSC Uzbekenergo by administrating the contract between SJSC Uzbekenergo and the contractor.
3) Check and approve the contractor’s design and drawings of the projects.
4) Check and approve the contractor’s temporary works and facilities.
5) Check and approve the contractor’s equipment.
6) Coordinate, supervise and inspect all construction and erection activities.
7) Check and approve the construction methods and site works carried out by the contractor.
8) Check and approve the contractor’s quality assurance and control program.
9) Issue instructions to the contractor on behalf of SJSC Uzbekenergo.
10) Indicate and approve final reference points for the setting out of all structures.
11) Check and approval of test procedure for materials and equipment to be tested on site by the contractor and witness of such tests.
12) Check and approve work progress for purpose of certifying progress payment.

13) Assist issuance of payment certificates by SJSC Uzbekenergo.
14) Maintain records of payment made by SJSC Uzbekenergo to the contractor.
15) Monitor and control work progress and initiation of corrective measures, if required
16) Recommended any modification of complementary items to be necessary to the contractor.
17) Hold monthly progress meeting and submission of monthly progress reports to SJSC Uzbekenergo.
18) Support SJSC Uzbekenergo to prepare quarterly progress reports to GOU/JICA.
19) Maintain records of contractual matters (Guarantees, performance bonds, issuance, claims etc.)
20) Assist SJSC Uzbekenergo in contractual matters (Guarantees, performance bonds, issuance, claims etc.)
21) Inspect and direct preventive safety and environmental control measures.
22) Prepare project complementation report.
23) Check and approve as built drawings.
24) Issue “Certificate of Readiness” for commissioning certificates.
25) Assist SJSC UZBEKENERGO for submitting Project Completion Report to SJSC UZBEKENERGO within six (6) months after the project completion

H) Commissioning and Acceptance Tests

The consultant shall undertake the following.

1) Assist SJSC Uzbekenergo during the various commissioning stages of the plants.
2) Check and approve the contractor’s start-up and testing procedures including performance test to meet guarantees.
3) Coordinate and supervise all tests according the contract.
4) Check and approve the contractor’s commissioning test report after taking into consideration of SJSC Uzbekenergo `s comments
5) Issue tentative taking over certificates and final acceptance certificates for power plant equipment subject to prior approval of SJSC Uzbekenergo.

I) Ensure the quality of transfer of knowledge and technology from Manufacture to SJSC Uzbekenergo Personnel

The consultant shall undertake the following:

1) Define the manufacture’s responsibility to develop, arrange and implement adequate on-the-job training program, both during construction period for SJSC Uzbekenergo’s operation and maintenance (O&M) staff assigned to operation and maintenance of the plant.

   It should be ensured that the manufacture shall provide the O&M training during the construction period of, including but not limited to, the assembly of the structure of the equipment of the power plant which cannot be checked during operation, and test operation, where SJSC Uzbekenergo O&M staff should be able to observe and record the manufacture’s off-site maintenance activities.
2) Incorporate the manufacture’s responsibility for the above mentioned on-the-job training for SJSC Uzbekenergo `s operation/maintenance staff into the Bid Documents.
3) Ensure the quality of training and knowledge transfer provided from the manufacture to SJSC Uzbekenergo `s O&M staff during both the construction period.

   If it is found necessary, take corrective action to materialize the training and knowledge transfer outcome, where SJSC Uzbekenergo become able to implement independently quality operation and maintenance activities, of which training are provided by the manufacture. Corrective action may include programming training of power station staff in coordination with the manufacture.

4) Support SJSC Uzbekenergo O&M staff to acquire quality assurance skills to assess the quality of O&M training and to identify training-needs.
5) Encourage and ensure SJSC Uzbekenergo staff to acquire such skills as reading design drawings and circuit diagrams, listen to contractor on near-miss experiences and learn safety management scheme from contractors implementation scheme, learn maintenance skills from the manufacture and record such construction and maintenance experiences by video recording and through documentation.

J) Assist SJSC Uzbekenergo in Operation and Maintenance

The consultant shall undertake the following:

Strategic Planning

a) Assist SJSC Uzbekenergo to develop the Operation and Maintenance Strategy, including but not limited to, the plant performance target and plant Operation and Maintenance policy where SJSC Uzbekenergo O&M staff are to become able to conduct O&M activities in sustainable and independent manner.
b) Assist SJSC Uzbekenergo to develop the procedure to make the breakdown targets from Key Performance Indicators for each department/division of the plant and employees.
c) Assist SJSC Uzbekenergo to establish and implement PDCA .

Good Practice

a) Assist SJSC Uzbekenergo to develop and implement a system for recording data on plant efficiency and performance, including but not limited to, daily operation, daily inspection, periodical inspection, maintenance record and accident record.
b) Assist SJSC Uzbekenergo to establish and implement maintenance schedule and procedure.
c) Assist SJSC Uzbekenergo to acquire knowledge and skills of monitoring and checking during operation, such as materializing equipment functions, maintaining heat efficiency, reducing equipment wear, reducing creep and fatigue degradation of hot parts, by utilizing computer-based simulator and OJT through daily operation.
d) Assist SJSC Uzbekenergo to establish and implement a trouble-management scheme, including trip cause analysis and recurrence prevention.
e) Assist SJSC Uzbekenergo to establish and implement safety management scheme, including ex-ante and ex-post safety activities.
f) Assist SJSC Uzbekenergo to prepare inventory records (assets listing) of nameplate, summary list of equipment facilities “as-built” drawings for electro-mechanical equipment
g) Assist SJSC Uzbekenergo to acquire knowledge and skills to conduct non-destructive inspection.
h) Assist SJSC Uzbekenergo to develop basic design of IT-enabled Operation and Management System which includes, but not limited to the plant budgeting database and parts management system for system detailed design to be taken up in later stage.
i) Closely coordinate and communicate with management consultant, who will be responsible to develop SJSC Uzbekenergo`s finance and accounting capacity including budget management;

j) Guidance and coordination of the preparation of the Contractor’s operation and maintenance manuals, which includes negotiation with the contractor to provide their operation/maintenance manuals before the commissioning so that SJSC Uzbekenergo could customize the provided manuals to their operation/maintenance before the commissioning.

K) Assist SJSC Uzbekenergo for Environmental and social aspect

The consultant shall undertake the following:

1) Assist SJSC Uzbekenergo in the further elaboration of environmental management and monitoring programs, both at corporate level and at management level.
2) Assist SJSC Uzbekenergo to enhance respect to compliance in environmental and social aspects.
3) Assist SJSC Uzbekenergo to implement energy conservation education.
4) Assist SJSC Uzbekenergo to monitor the compensation and living situation of the resettled residential people, and evaluate and report to JICA.

V. REPORTS & DOCUMENTS

The consultant shall prepare and submit to SJSC Uzbekenergo the following documents reports.

1. Inception report (including schedule).
2. Engineering report (including basic design report).
3. Construction schedule and cost estimate.
4. Draft of pre-qualification documents.
5. Draft of Bid documents.
6. Draft of evaluation criteria and method of pre-qualification.
7. Draft of evaluation report of pre-qualification.
8. Draft of evaluation criteria and method of international competitive biddings.
9. Draft of evaluation report of international competitive biddings.
10. Monthly progress report.
11. Quarterly progress report.
12. Project completion report.

VI. EXPERTISE REQUIREMENT

The engineering services shall be provided by the foreign and local consultants, which shall include but not be limited to the following:

Foreign Consultant

1. Project Manager (Team leader: M or E). –Full time
2. Mechanical Engineer (Heat Supply).
3. Mechanical Engineer (Gas Turbine).
4. Mechanical Engineer (Steam Turbine).
5. Mechanical Engineer (HRSG).
6. Electrical Engineer.
7. I & C Engineer.
8. Civil Engineer
9. Contract Engineer.
10. Transmission & Substation Engineer.
11. Environmental specialist
12. Social specialist

13. Protection Expert

Local Consultant

1. Deputy Project Manager (Deputy Team leader).	–Full time
2. Mechanical Engineer (Heat Supply).	–Full time
3. Mechanical Engineer (Gas Turbine).	–Full time
4. Mechanical Engineer (Steam Turbine).	
5. Mechanical Engineer (HRSG).	
6. Electrical Engineer	
7. I & C Engineer.	
8. Civil Engineer.	
9. Protection Expert	
10. Transmission & Substation Engineer.	
11. Specialist for Cooling Tower and Water Treatment Plant	
12. Environmental specialist	
13. Social specialist	

***Note:** Full time consultants shall provide service for minimum 45 months*

VII. DURATION OF SERVICE

The engineering service shall cover the duration of fifty six (56) months, starting from commencement of consultant services to the completion of the project.

1)	Pre-Construction stage	:	19 Months
2)	Construction stage	:	37 Months
3)	International Consultant	:	370-Man- Months
4)	Local Consultant	:	445-Man- Months

VIII. SELECTION CRITERIA OF CONSULTANTS

1. Basic Qualification

Based on submission after EOI, State Joint Stock Company Uzbekenergo (SJSC Uzbekenergo) shall prepare a Short List of Consultants to be invited to submit proposals. The number of the short-listed consultants will be 3 to 5. The consulting firms shall satisfy the following conditions to be listed in the short list

1.1 Overseas experience of consulting services in similar power station project. Minimum requirement: A firm shall have experience of consulting services of at least in a developing country under similar environment 340 MW of (1+1) or above capacity combined cycle power station project under a single contract to be considered for short listing and contract value of such services shall be more than US $ 20 Million. Consultants must have origin from eligible source countries (i.e. *All countries and areas of the world*) as defined under Japanese ODA loans.

1.2 Firms that propose Man-Months less than those specified in the 'TOR' will be disqualified.

2. Technical Capability

Following additional criteria will be considered during evaluation of firms

2.1 Experience in a developing country in similar environment.

2.2 Experience under Japanese finance ODA Loan Projects.
2.3 Professional Strength.
2.4 Experience in relevant field.

Relevant field means experience in the following fields but not limited to:

- 2.4.1 Preparation of Specification of Power Station as well as Substation materials.
- 2.4.2 Preparation of bill of quantities.
- 2.4.3 Preparation of bidding document with commercial terms & designs.
- 2.4.4 Experience in Bid document evaluation.
- 2.4.5 Preparation of Contract document.
- 2.4.6 Review and Approval of technical design, drawing.
- 2.4.7 Preparation of Project Implementation Schedule.
- 2.4.8 Supervision and Monitoring of Construction works, Quality control, testing, & commissioning works.
- 2.4.9 Preparation of Test Schedule.
- 2.4.10 Completion and Acceptance certificate Issuance.
- 2.4.11 Preparation of Operation and Maintenance (O&M) Manual.

3. Financial Capacity

3.1 Turnover of the consulting firm
3.2 Contract value of consulting services already performed

4. Specific Requirement:

4.1 Both Foreign & Local consultant shall maintain their office separately at Tashkent and Navoi, Uzbekistan.
4.2 Foreign consultant should render their service staying in Uzbekistan for a reasonable time mutually agreed by Employer and Engineer.
4.3 Full time engineers shall stay in Uzbekistan covering 100% of Man-Months allocated for them.

Short listing will be made on the basis of the stated Criteria Section. VIII of EOI in accordance with the “Guidelines for Employment of consultant under Japanese ODA Loans” March 2009.

10.3 Draft of Project Implementation Schedule

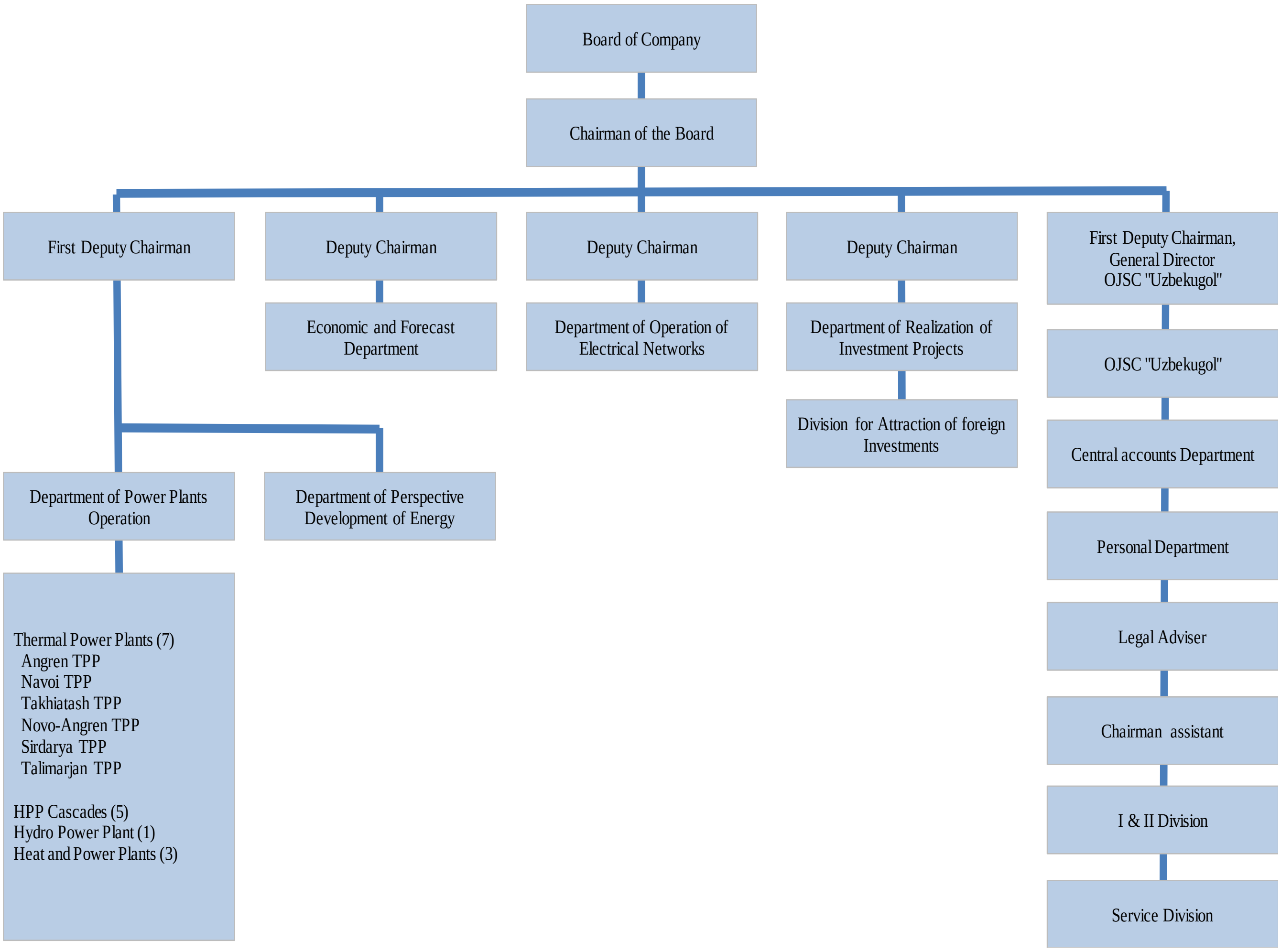
Refer to item 6.6 Project Implementation Schedule

Chapter 11 Proposal for implementation scheme and operation, maintenance and management system

11.1 Verification of the project implementation system, financial stability, technological capacities and others of the implementation body

11.1.1 Project implementation system

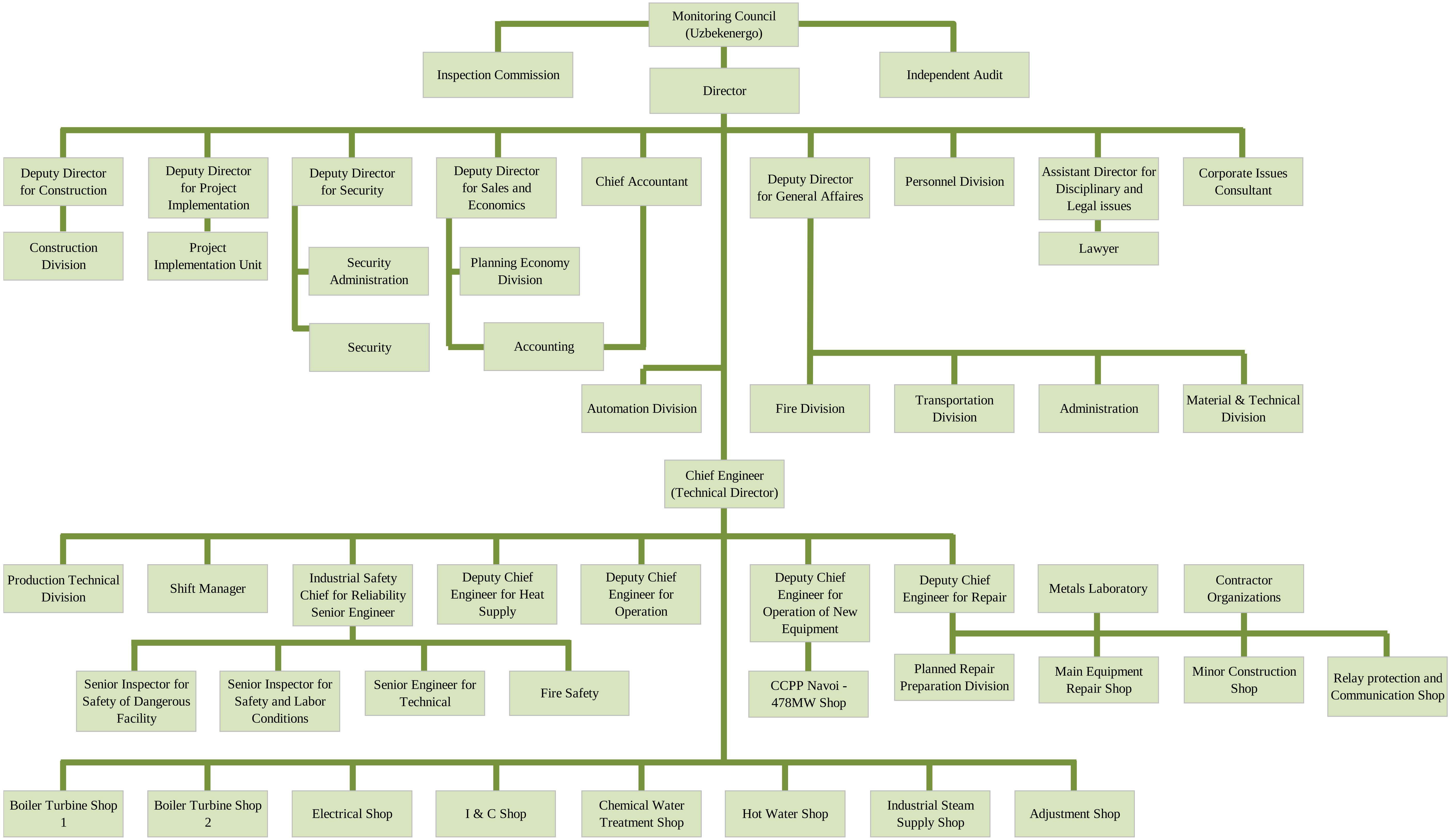
Figure 11.1.1-1 shows the organization chart of the SJSC Uzbekenergo. The organization is operated by Chairman and five Deputy Chairmen. The Navoi thermal power plant pertains to the Department of Power Plants Operation, and is placed under the jurisdiction of the first Deputy Chairman.



Source: SJSC Uzbekenergo

Figure 11.1.1-1 Organization Chart of SJSC “Uzbekenergo”

Figure 11.1.1-2 is an organization chart of the Navoi thermal power plant. The Navoi thermal power plant is staffed by 1,522 members as of October 2012. The operation and maintenance management of CCCGP No.1 where the commercial operation was commenced in October will continue to be placed under the charge of the “CCPP Navoi - 478MW Shop” which took charge of the construction of the same facilities. This organization is staffed by 84 members as of October 2012. Furthermore, the Project Implementation Unit (hereinafter referred to as “PIU”) is already organized within the Navoi thermal power plant. This organization will take charge of the administrative reception office for the construction work of CCCGP No.2 as this Project, following CCCGP No.1. In addition to that, PIU in the SJSC Uzbekenergo headquarters will take charge of the counterpart of this project.



Source: Navoi TPP

Figure 11.1.1-2 Organization Chart of Navoi TPP

Table 11.1.1-1 Actual Personnel in October 2012

Management	Specialist	Workers	Total
178	125	1,219	1,522

Source: Navoi TPP

11.1.2 Financial stability

SJSC Uzbekenergo was established in the form of open joint stock company in 2001. For open joint stock companies, financial audit is mandatory. A domestic auditing firm had audited Uzbekenergo's financial statements every year based on national accounting standards. Although there are still differences between national accounting standards and IFRS, especially on those related with Uzbek civil, tax and corporate legislation, national accounting standards have been being evolved based on IFRS. According to SJSC Uzbekenergo, auditing by a global auditing firm is currently on-going with the support of ADB.

At the end of 2011, SJSC Uzbekenergo was financially sound. Both current ratio and quick ration are more than 1.0 time with sizable margins upon 0.7 times, which is conventionally considered a cut-off point. As both current assets and quick assets were larger than current assets, liquidity is unlikely to be a problem in the foreseeable future. SJSC Uzbekenergo depended mostly on internal funding for its capital investment. Although the debt-to-equity ratio increased for the last several years, Uzbekenergo's debt reached only 30% of its equity in 2011. This suggests that size of debt was at manageable level. In addition, net interest payment was far smaller than EBIT. Uzbekenergo's profitability effectively covered interest payment.

Table 11.1.2-1 Financial Ratios of SJSC Uzbekenergo

	2008	2009	2010	2011	Average
Liquidity					
Current Ratio	1.16	1.18	1.20	1.21	1.19
Quick Ratio	1.10	1.12	1.15	1.06	1.11
Solvency					
Net Interest Payment/EBIT	0.01	0.01	0.02	0.02	0.02
Debt-to-Equity Ratio	3.0%	7.6%	27.1%	30.1%	16.9%
Debt-to-Total Asset	1.2%	3.0%	10.1%	10.7%	6.2%
Profitability					
Net Profit Margin	5.9%	8.6%	7.3%	6.4%	7.1%
Return on Equity (before tax)	14.5%	21.3%	15.8%	14.0%	16.4%
Return on Equity (after tax)	11.5%	17.5%	12.8%	11.4%	13.3%

This project is unlikely to affect the financial health of SJSC Uzbekenergo. As shown in "9.4.5 Financial Analysis", cash flow from operating activities can cover debt service in the base case. Although cash flow is expected to be tight in Year 11-15, healthy balance sheet can absorb unexpected adverse changes in cash flow as long as cash is retained for several years after commissioning. The result suggests that this project is self-sufficient in terms of cash flow and unlikely to need additional financial support after the commencement of commercial operation.

11.1.3 Technological capacities

The “CCPP Navoi-478MW Shop” has an experience in the construction and commissioning of CCCGP No.1 and is considered to have a sufficient level of skill required to implement this Project. Furthermore, some of the engineers have participated in the training course held by the gas turbine manufacturer and have taken part in the witnessed inspection implemented in the factories of the manufacturer so that their technological knowhow level has been improved.
On the other hand, the “CCPP Navoi-478MW Shop” has never experienced the combined cycle power plant operation. Therefore the skill improvement of operation and maintenance is necessary through CCCGP No.1 operating experience.

11.2 Proposal for the operation maintenance management system and scheme for this Project

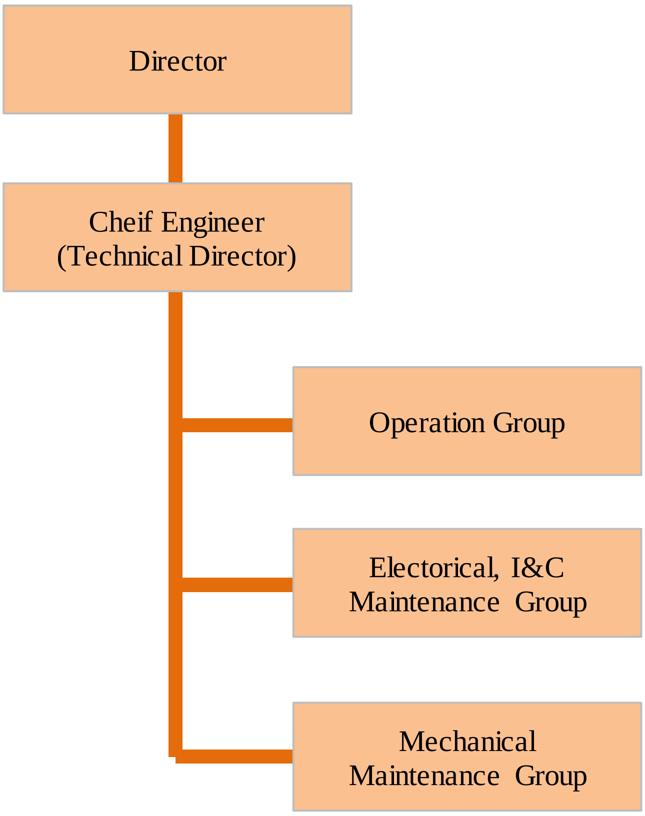
The engineers in the Navoi Thermal Power Plant have never experienced the combined cycle power plant operation and maintenance. It is necessary to be trained in the following skills.

- Trouble response operation and maintenance
- Performance management of CCCGP
- Maintenance of gas turbine

Therefore, the Study Team would like to propose the following for the operation maintenance management for this Project.

(1) Operation maintenance management system for this Project
For the implementation of this Project, the Study Team proposes that those having experience in the construction of CCCGP No.1 should take charge of the major responsible positions in the organization. This is because smoother implementation of the project will result from the organization where the experienced personnel play a major role.

Figure 11.2-1 illustrates the operation maintenance management system proposed by the Study Team.



Source: Study Team

Figure 11.2-1 Operation maintenance management system proposed by the Study Team

Table 11.2-1 shows typical number and the duties of each group.

Table 11.2-1 Typical number and the duties of each group

Group	Type	Number	Duties
Operation Group	Shift Worker	20	・ Stable power supply operation in accordance with the demand power by Load Dispatch Center ・ Operation and monitoring of CCCGP in the central control room ・ Daily maintenance ・ Trouble response operation
	Daytime Worker	10	・ Response to Load Dispatch Center ・ Performance management of CCCGP ・ Response to regular and combustor inspection of piping isolation and power outages operation
Electrical, I&C Maintenance Group	Daytime Worker	10	・ Repair or replacement for gas turbine, steam turbine, HRSG, condenser, pumps, fans and heat exchanger after the accident and for regular and combustor inspection

Group	Type	Number	Duties
Mechanical Maintenance Group	Daytime Worker	10	・ Repair or replacement for generators, transformers, power supplies, switchgear, instruments, control equipment and computer after the accident and for regular and combustor inspection

Source: Study Team

(2) Improvement of operation skill

For the “CCPP Navoi - 478MW Shop”, the facilities operation technique has been acquired at the time of commissioning. The Study Team propose introduction of simulator facilities for the purpose of further improvement of the operation skill in future. The simulator facilities contain the functions of performing a series of operations consisting of gas turbine startup, parallel-in, rated load and parallel-off operations in the plant operations. Furthermore, a trouble simulation function is also provided so that training can be conducted in troubleshooting.

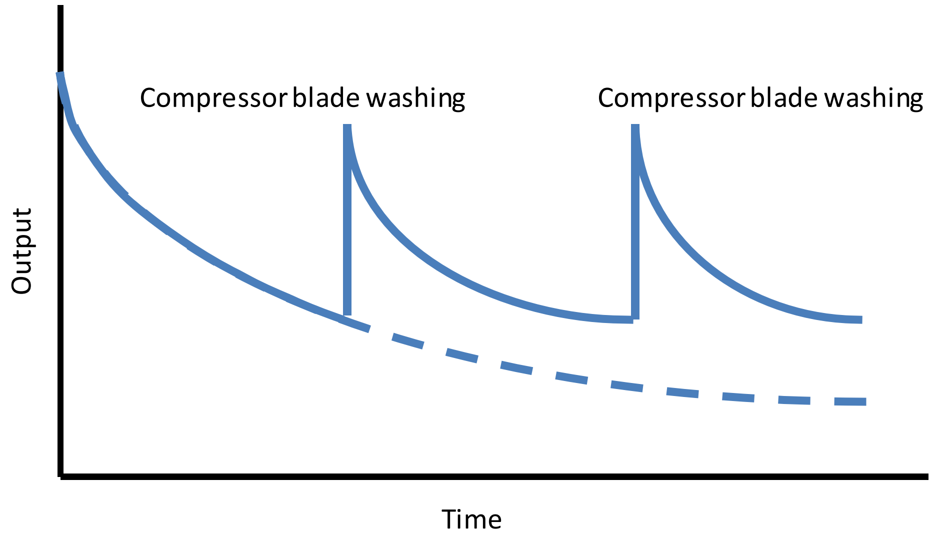
The simulator facilities can be operated on a commonly used PC and are characterized by reduced costs and compact configuration. They can be installed in a training room of the power plant. When software is to be created based on the information of the plant model and control system model in a power plant, the properties inherent to the plant can be represented. This will ensure an advanced level of training efficiency.

(3) Performance management

One of the biggest causes for deterioration of the gas turbine performance is found in the contamination of the compressor passageway. When the gas turbine has been operated for a long period of time, the foreign substances that cannot be removed from air sucked into the compressor will deposit on the vane and passageway of the compressor, with the result that the compressor will be contaminated. Contamination of the compressor will reduce the air flow rate and deteriorates the compressor efficiency so that the output will be subjected to a gradual reduction and the fuel consumption rate will be increased, with the result that the gas turbine performances will be reduced. Compressor blade washing provides one of the methods for recovering the reduced performances of the gas turbine.

The frequency of compressor blade washing is determined by the trade-off between the profit of improving the gas turbine efficiency and the loss caused by suspension of the gas turbine. The Study Team would like to propose that the optimum compressor blade washing frequency should be determined by subsequently accumulating the operation data and compressor blade washing efficiency data.

Figure 11.2-2 illustrates the conceptual view of the compressor blade washing efficiency.



Source: Study Team

Figure 11.2-2 Conceptual view of the compressor blade washing efficiency

(4) Maintenance of gas turbine

The combined cycle power plant includes the major equipment consisting of a gas turbine, steam turbine and HRSG. The maintenance level of the gas turbine in particular out of these major facilities has a serious impact on the availability factor of the overall power generation facilities.

The combustor and turbine blade as hot parts of the gas turbine are operated at a high temperature of more than 1,000°C. Thus, these hot parts require inspection, repair and replacement in shorter intervals of time due to more serious deterioration and damage, as compared with the blade of the steam turbine. For each of these hot parts, the expected service life and inspection time intervals are determined by the Original Equipment Manufacturer (hereinafter referred to as “OEM”). Table 11.2-2 illustrates an example of the time intervals for gas turbine inspection. The Study Team would like to propose that the hot parts should be inspected and replaced under supervision of the technical advisor of the OEM.

Table11.2-2 An example of time intervals for gas turbine inspection

Type of Inspection	Inspection Interval
Combustor Inspection	8,000 hour
Turbine Inspection	16,000 hour
Major Inspection	48,000 hour

Source: Study Team

Since the hot parts are made of superalloy based on nickel and cobalt, special welding technique and coating skill are required to repair these parts. Thus, it is a common practice to repair these hot parts in the OEM factory. Generally, approximately three months are required to repair the hot parts, although this depends on the degree of a particular damage. Further, when consideration is given to the transportation period from the power plant to the OEM factory, a considerable time period will be required. To solve this problem, The Study Team would like to propose that one set of spare parts should be kept in stock as spare parts.

Chapter 12 CDM Related Surveys

12.1 CDM Methodology

In CDM, the emission reduction volume under the project is defined as follows:

・Emission reduction volume = Baseline emission volume - Project emission volume

A project emission volume refers to the volume of emission from an actual project, whereas the emission volume in the baseline scenario means an emission volume in a "scenario unrealized if the project does not fall under a CDM project."
This project is power generation and heat supply business. UNFCCC (United Nations Framework Convention on Climate Change) stipulates the specific method in the following report:
・AM 0048 – Electric Power Stations of Cogenerative Type which Operate on Carbon Fuel and Produce Heat and Electric Energy for Consumer and Produce Electric Power in Network)

The EIA of this project calculates the emission reduction volume according to the stipulations in the above-mentioned report. The specific calculation method and calculation results are mentioned in page 63 of EIA.

12.1.1 Estimation of Effect of GHG Reduction Based on the CDM Methodology

(1) Calculation result

a. Baseline emission volume

The annual baseline emission volume is obtained by multiplying the annual power supply from the project operation to the power networks in Uzbekistan by the baseline emission coefficient of the power networks in Uzbekistan.

- Annual power supply: 450,000 kW × 8,000 hr = 3.60 GWh
- Emission coefficient: 593 g CO_2 / kWh
  Reference: UNDP Project "Capacity Building for MChR in Uzbekistan"
- Annual baseline emission volume: 2,134,800 t CO_2

b. Project emission volume

The annual project emission volume is obtained by multiplying the annual fuel consumption by the project by the CO2 emission coefficient.

- Annual fuel consumption: 763.5 × 10^6 Nm^3 (natural gas)
- Emission coefficient: 1.9 t CO_2 / 1,000 Nm^3
- Annual project emission volume: 1,450,650 t CO_2

c. Emission reduction volume when the project is implemented

The annual reduction volume when the project is implemented will be 684,150 t CO2, which is the result when the project emission volume is subtracted from the annual baseline emission volume mentioned above.

- Annual emission reduction volume = 2,134,800 t CO_2 - 1,450,650 t CO_2 = 684,150 t CO_2

12.2 CDM Related Procedure

The DNA (Designated National Authority) of Uzbekistan, the Technology Transfer Agency under the Ministry of Economy of the nation, is responsible for CDM.

Uzbekistan worked on the introduction of global warming gas emission control measures. As a result, the nation has introduced as many as 100 laws and regulations, including the "Law of Republic of Uzbekistan on the Rational Energy Use" enacted in 1997, to protect the environment directly and indirectly and control use of natural resources and energy.

(Source: http://www.jef.or.jp/PDF/report_b7_h20.pdf)

12.3 CDM Application

Uzbekistan has established the DNA in the country and been working on CDM projects ever since to meet the Kyoto Protocol.

To this end, the Government of Uzbekistan picked up 33 projects in 2009 to work on whether CDM is applicable to these projects.

Table 12.3-1 Projects Where Uzbekistan Worked on CDM Application (2009)

CDM Project Portfolio		
Type	(a) Number of projects listed	(b) Number of projects listed: PIN
Small-scale hydropower generation	10	8
Improvement in chemical processes	7	0
Compressor-driven motor changed-speed operation	5	4
Associated gas utilization (including flaring)	5	0
LFG collection	5	0
Nat-Gas leak reduction (incl. collection)	4	1
Power generation by gas turbines	3	1
Improvement in heat source facilities	3	0
Cogeneration	3	2
Livestock/poultry bio power generation	3	0
Power transmission and distribution	3	1
Wind power/solar power generation	2	0
Other	4	2

Note: The projects in section (a) above are those where the DNA who has decided to work on CDM application, according to the developer's information.

The projects in section (b) are those, among the projects in section (a), in an advanced stage where detailed study for CDM application was carried out.

(Source: http://www.jef.or.jp/PDF/report_b7_h20.pdf)

CDM application in the power generation sector has been studied mostly by SJSC Uzbekenergo. This body has been working currently to file application documents of this project and preceding CCCGP No.2 Project in 2013 to the Ministry of Economy.

Chapter 13 Workshop in Japan

13.1 Purpose of Workshop

This workshop was held to obtain findings and experiences that could be effectively employed in the phase of implementing a yen loan project in the future. The counterparts of Uzbekistan were invited to Japan to make a field trip to the factories of major equipment manufacturers and combined cycle power plants and to listen to the lectures on the combined cycle power generation, in such a way that the related people would get required information.

13.2 Schedule and Lists of Trainees in Workshop

With the cooperation of Japanese Gas Turbine and HRSG manufacturers, the trainees of SJSC Uzbekenergo were invited to visit the Gas Turbine Works and the Steam Turbine and HRSG Works from February 25 and 27 March, 2013. The trainees also visited the Kawasaki Thermal Power Plant of TEPCO to extend their knowledge of operation and maintenance of the modern combined cycle power plant.

The trainees of SJSC Uzbekenergo are listed in Table 13.2-1 List of SJSC Uzbekenergo's trainees.

Table 13.2-1 List of SJSC Uzbekenergo's trainees

No	Name	Position	
1	Mr. AZIMJON YAKUBOV	Deputy Chief Engineer	Navoi TPP
2	Mr. KHURSHID KHUSHVAKOV	CCPP Operator	Navoi TPP
3	Mr. UTKIR IKROMOV	Deputy Chief of CCPP-1 (repair)	Navoi TPP
4	Mr. ALVAR GAYBULLAEV	Engineer	SCSJ Uzbekenergo headquarters
5	Mr. KHAMDAM ESHEV	Electric shop engineer	Navoi TPP
6	Mr. ISTAM TOSHOV	Engineer	Navoi TPP
7	Mr. TUYMUROD MENGLIEV	Electric shop engineer	Navoi TPP
8	Mr. AZIZJON PULOTOV	Operator	Navoi TPP
9	Mr. ISMAIL ISLAMOV	Senior foreman for repair of CCPP-1	Navoi TPP
10	Mr. SHUKHRAT DOSTOV	Engineer	Navoi TPP

13.3 Workshop Contents

(1) Kick off meeting

Date: February 20, 2013

Implementation contents:

- Explanation on JICA’s Roles, Functions and Activities

Figure 13.3-1 Kick off meeting at JICA

(2) Lecture

Date: February 21, 2013

Implementation contents:

- Technical explanation on Combined Cycle Power Plant (CCPP)

Material: Refer Appendix 13-1.

Figure 13.3-2 Lecture at TEPSCO

(3) Kawasaki Thermal Power Station of TEPCO

Date: February 22, 2013

Item: Tour to Thermal Power Station

Implementation contents:

- Explanation on TEPCO overview
- Thermal power plant tour
- Explanation on actual interval for gas turbine inspection

- Explanation on type of water treatment system

Figure 13.3-3 Visit to Kawasaki P.S. of TEPCO

(4) Gas Turbine Work in Japan

Date: February 25, 2013

Item: Tour to Gas Turbine Manufacturing Factory

Implementation contents:

- Explanation on factory overview
- Factory tour (Gas turbine)
- Discussion about problem for freezing of gas turbine compressor inlet air filter at Navoi CCCGP No.1

Figure 13.3-4 Visit to Gas Turbine Works in Japan

(5) Steam Turbine and HRSG Works in Japan

Date: February 27, 2013

Item: Tour to Steam Turbine and HRSG Manufacturing Factory

Implementation contents:

- Explanation on factory overview
- Factory tour (Steam turbine, HRSG)

Figure 13.3-5 Visit to Steam Turbine and HRSG Works in Japan

Appendix 13-1 Material

SJSC “Uzbekenergo”

Technical Explanation on Combined Cycle Power Plant (CCPP)

February 2013

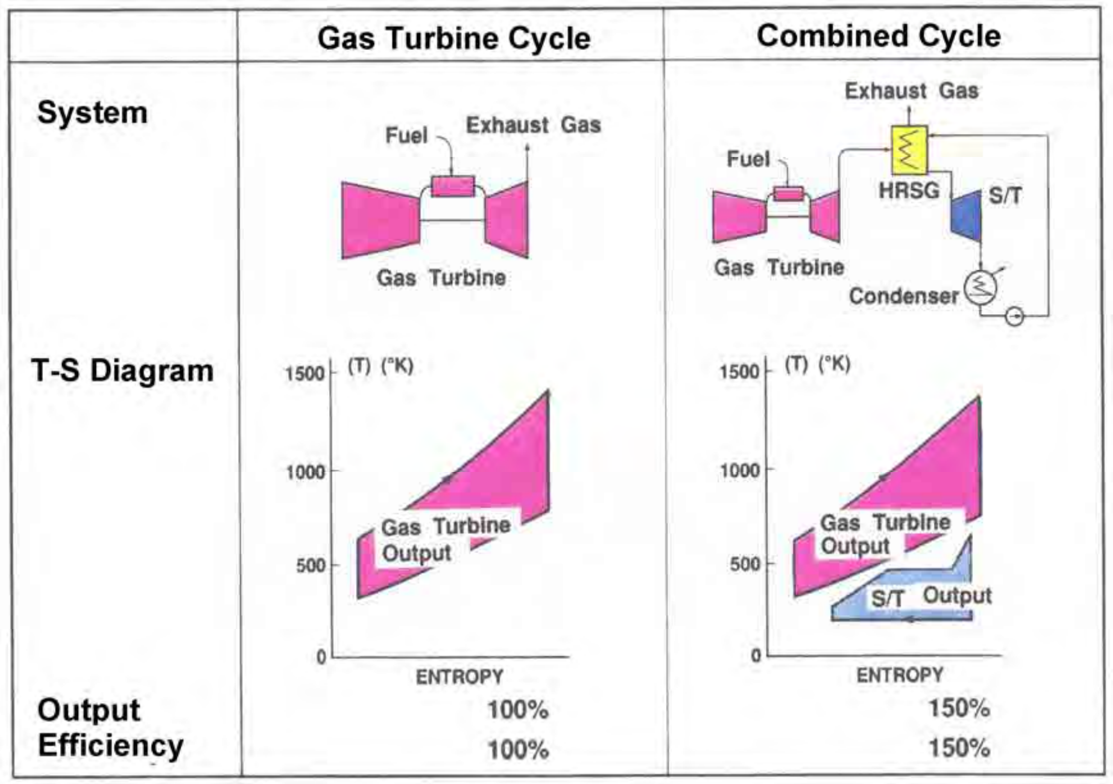
Japan International Corporation Agency (JICA)

Tokyo Electric Power Services Co., Ltd. (TEPSCO)

Specific Features of Combined Cycle Power Plant

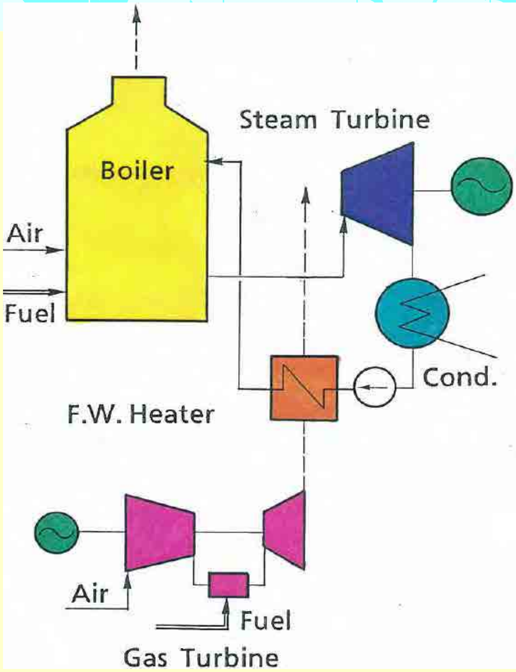
1. **Highest Thermal Efficiency**
2. **Fast Start-up & Rapid Load Change**
3. **Less Impact on Environment**
4. **Less Cooling Water Requirement**
5. **Phased Construction with Power Demand Increase**
6. **Less Construction Cost per kW**
7. **Fully Automatic Controlled Operation**

Performance Relationship between GTC and CC

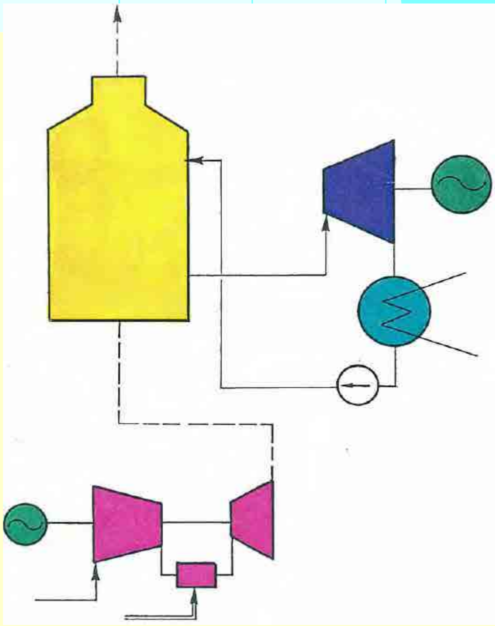


	Gas Turbine Cycle	Combined Cycle
System		
T-S Diagram		
Output	100%	150%
Efficiency	100%	150%

Type of Combined Cycle Power Plant (1/2)

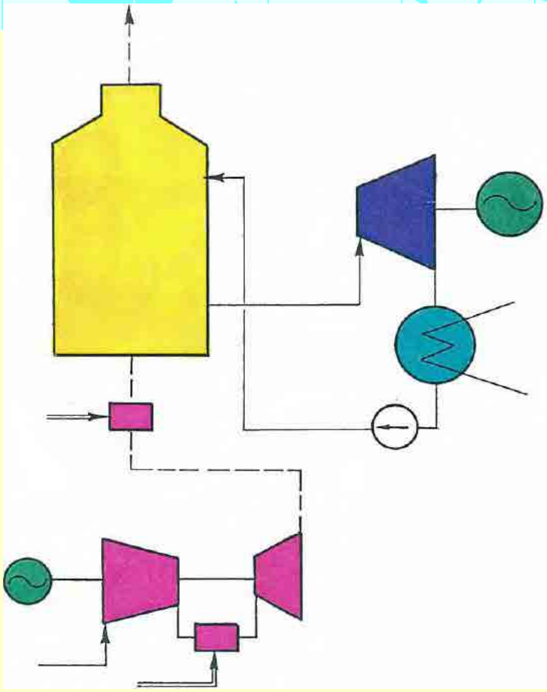


Feed Water Heating Type

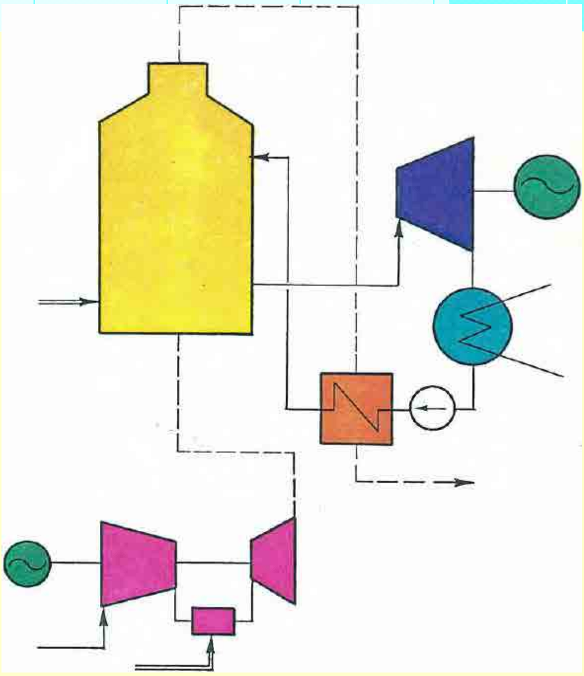


Unfired Type

Type of Combined Cycle Power Plant (2/2)

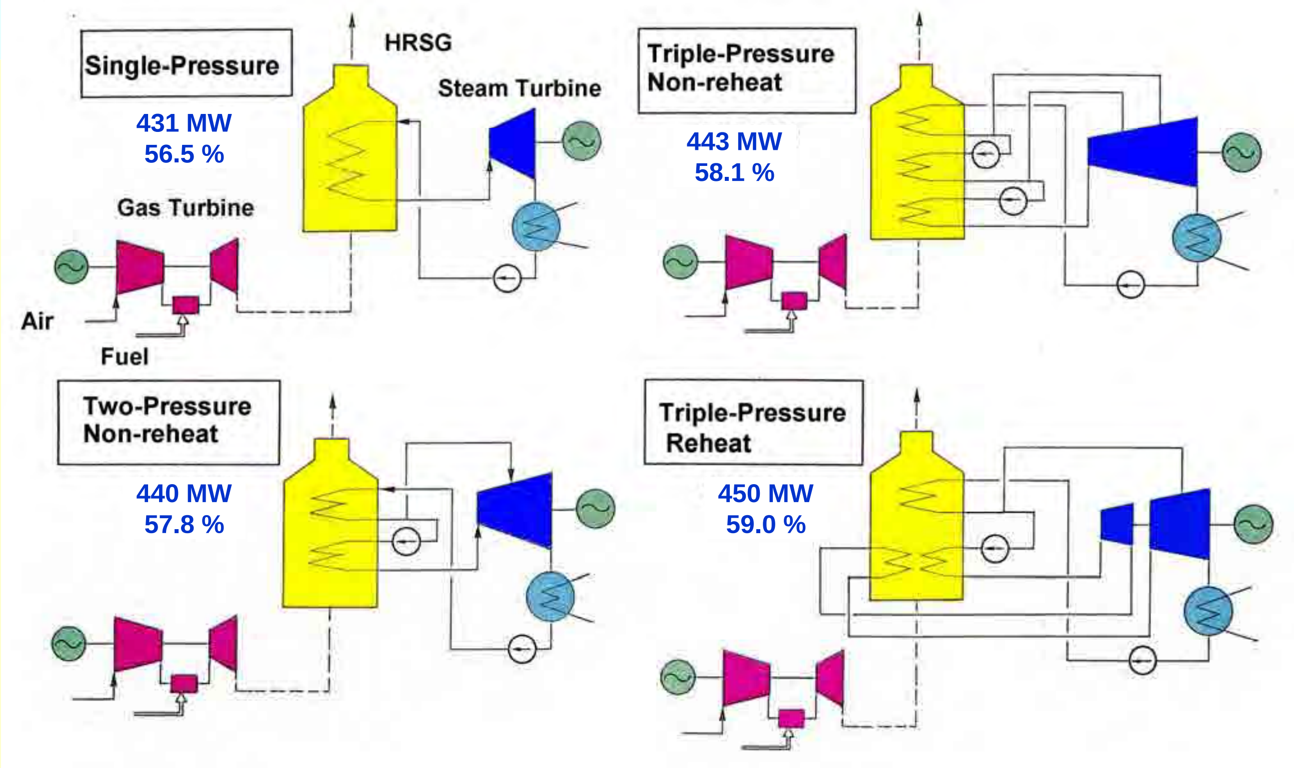


Supplementary Fired Type



Fully Fired Type

Efficiency Change due to Type of Bottoming System



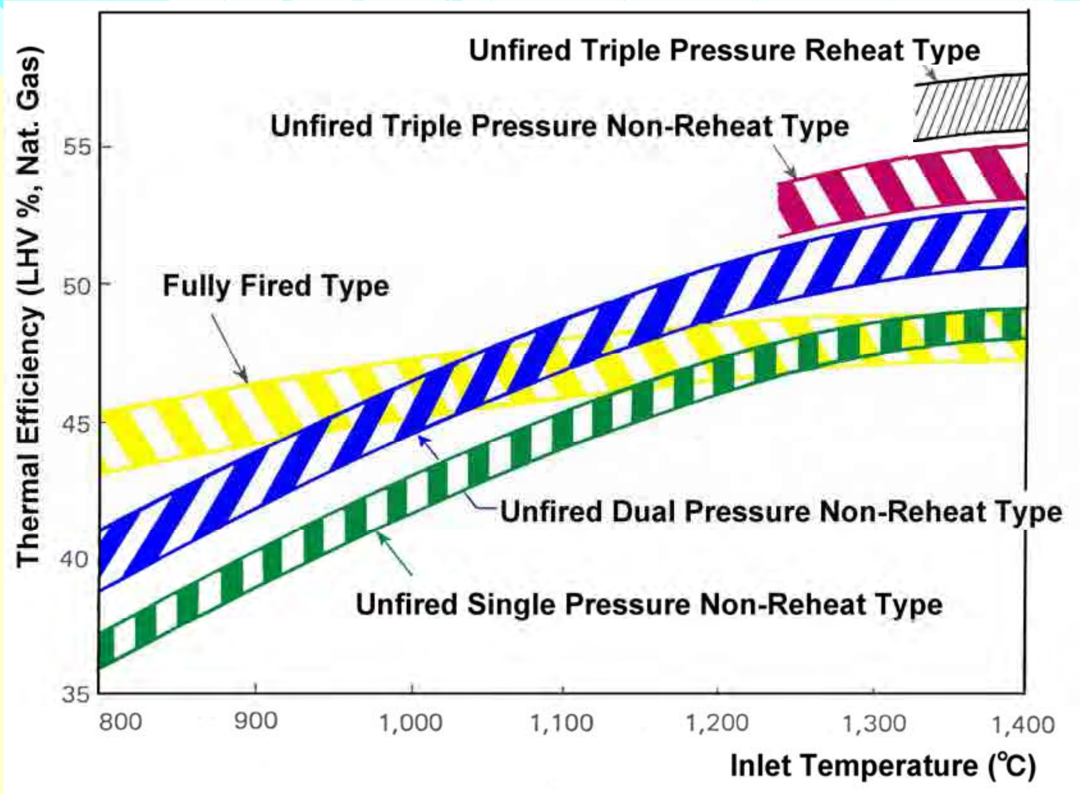
Single-Pressure: 431 MW, 56.5 %

Triple-Pressure Non-reheat: 443 MW, 58.1 %

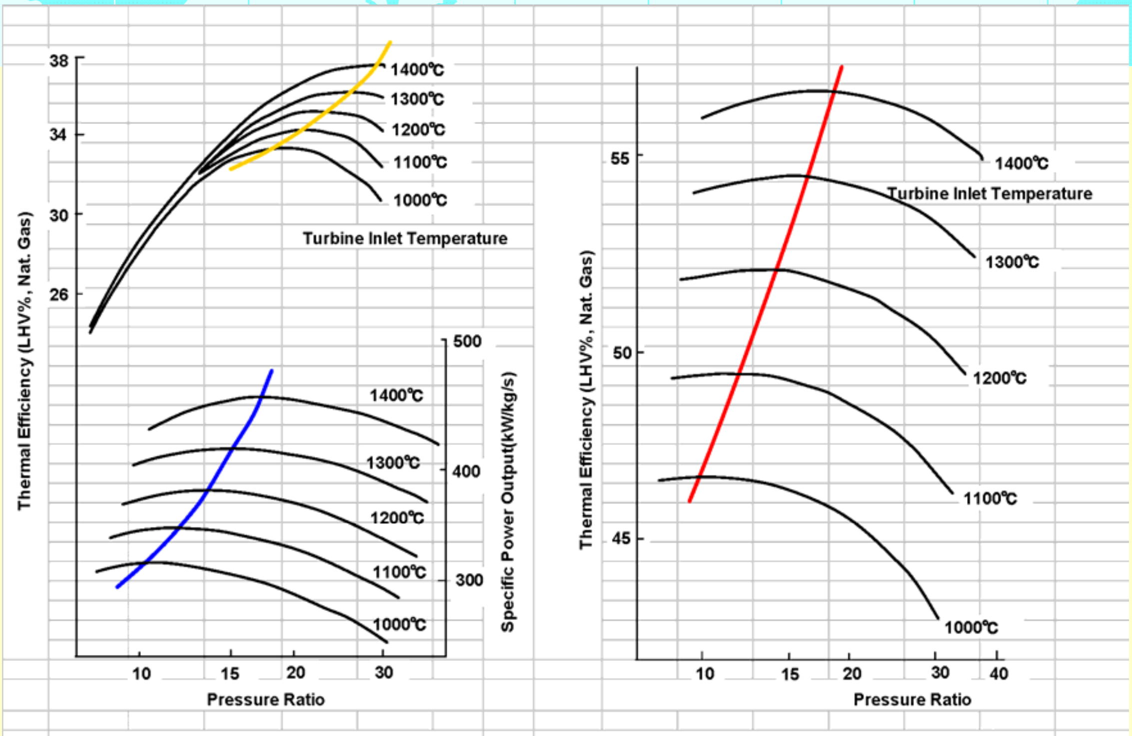
Two-Pressure Non-reheat: 440 MW, 57.8 %

Triple-Pressure Reheat: 450 MW, 59.0 %

CCPP Efficiency Change due to GT Temperature



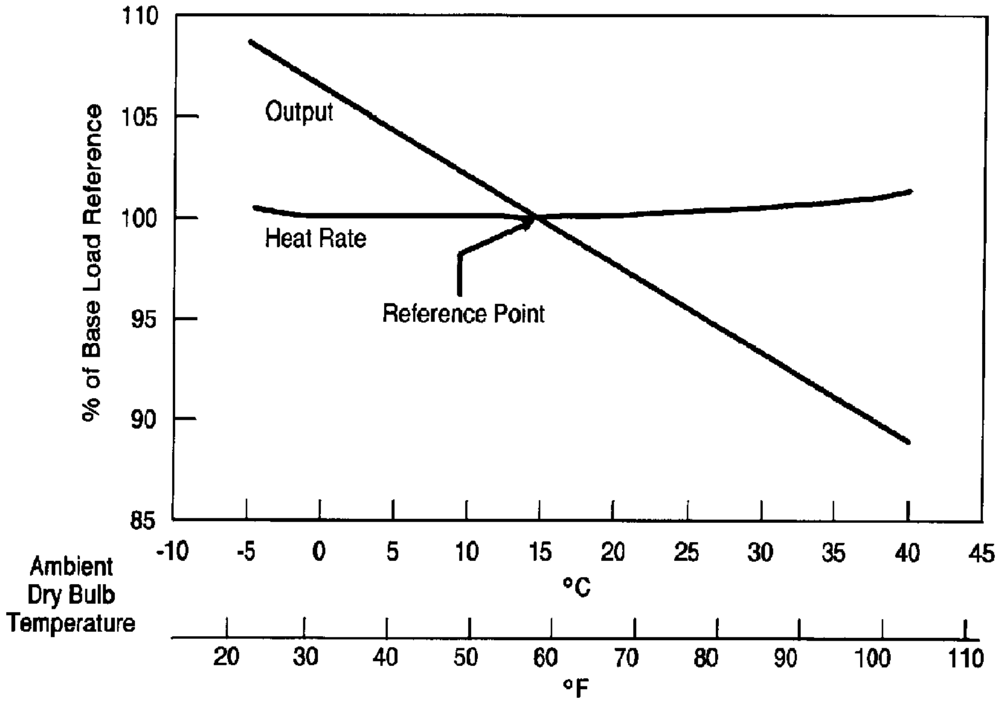
Relationship between GT and CC Performances



Gas Turbine Cycle Performance

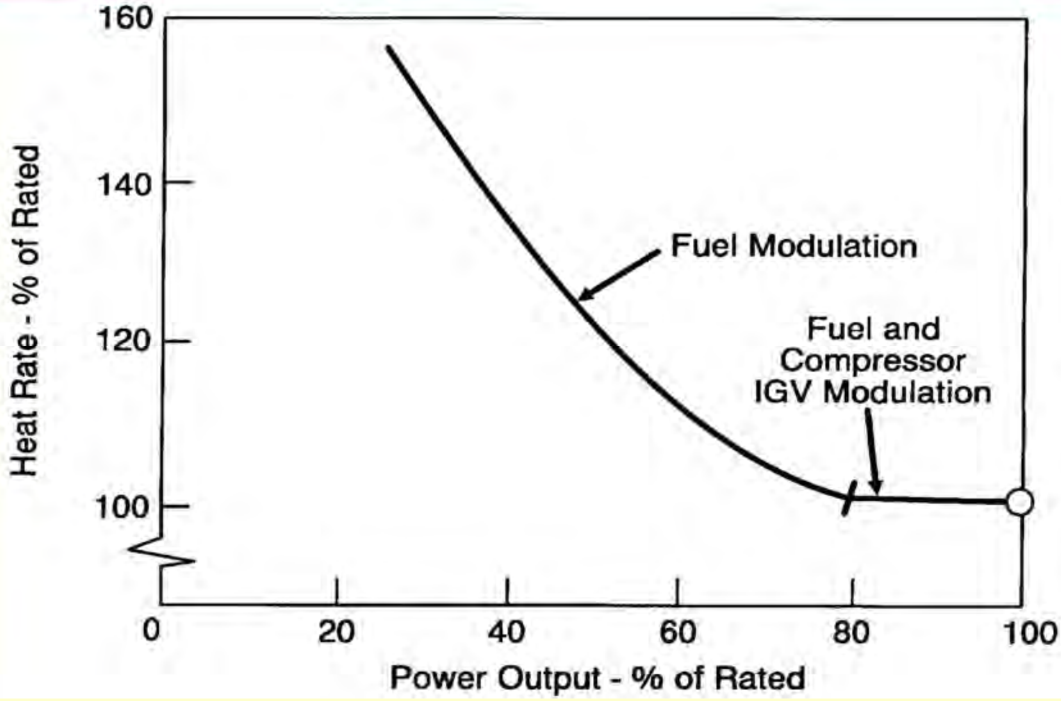
Thermal Efficiency of Combined Cycle

Performance Variation of CCPP with Ambient Temperature



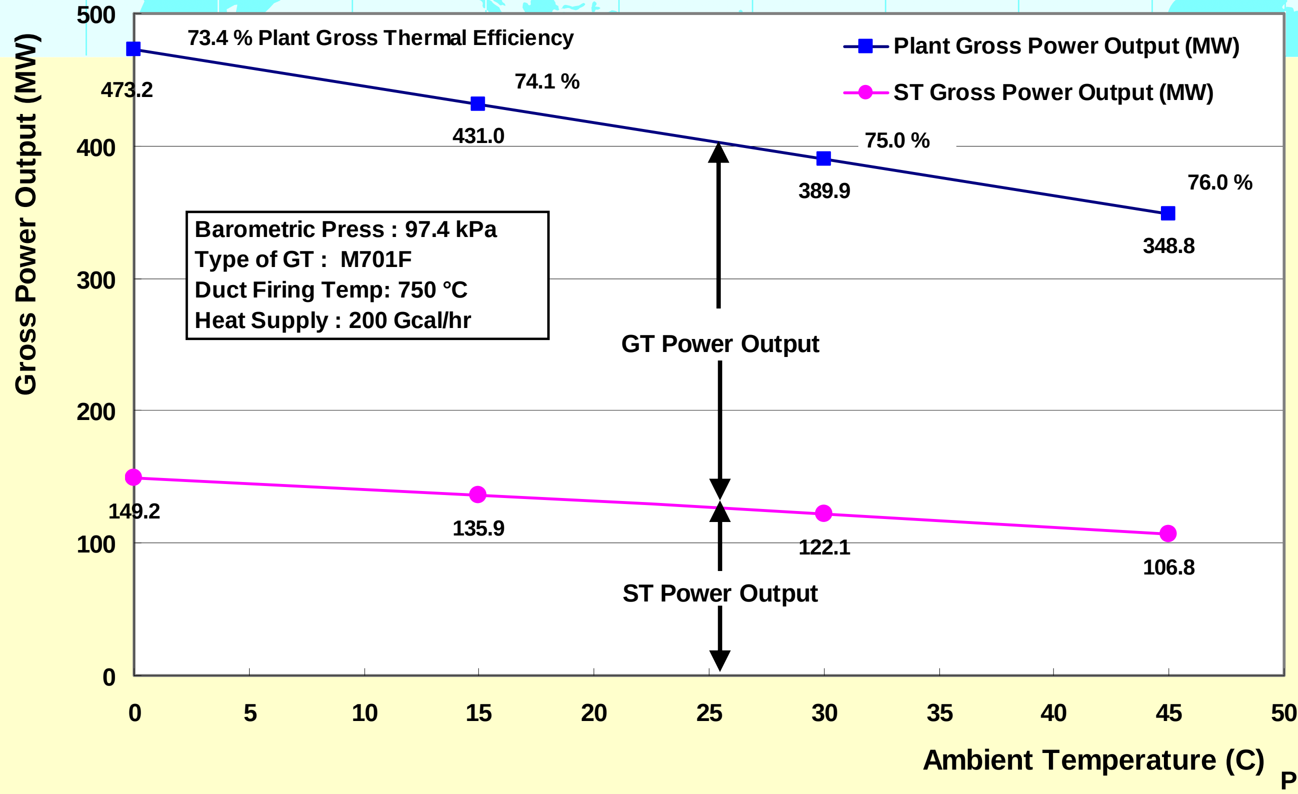
Data Source: GE Library 3967c

Heat Rate Variation of CCPP with Power Output



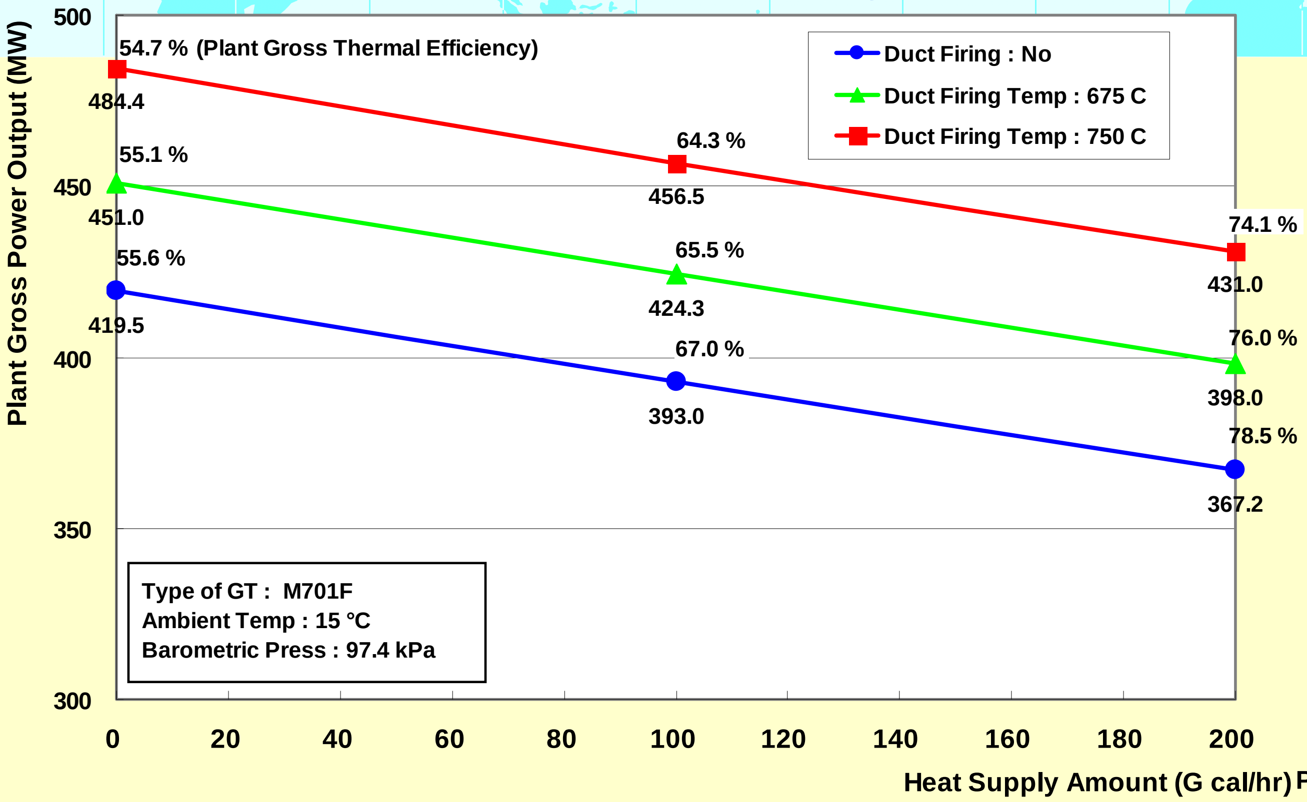
Data Source: GE Library 3967c

Performance Variation with Ambient Temperature of Navoi CC Cogeneration Plant



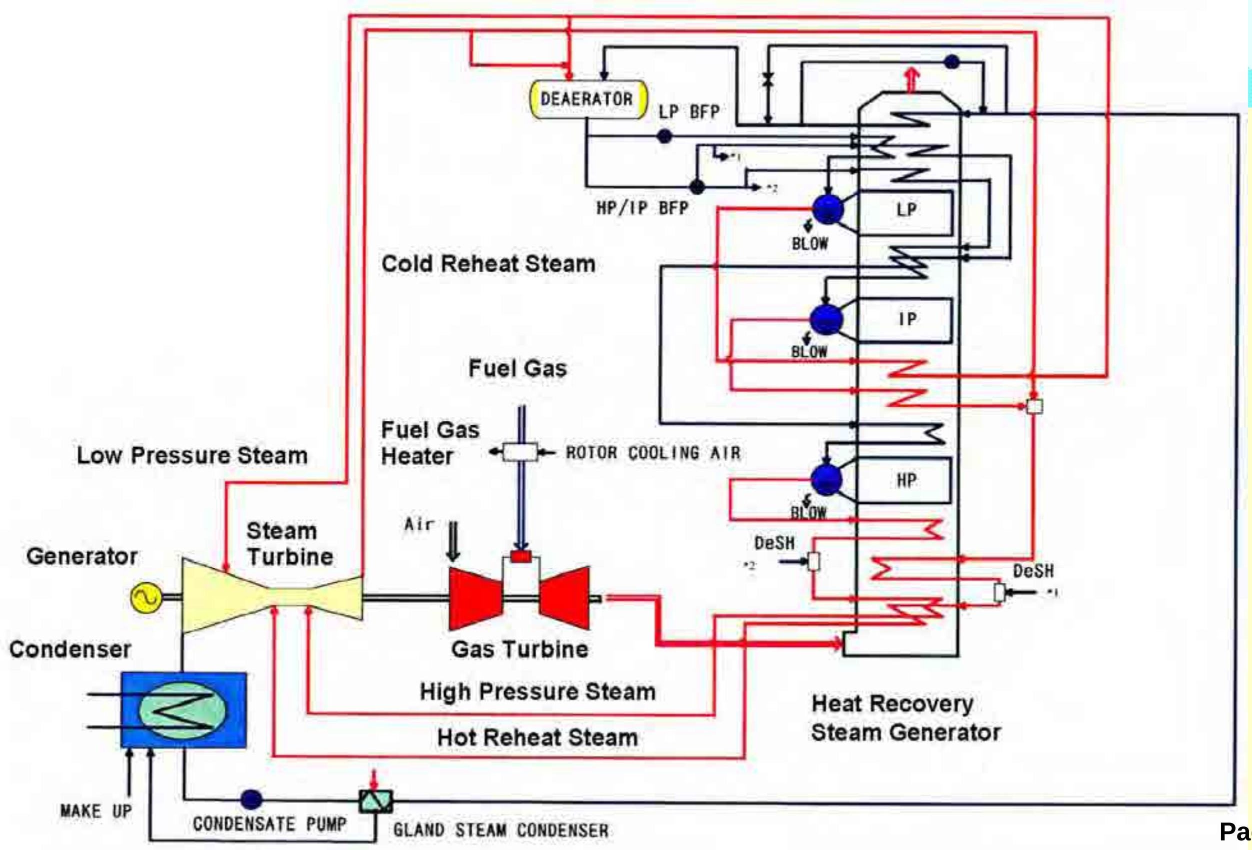
Barometric Press : 97.4 kPa
Type of GT : M701F
Duct Firing Temp: 750 °C
Heat Supply : 200 Gcal/hr

Relationship between Power Output and Heat Supply Amount of Navoi CC Cogeneration Plant

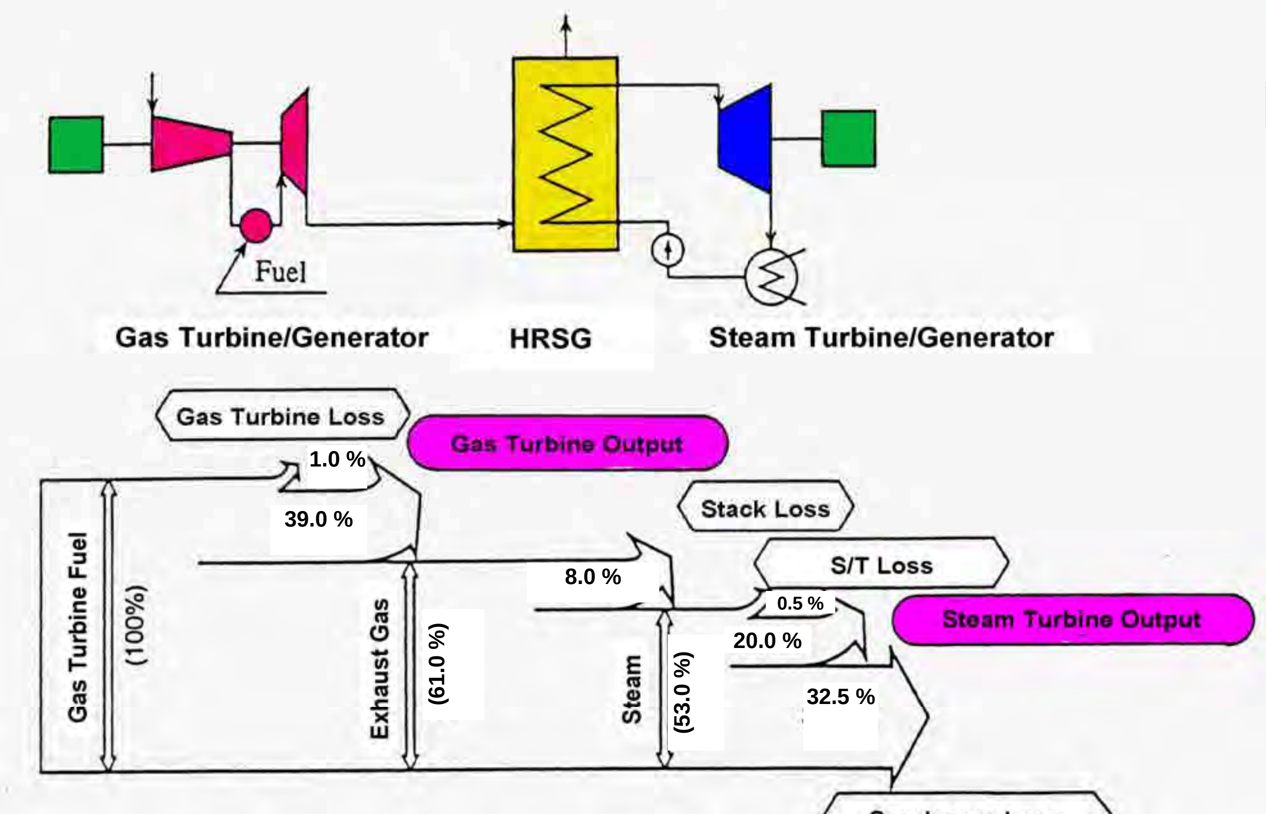


Type of GT : M701F
Ambient Temp : 15 °C
Barometric Press : 97.4 kPa

Typical Diagram of Triple-Pressure Reheat CCPP



Typical Heat Balance of Unfired CCPP



Unfired CCPP Thermal Efficiency 39.0 + 20.0 = 59.0 %

Specification of Large Capacity Gas Turbines for 50 Hz Use

Manufacturer	Alstom		General Electric	
Type of Model	GT 26	GT 26	PG9351 (FA)	PG9371 (FB)
Type of Class	F	F	F	F
Gross Power Output (MW)	292.1	292.8	256.2	284.2
Gross Thermal Efficiency (%)	38.5	39.6	37.0	37.9
Pressure Ratio	34.7	34.2	16.6	18.0
Air Flow Rate (kg/s)	653.2	644.1	642.9	654.1
Exhaust Temperature (℃)	615	614	599	642
Specific Power Output (kW/kg/s)	447	455	399	434
Fuel to Air Ratio (%)	2.37	2.34	2.20	2.34
ISO Turbine Inlet Temp Difference (^{o}C)	Base	Approx -10	Base	Approx +70
Remarks	GTW HB Vol.28 with AQC	GTW HB Vol.28 with OTC	GTW HB Vol.28	GTW HB Vol. 28

Manufacturer	Mitsubishi		Siemens	
Type of Model	M701F3	M701F4	SGT5-4000F	SGT5-4000F
Type of Class	F	F	F	F
Gross Power Output (MW)	278.3	312.1	286.6	292.0
Gross Thermal Efficiency (%)	38.7	39.3	39.5	39.8
Pressure Ratio	17.0	18.0	17.9	18.2
Air Flow Rate (kg/s)	649.5	702.6	689.5	692.2
Exhaust Temperature (℃)	592	597	577	577
Specific Power Output (kW/kg/s)	428	444	416	422
Fuel to Air Ratio (%)	2.26	2.31	2.15	2.16
ISO Turbine Inlet Temp Difference (^{o}C)	Base	Approx +30	Base	Approx +10
Remarks	GTW HB Vol.25	GTW HB Vol.28	GTW HB Vol.26	GTW HB Vol.28

Note 1. Above figures are made up with data from Gat Turbine World Handbooks of Vol. 25,26 and 28.
2. Above figures are for ISO conditions on Natural Gas.
3. Efficiency is based on LHV of Natural Gas fuel.
4. LHV is assumed to be 49,000 kJ/kg.

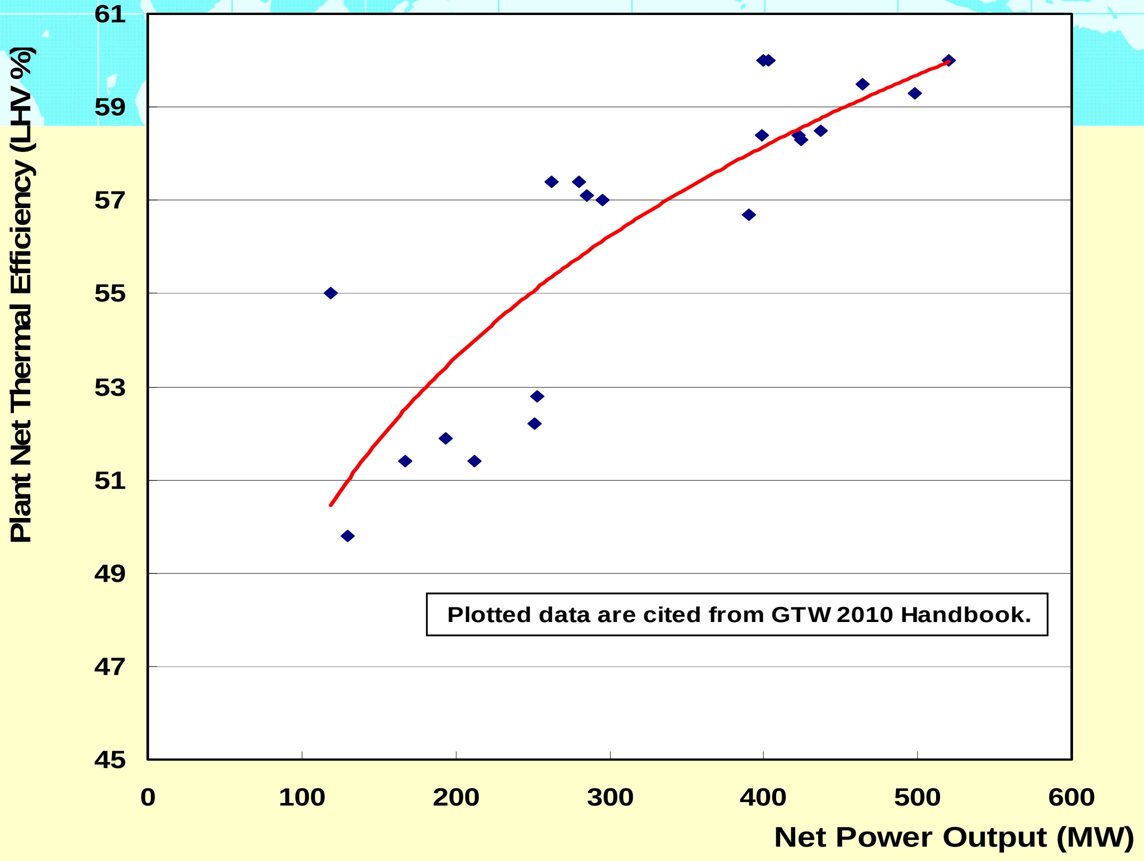
Expected Performance of 1 on 1 Large Capacity CCPP

Manufacturer	Alstom		General Electric	
Type of Model	KA 26-1	KA 26-1	109FA	109FB
Model of Gas Turbine	GT 26	GT 26	9FA	9FB
Type of Bottoming Cycle	Reheat Triple-pressure	Reheat Triple-pressure	Reheat Triple-pressure	Reheat Triple-pressure
Plant Net Power Output (MW)	410.3	424.0	390.8	437.2
Plant Net Thermal Efficiency (%)	57.8	58.3	56.7	58.6
Condenser Pressure (kPa)	-	-	4.1	4.1
Remarks	GTW HB Vol.24	GTW HB Vol.28	GTW HB Vol.28	GTW HB Vol.28

Manufacturer	Mitsubishi		Siemens	
Type of Model	MPCP1(M701)	MPCP1(M701F)	SCC5-4000F	SCC5-4000F
Model of Gas Turbine	M701F3	M701F4	SGT5-4000F	SGT5-4000F
Type of Bottoming Cycle	Reheat Triple-pressure	Reheat Triple-pressure	Reheat Triple-pressure	Reheat Triple-pressure
Plant Net Power Output (MW)	416.4	464.5	416.0	423.0
Plant Net Thermal Efficiency (%)	59	59.5	58.2	58.4
Condenser Pressure (kPa)	-	5.1	-	-
Remarks	GTW HB Vol.25	GTW HB Vol.28	GTW HB Vol.26	GTW HB Vol.28

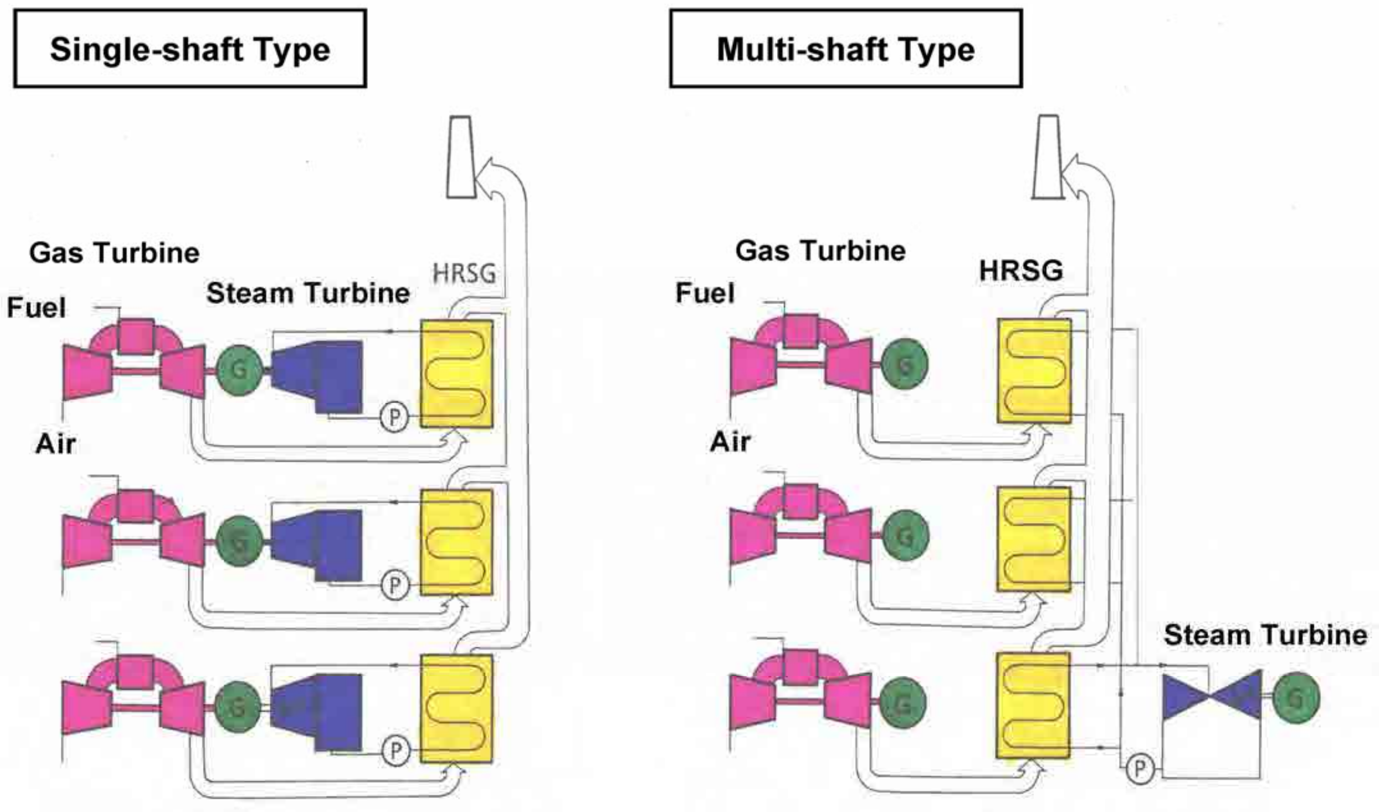
Note 1. Above figures are made up with data from Gat Turbine World Handbooks of Vol. 24 to 28.
2. Above figures are for ISO conditions on Natural Gas.
3. Efficiency is based on LHV of Natural Gas fuel.

Plant Net Thermal Eff. of 1 on 1 Type CCPP



Plotted data are cited from GTW 2010 Handbook.

Shaft Configuration of CCPP



Single-shaft Type

Multi-shaft Type

Simple Comparison of Single and Multi-shaft Design CCPP

1 on 1 Single-shaft Design		1 on 1 Multi-shaft Design	
Relative Advantage	**Relative Disadvantage**	**Relative Advantage**	**Relative Disadvantage**
1. Easier start/stop operation due to simple shaft configuration 2. Less construction cost due to less electrical equipment 3. Slightly higher thermal efficiency due to employment of large capacity generator	1. No simple cycle operation of GT 2. Difficult inland transportation due to more heavy and bulky cargos	1. Higher availability operation to be expected due to GT simple cycle operation 2. Less capacity of start-up device 3. Phased construction with power demand increase	1. Slightly complicated operation 2. Higher construction cost due to many electrical equipment 3. More construction area requirements

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Overall Engineering Activities on CCPP of TEPSCO

Type of Engineering Service	No. of Projects	No. of Different Outside Countries	Total Capacity (MW)	Remarks
Feasibility Study	25	17	10,606	Saudi Arabia, Uzbekistan, Sri Lanka, Turkmenistan, Rumania, Philippines, Mainland China, Viet Nam, Thailand, Bangladesh, Mozambique and others
Pre and Post-contract Consultancy Service	10	6	4,710	Malaysia, Azerbaijan, Uzbekistan (ES-I), Armenia, Indonesia, Bangladesh,
Specific Engineering Service and Detailed Design	10	for TEPCO	13,360	TEPSCO provides detailed designs of buildings, foundations and BOP piping systems of all power stations of TEPCO.
Other Engineering Service	10	7	5,214	TEPSCO provides engineering services as an independent engineer and such as SAPROF and SAPI.
Total	55	21	33,890	

Pre and Post Contract Consultancy Services of CCPP

Name of Project	Country	Unit Capacity (MW)	Type of Fuel	Type of Shaft Configuration	Model No. of GT	Start-up Year	Type of Service	Financed by
Port Dickson #1	Malaysia	750	Nat. Gas	Multi-shaft (2 on 1)	M701F	2006	Full consultancy	JBIC
Port Dickson #2	Malaysia	750	Nat. Gas	Multi-shaft (2 on 1)	MS9001FA	2008	Full consultancy	JBIC
Tashkent TPP	Uzbekistan	370 (with Heat Export)	Nat. Gas	Multi-shaft (1 on 1)	Undecided	Terminated	Pre-contract consultancy	JICA
Shimal #1	Azerbaijan	400	Nat. Gas	Single shaft	M701F	2005	Subordinate consultancy	JBIC
Shimal #2	Azerbaijan	400	Nat. Gas	Single shaft	M701F	2013	Full consultancy	JBIC
Yerevan	Armenia	205 (with Heat Export)	Nat. Gas	Multi-shaft (1 on 1)	GT13E2	2010	Full consultancy	JICA
Japan Railway East Kawasaki	Japan	200	LNG	Multi-shaft (1 on 1)	M701D	2013	Pre-contract consultancy	Own finance
Muara Karang	Indonesia	740	Nat. Gas	Multi-shaft (2 on 3)	M701F	2011	Full consultancy	JBIC
Muara Tawar	Indonesia	241	Nat. Gas	Multi-shaft (1 on 1)	GT13E2	2011	Full consultancy	JBIC
Tanjung Priok	Indonesia	740	Nat. Gas	Multi-shaft (2 on 1)	M701F	2012	Full consultancy	JBIC

Combined Cycle Power Plants of TEPCO in Japan

Name of Power Station	Block No.	Unit No.	Unit Capacity (MW)	Block Capacity (MW)	Type of Fuel	Type of Shaft Configuration	Model No. of GT	Design Efficiency (% LHV)	Start-up Year of 1st Unit
Futtsu	1	7	165	1,000	LNG	Single Shaft	MS9001E	47.2	1985
	2	7	165	1,000	LNG	Single Shaft	MS9001E	47.2	1987
	3	4	380	1,520	LNG	Single Shaft	MS9001FA +	55.3	2001
	4	3	507	1,520	LNG	Single Shaft	MS9001H	58.6	2008
Yokohama	7	4	350	1,400	LNG	Single Shaft	MS9001FA	54.1	1996
	8	4	350	1,400	LNG	Single Shaft	MS9001FA	54.1	1996
Chiba	1	4	360	1,440	LNG	Single Shaft	M701F	54.2	1998
	2	4	360	1,440	LNG	Single Shaft	MS9001FA	54.2	1999
Shinagawa	1	3	380	1,140	City Gas	Single Shaft	MS9001FA +	55.3	2001
Kawasaki	1	3	500	1,500	LNG	Single Shaft	M701G2	58.6	2007
	1	3	500	1,500	LNG	Single Shaft	M701G2	58.6	2013
Total	10	43	-	14,860	-	-	-	-	-

Yokohama Combined Cycle Power Station

Chiba Combined Cycle Power Station

Kawasaki Combined Cycle Power Station

IPP Business of TEPCO in Foreign Country

Name of Project or Plant	Country	Type of Power Plant	Type of Fuel	Power Output (MW)	Start-up Year	Remarks
Loy Yang A	Australia	Conventional Power Plant	Pulverized Coal	2,200 in Total	1984 ~ 1988	Brown coal
Phu My II-2	Vietnam	Combined Cycle Power Plant	Natural Gas	715 ×1	2005	2 on 1 9FA
Chang Bin	Republic of China	Combined Cycle Power Plant	Natural Gas	490 ×1	2004	2 on 1 M501F
Fong Der	Republic of China	Combined Cycle Power Plant	Natural Gas	490 × 2	2004	2 on 1 M501F
Star Buck	Republic of China	Combined Cycle Power Plant	Natural Gas	490 × 1	2009	2 on 1 7FB
Um Al Nar Power and Desalination	United Arab Emirates	Combined Cycle Cogeneration Plant	Natural Gas	1,550 in Total with 110,000 ton/day	2007	5 on 2 9FA
Paiton I	Indonesia	Conventional Power Plant	Pulverized Coal	615 × 2	1999	Sub-bituminous
Paiton III	Indonesia	Conventional Power Plant	Pulverized Coal	815 × 1	2012	Sub-bituminous
Pagbilao	Philippine	Conventional Power Plant	Pulverized Coal	375 × 2	1996	
Sual	Philippine	Conventional Power Plant	Pulverized Coal	609 × 2	1999	
Ilijan	Philippine	Combined Cycle Power Plant	Natural gas	625 × 2	2002	2 on 1 M501F