

**THE DETAILED DESIGN STUDY
FOR
MODERNIZATION OF TASHKENT THERMAL POWER PLANT
IN
THE REPUBLIC OF UZBEKISTAN
FINAL REPORT (MAIN REPORT)**

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ABBREVIATIONS

JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JBIC	Japan Bank for International Cooperation
S/W	Scope of Work
E/N	Exchange of Notes
L/A	Loan Agreement
EPC	Engineering, Procurement and Construction
DCS	Distributed Control System
FIRR	Financial Internal Rate of Return
EIRR	Economical Internal Rate of Return
ROE	Return of Equity
CDM	Clean Development Mechanism
UNDP	United Nations Development Programme
CIS	Commonwealth of Independent States
IMF	International Monetary Fund
GDP	Gross Domestic Product
DAC	Development Assistance Committee
CAOP	Central Asia Oil Pipeline
CAD	Computed Aided Design
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
SEC	Statement of Environmental Consequences
CCPP	Combined Cycle Power Plant
NO _x	Nitrogen Oxyside
SO ₂	Sulfur De-oxyide
NDC	National Dispatching Center
CRIEPI	Central Research Institute of the Electric Power Industry in Japan
LGO	Line Grounding Fault
UDC	Unified Dispatch Center
UNFCCC	United Nations Framework Convention on Climate Change
GHG	Greenhouse Gas

UNITS

Prefixes

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

Units of Length

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

Units of Area

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

Units of Volume

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

Units of Mass

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

lb : pound

Units of Density

kg/m³ : kilogram per cubic meter

t/m³ : ton per cubic meter

mg/m³N : milligram per normal cubic meter

g/m³N : gram per normal cubic meter

ppm : parts per million

μg/scm : microgram per standard cubic meter

Units of Pressure

kg/cm² : kilogram per square centimeter (gauge)

lb/in² : pound per square inch

mmHg : millimeter of mercury

mmHg abs : millimeter of mercury absolute

mAq : meter of aqueous

lb/in², 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/m²h : kilocalorie per square meter hour

Btu/ft²H : 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 ³ N/s	:	cubic meter per second at normal condition
m ³ N/h	:	cubic meter per hour at normal condition

Units of Conductivity

μS/cm	:	microSiemens per centimeter
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Units of Sound Power Level

dB : deci-bell

Units of Currency

Sum : Uzbekistan Sum

US\$: US Dollar

¥ : Japanese Yen

Exchange Rate : US\$ 1 = 1000 Sum

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Unit:GWh

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**COMPREHENSIVE EVALUATION
AND
RECOMMENDATION**

OVERALL EVALUATION AND RECOMMENDATION

I. Overall Evaluation

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

The study was conducted for such main purposes as shown below:

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

In addition, Uzbekistan's efforts for establishment of CDM structure through preparation of the Project Design Document (PDD) as if the project were regarded to be a CDM project.

The followings are the overall evaluation for each study item.

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

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

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

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

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

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

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

- It was cleared that there would be no effect on the existing Uzbekistan's electrical power network system in the year 2002 as the analysis results of the effects on the network system due to the introduction of the power plant. As a result, regarding the basic technical requirements for electrical equipment of tender documents of the power plant, the considerations at the time of the feasibility study for the introduction of the power plant were employed as they were. However, the analysis results revealed that there are inherent problems with the existing network system and it was also recognized by the Uzbekistan side as their challenging issues in the future. Therefore, this analysis study is considered to have been useful.
- As the study results on the present status of the management system of existing Tashkent Thermal Power Plant, issues on repair plan, financial affairs, management organization and safety management were revealed, and items and contents to be improved were clarified. We are not told that such comprehensive studies have not been conducted in SJSC "Uzbekenergo" and the experience with such studies could be valued in that it will be believed to lead to the examinations of management situations of other power plants in the future.
- The financial internal rate of return (FIRR) of the new combined cycle power plant is calculated on the preliminary survey of the project when its introduction was decided.

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

- The combined cycle power plant is the first experience with Uzbekistan. The basic concept related to the nature of operation and maintenance established based on experiences of many similar power plants in Japan will be significantly useful for SJSC "Uzbekenergo".
- Uzbekistan is a country that ratified the Kyoto Protocol on climate change earlier than many other countries and it has carried out many domestic activities such as examinations of the current levels and future trend prediction of greenhouse gases in relation to climate change. However, it has not yet created any practical system or laws and regulations for introduction of CDM. However, we recognized through this study that Uzbekistan has just undertaken to stipulate any system or laws and regulations required for CDM as Uzbekistan country, considering that the procedures to structure a CDM project were cleared by the United Nations Framework on Climate Change mechanism,.

II. Recommendations

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

- Through the technical understanding and knowledge and the bid evaluation method of the combined cycle power plant gained and learned during the joint preparation of tender documents for international competitive bidding of this project, the actual bid evaluation should be conducted smoothly and impartially.
- The introduction of this project is also sanctioned by local residents as a result of a detailed EIA and a public hearing. We hope that the same procedures will be made as a rule to introduce any similar facility for Uzbekistan in the future.
- The analysis of Uzbekistan's electric power network system to assess the impact due to introduction of this project was conducted based on the data obtained in 2002. However, it is desirable that similar analysis shall be conducted based on the forecast data considering the electric power demand, power source development plans and power transmission and distribution facility development plans at the time of start of the project

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

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

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

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

- According to the results of the study, the profit contribution of the Tashkent Thermal Power Plant is 1.31 sums/kWh under the assumptions of the ratio of the cost of power generation facilities to the electricity tariff and the power transmission and distribution losses. It is also necessary to closely scrutinize such figures as previously assumed that were not clarified in this study and to aware of the profit contribution that is the closest to the real figure as a guideline for the power plant management.
- The financial internal rate of return and the return on equity of the new power plant are not necessarily attractive values for the new project. One reason is that most materials and equipment for the plant are procured from countries with market economy, while the electricity tariff is significantly lower. Uzbekistan intends to turn to a market economy

country and the electricity tariff should be legislated accordingly.

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