No.

Japan International Cooperation Agency (JICA)

State Joint Stock Company "Uzbekenergo"

THE DETAILED DESIGN STUDY

FOR

MODERNIZATION OF TASHKENT THERMAL POWER PLANT

IN

THE REPUBLIC OF UZBEKISTAN

FINAL REPORT
(ANNEX)

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Tokyo Electric Power Services Co., Ltd.

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Japan International Cooperation Agency (JICA)
State Joint Stock Company "Uzbekenergo"

The Comparison Study on Type of Shaft Arrangement of 370MW combined Cycle Power Plant

Document No. TMP-0008

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Tokyo Electric Power Services Co., Ltd.

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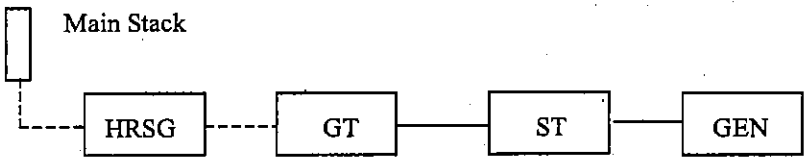
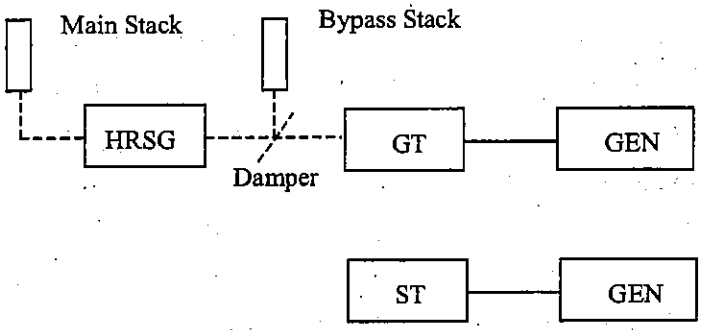
Comparison Study on the Shaft Arrangement

Here made is the comparison study on the type of the shaft arrangement of the combined cycle power plant comprised of the one (1) same model of gas turbine. Basically, there are two (2) types of shaft arrangements. One is called single-shaft arrangement where the gas turbine, a steam turbine and a generator are connected on the same shaft. The other is called multi-shaft arrangement where the gas turbine/generator shaft and the steam turbine/generator are separate. The following figures show the both types of shaft arrangements:

Single-shaft combined cycle power plant



Multi-shaft combined cycle power plant



As shown above, in case of the multi-shaft arrangement a generator and a bypass stack with a damper are additionally necessary.

The comparison study is performed from the viewpoints of operability, thermal efficiency, operating availability, maintainability, installation area requirement and construction cost.

1. Operability

In case of the shingle-shaft arrangement, the power plant could not be operated unless the components of the gas turbine, the heat recovery steam generator and the generator are all healthy.

On the other hand, in case of the multi-shaft arrangement, even if any components of the heat recovery steam generator, the steam turbine, and the steam turbine generator are

out of service due to any reasons, the gas turbine/generator could be operated as a simple cycle provided that the exhaust gas from the gas turbine is discharged into atmosphere through the bypass stack.

Thus, the operability of multi-shaft combined cycle power plant is more flexible than the single-shaft combined cycle power plant. The combined cycle power plant could be operated only by adjustment of the fuel flow into the gas turbine, so that there is no difference with the operation between both types of power plants. Such things as stated above are reasons why the multi-shaft combined cycle power plants are commonly employed in the developing countries for continuous base load operation

Moreover, in case of the multi-shaft combined cycle power plant, two-stage construction could be also expected. That is to say, there is an advantage that the gas turbine/generator will be put into service at the former stage because the completion period is shorter, and the bottoming cycle equipment will be constructed at the latter stage to meet the increment of the power demand.

In case of the single-shaft combined cycle power plant, the auxiliary steam for cooling, sealing and hogging is required because the steam turbine has to be accelerated with start-up of the gas turbine. For the purpose, an auxiliary boiler will be needed unless the steam is available from external sources. While, such steam is not needed for start-up of the multi-shaft combined cycle power plant because the steam turbine will be started up after the necessary steam is available from the heat recovery steam generator. However, the start-up time to the full load of the multi-shaft combined cycle power plant will be longer because of sequential start-up of the gas turbine and the steam turbine.

2. Experience with Both Types of Shaft Arrangements

As shown in the attached Tables 1 and 2, there are much application experiences with both shaft types of combined cycle power plants. It is understood that both types of shaft arrangements are technically feasible without any difficulties.

3. Thermal Efficiency

The single-shaft combined cycle power plant is equipped with one (1) large size generator, while two (2) small size of generators are employed in the multi-shaft combined cycle power plant. Therefore, the thermal efficiency of the single-shaft combined cycle power plant is theoretically higher by the difference of the generator efficiencies between both plants. However, the difference is negligibly small.

4. Operating Availability (Probability)

The operating availabilities of both power plants are calculated on the assumption that the reliabilities of components are as shown below:

Gas turbine:	$A_1 = 97.5\%$
Heat recovery steam generator	$A_2 = 99.0\%$
Steam turbine	$A_3 = 98.5\%$
Gas turbine generator and transformer	$A_4 = 99.7\%$
Steam turbine generator and transformer	$A_5 = 99.7\%$

The impact on the operating availability due to the maintenance is not considered for this comparison because it is not envisaged that there exists the significant difference between the operating availabilities of both power plants.

The followings are the theoretically calculated operating availabilities on an hour basis of the single-shaft combined cycle power plant as OAH_S and the multi-shaft combined cycle power plant as OAH_M.

$$OAH_S = A_1 \times A_2 \times A_3 \times A_4 = 0.975 \times 0.990 \times 0.985 \times 0.997 = 0.948 = 94.8\ \%$$

$$OAH_M = A_1 \times A_2 \times A_3 \times A_4 \times A_5 + A_1 \times A_4 (1 - A_2 \times A_3 \times A_5)$$

$$= 0.975 \times 0.990 \times 0.985 \times 0.997 \times 0.997 + 0.975 \times 0.997(1 - 0.990 \times 0.985 \times 0.997)$$

$$= 0.945 + 0.027 = 0.972 = 97.2\ \%$$

The figure of 94.5% out of the operating availability (97.2%) of the multi-shaft combined cycle power plant shows the operating availability where the power plant will be wholly operated. While, the figure of 2.7% is the operating availability (probability) where only the gas turbine/generator will be operated.

As far as the operating availability on an hour basis is concerned, the multi-shaft combined cycle power plant is higher by 2.4%(=97.2 - 94.8) than the single-shaft combined cycle power plant.

Similarly, the operating availabilities on an energy basis of both types of plants are can be theoretically calculated as follows:

Single-shaft combined cycle power plant:	94.8%
Multi-shaft combined cycle power plant:	96.3%

Where, the ratio of the gas turbine power output is assumed to be two third (2/3) of the power plant.

As the results, the operating availability on an energy basis of the multi-shaft combined cycle power plant is higher by 1.5% (=96.3 - 94.8) than the single-shaft combined cycle power plant.

5. Maintainability

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

6. Installation Area Requirement

The requirement area for installation of one (1) unit of single-shaft combined cycle power plant is 69,000m^2 (60m by 115m) as shown in the attached Figure 1 "Typical Layout of Single-shaft Type". While 86,250m^2 (75m by 115m) is required for one (1) unit of multi-shaft combined cycle power plant with 25% of requirement area increase as shown in the attached Figure 2 "Typical Layout of Multi-shaft Type". However, one (1) unit of multi-shaft combined cycle power plant can be installed on the given site area without any difficulties.

7. Construction Cost

The multi-shaft combined cycle power plant is constituted of more components as mentioned in above clauses. Therefore, the construction cost will increase compared with the single-shaft combined cycle power plant. The attached Table 3 shows the tentative cost comparison between the multi-shaft type and single-shaft type. As shown in the table, the cost of the former is higher by some 4 % than the latter. The detailed cost comparison will be made through the Study.

8. Generation Cost

The generation cost of the single-shaft combined cycle power plant is estimated at 2.13 US cents in Table 13-2 of Feasibility Stage Report. While that of the multi-shaft combined cycle power plant can be calculated as follows:

(1) Fuel cost

Fuel cost is increased by 2.4 % due to the improvement of the operating availability on an hour basis. Therefore, the fuel cost is calculated at 41.28 MMUS$ (= 40.313 × 1.024).

(2) Operating and maintenance cost

If the fixed maintenance cost is proportional to the construction cost and the variable maintenance cost is proportional to the operating availability, the operating and maintenance cost can be calculated as follows referring to 3) of Clause 13.1.3 of the Report.

$$1.8 \times 1.041 + 1.8 \times 1.024 + 0.091 + 1 = 4.81 \text{MMUS\$}$$

(3) Capital cost

Since the capital cost is proportional to the construction cost, it is calculated at 41.28MMUS$ (40.313 × 1.04).

(4) Energy sales

Since the energy sales is proportional to the operating availability on an energy basis, it is calculated at 2,558MMkWh (2,520 × 1.015).

Therefore, the generation cost of the multi-shaft arrangement power plant is estimated at 2.16 US cents/kWh (= (41.28+4.81+41.28) × 100/2,558)

9. Conclusion

Above study results are summarized as described below:

(1) Operability

The operability of multi-shaft combined cycle power plant is more flexible than the single-shaft combined cycle power plant because the gas turbine/generator could be operated as a simple cycle even if any components of the heat recovery steam generator, the steam turbine, and the steam turbine generator are out of service due to any reasons.

Moreover, in case of the multi-shaft combined cycle power plant, two-stage construction could be also expected.

(2) Experience

As shown in attached Tables 1 and 2, there is much experience with both types of combined cycle power plants. Therefore, both types can be deemed technically proven.

(3) Thermal Efficiency

The difference of the thermal efficiencies between both types of combined cycle power plants is negligibly small.

(4) Operating Availability

The hour and energy basis operating availabilities of both power plants are as calculated as below:

	Single-shaft	Multi-shaft
Hour basis operating availability	Base (1.0)	1.024
Energy basis operating availability	Base (1.0)	1.015

(5) Maintainability

The maintenance of the multi-shaft combined cycle power plant needs more man-hour requirement and is costly.

(6) Installation Area Requirement

The multi-shaft combined cycle power plant needs more installation area, but can be installed on the given area without any difficulties.

(7) Construction Cost

It is estimated that the construction cost of the multi-shaft combined cycle power plant is higher by approximately 4% than that of the single-shaft one. The detailed cost estimation of both types of combined cycle power plants will be made through the Study, but it is foreseen that either of their costs will be settled in the specified budget cost.

(8) Generation Cost

The generation cost of the multi-shaft combined cycle power plant is estimated at 2.16 US cents/kWh compared with 2.13 US cents/kWh of the single-shaft combined cycle power plant described in the clause 13.2.4 of Feasibility Study Report. The generation cost difference is approximately 1.4%.

As described above, there is no significant difference between the single-shaft and multi-shat combined cycle power plants.

We understand that the type of the shaft arrangement of the combined cycle power plant to be introduced in Tashkent Thermal Power Plant will be determined depending on the intent of Uzbekistan side.

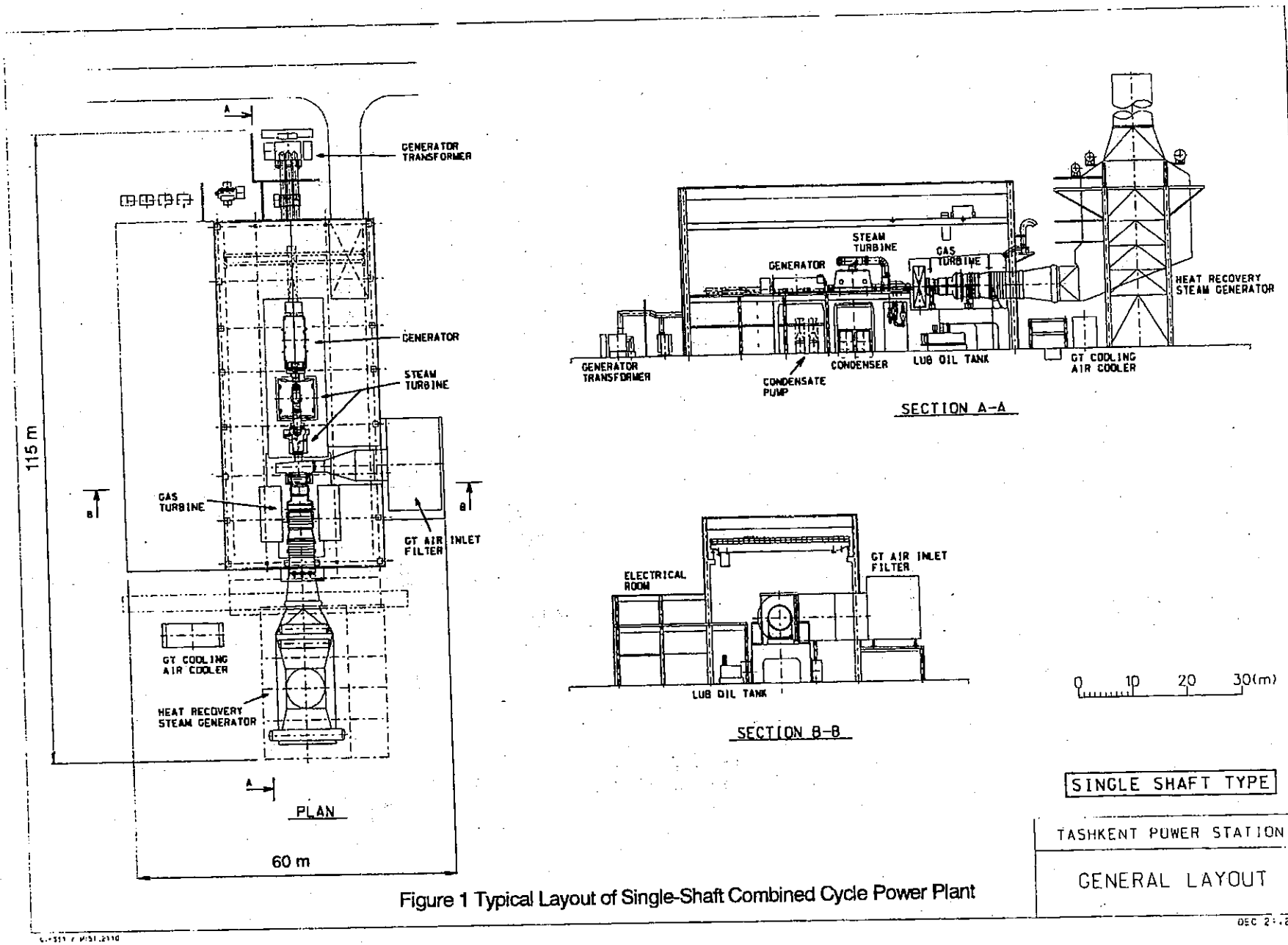


Figure 1 Typical Layout of Single-Shaft Combined Cycle Power Plant

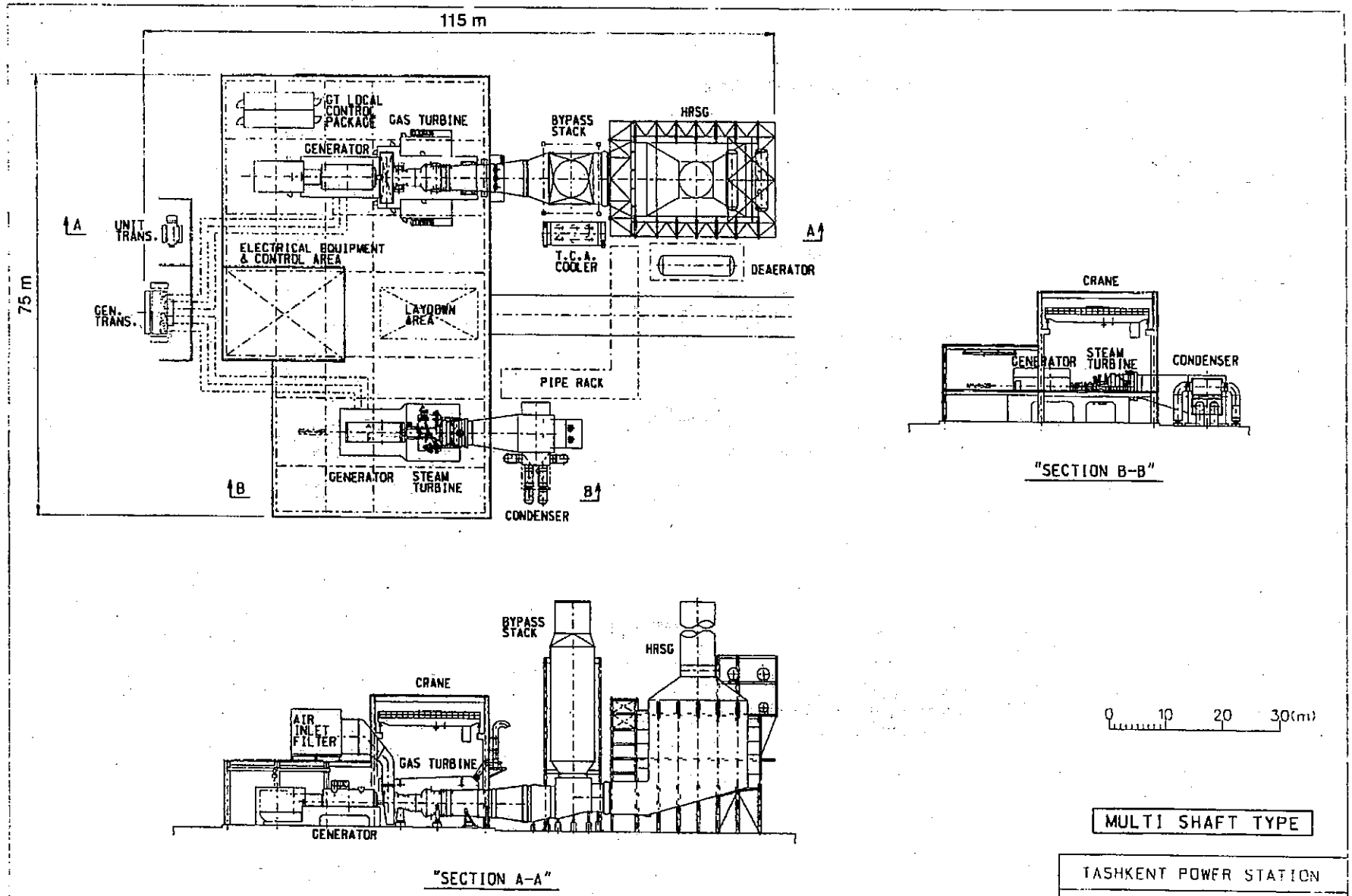


Figure 2 Typical Layout of Multi-Shaft Combined Cycle Power Plant

Table 1 Single-shaft Combined Cycle Power Plant (above 100MW) Experience

Model	Plant Name	Country	Operation Year	Unit Capacity	No. of Unit
ABB					
KA26	Staythorpe	UK	2003	400	4
KA24	Monterrey	Mexico	2003	250	4
KA26	San Roque	Spain	2002	400	2
KA26	B sos	Spain	2002	400	2
KA26	Bowin	Thailand	2002	350	2
KA26	Chiba	Japan	2002	400	1
KA26	Swanbank	Austraria	2002	380	1
KA26	Bang Bo	Thailand	2002	350	1
KA26	Castejan	Spain	2002	380	1
KA24	Termobahia	Brazil	2002	185	1
KA24	Termorio	Brazil	2002	185	1
KA24	Hermosillo	Mexico	2001	253	1
KA24	Milford	USA	2001	265	2
KA24	Bellingham	USA	2001	265	2
KA26	Enfield	UK	1999	396	1
KA24	Agawan	USA	1999	271	1
KA11N2	Dighton	USA	1999	168	1
KA26	Taranaki	NZ	1998	360	1
KA26	RDK-4S	Germany	1998	360	1
KA13E2	AP11GCC	Italy	1998	275	1
KA11N2	Bao Shan	China	1997	150	1
KA13E2	Meishi II	China	1996	237	1
KA13E2	Diemen 33	NZ	1995	160	1
KA11N	West Winsor	Canada	1995	120	1
KA13E2	Lage Weide 6	NZ	1994	248	1
KA13D	Deep	Dubai	1993	135	1
KA11N	Orland	USA	1993	120	1
KA13E	Roosecote	UK	1991	224	1
KA11	Hazleton	USA	1989	135	1
KA13E	MK 12	NZ	1989	225	1
KA13E	Hemweg	NZ	1988	200	1
KA13D	Korneuburg	Austria	1980	128	1
TOTAL					*43*
GE					
STAG 109 FA	Shinagawa	Japan	2001-2003	380	3
STAG 109 FA	Chiba	Japan	1998	360	4
STAG 109 FA	Akzo	NZ	1998	360	1

Model	Plant Name	Country	Operation Year	Unit Capacity	No. of Unit
GE					
STAG 106FA	Baffolora	Italy	1998	110	1
STAG 107FA	Kawagoe	Japan	1998	235	7
STAG 109 FA	Yokohama	Japan	1997	350	8
STAG 107FA	Hermiston	USA	1996	213	2
STAG 107FA	Cogentrix	USA	1996	248	1
STAG 109FA	Gent	Belgium	1996	350	2
STAG 109FA	Black Point	China	1995	340	8
STAG 109FA	EPON	Netherland	1995	350	5
STAG 107F	Connah's Quey	UK	1995	350	4
STAG 107EA	Shin-Oita	Japan	1992	138	5
STAG 107F	Yanai	Japan	1990	125	6
STAG 107E	Yokkaichi	Japan	1988	112	5
STAG 109E	Futtsu	Japan	1986	165	14
TOTAL					***76***
MHI					
MPCP1(M701F)	Serervaya	Azerbaijan	2002	438	1
MPCP1(M701F)	Harripur	Bangladesh	2001	365	1
MPCP1(M701F)	Tuas II	Singapore	2001	360	2
MPCP1(M701F)	PPN	India	2001	348	1
MPCP1(M701F)	Saltend	UK	2000	400	3
MPCP1(M701F)	San Ishidro	Chile	1998	370	1
MPCP1(M701F)	Chiba	Japan	1999	360	4
MPCP1(M701D)	JR Kawasaki	Japan	1999	190	1
MPCP1(M501F)	Nanpu	Taiwan	2003	251	1
MPCP1(M501F)	Trans Alta	Mexico	2002	282	1
MPCP1(M501D)	Hunamachi	Japan	1999	149	1
MPCP1(M501F)	Shin-Ohita	Japan	1997	218	2
MPCP1(M501F)	Kawagoe	Japan	1997	243	7
MPCP1(M701D)	STEAG	Netherland	1997	145	1
MPCP1(M501F)	Shin-Ohita	Japan	1996	218	2
MPCP1(M501D)	Fukuyama	Japan	1996	145	1
MPCP1(M501D)	Mizushima	Japan	1995	145	2
MPCP1(M701D)	Kawasaki Steel	Japan	1988	145	1
TOTAL					***33***
Siemens					
GUD 1S. V94.3A	Campo de Gibraltar	Spain	2003	385	2
GUD 1S. V94.3A	Pulau Seray	Singapore	2002	370	2
GUD 1S. V84.3A	San Lorenzo	Philippines	2002	250	2

Model	Plant Name	Country	Operation Year	Unit Capacity	No. of Unit
Siemens					
GUD 1S. V94.3A	Donaustadt	Austria	2001	385	1
GUD 1S. V64.3A	San Pedro	Domonican	2001	100	3
GUD 1S. V64.3A	Rzeszow	Poland	2001	100	1
GUD 1S. V94.3A	Seabank 2	U.K	2000	385	1
GUD 1S. V64.3A	Terni	Italy	2000	100	1
GUD 1S. V94.3A	Cottam	UK	1999	380	1
GUD 1S. V84.3A	Santa Rita	Philippine	1999	260	4
GUD 1S. V94.3A	Otahuhu	NZ	1998	260	1
GUD 1S. V84.3A	St. Fransis	USA	1998	260	2
GUD 1S. V94.3A	Quteiro	Portugal	1996	260	3
GUD 1S. V94.3	King's Lynn	U.K	1996	340	1
GUD 1S. V94.2	Buggenum	Netherlands	1993	280	1
TOTAL					*26*

Table 2 3,000rpm Multi-Shaft Combined Cycle Power Plant Experience (1/3)

Model	Plant Name	Country	Operation Year	Configuration	Unit Capacity(MW)	No. of Unit	Type of Fuel
ABB							
KA26-1	RDK Karlsruhe	DE	1997	1 on 1	360	1	NG/DO
KA26-2	Rocksavage	UK	1997	2 on 1	720	1	NG
KA26-2	Dock Sud	AR	2000	2 on 1	775	1	NG/DO
KA26-2	Coryton	UK	2001	2 on 1	775	1	NG/DO
KA26-1	Senoko	SG	2001	1 on 1	400	1	NG/DO
Total						*5*	
GE							
S209FA	Keadby	UK	1995	2 on 1	780	2	NG
S209FA	Little Barford	UK	1996	2 on 1	780	2	NG
S209FA	AES Medway	UK	1996	2 on 1	780	2	NG
S209FA	South Bangkok II	TH	1997	2 on 1	780	2	NG/DO
S109FA	Gent-Ringvaart	BE	1998	1 on 1	390	1	NG
S109FA	Nueva Renca	CL	1998	1 on 1	390	1	NG/DO
S109FA	Saint-Ghislain	BE	1999	1 on 1	390	1	NG
S209FA	Dabhol Power	IN	1999	2 on 1	780	2	NG/DO
S209FA	Rachaburi	TH	2000	2 on 1	780	1	NG/DO
S209FA	Tri Energy	TH	2000	2 on 1	780	2	NG/DO
S209FA	Sutton Bridge	UK	2000	2 on 1	780	2	NG
S209FA	Rachaburi	TH	2000	2 on 1	780	4	NG/DO
S109FA	Pulau Sakra	SG	2000	1 on 1	390	1	NG/DO
S109FA	Esch-Sur-Alzette	LX	2001	1 on 1	390	1	NG/DO
S209FA	Dabhol Power	IN	2001	2 on 1	780	4	NG/DO
S209FA	Castellon	SP	2001	2 on 1	780	2	NG/DO
Total						*30*	

Table 2 3,000rpm Multi-Shaft Combined Cycle Power Plant Experience (2/3)

Model	Plant Name	Country	Operation Year	Configuration	Unit Capacity(MW)	No. of Unit	Type of Fuel
MHI							
MPCP2(M701F)	EGAT Wang Noi I	TH	1997	2 on 1	650	2	NG/DO
MPCP2(M701F)	EGAT Wang Noi II	TH	1998	2 on 1	720	1	NG/DO
MPCP1(M701F)	San Isidro	CL	1998	1 on 1	370	1	NG/DO
MPCP2(M701F)	TEAS Bursa	TK	1999	2 on 1	700	2	NG
MPCP2(M701F)	Costanera	AR	1999	2 on 1	830	1	NG/DO
MPCP3(M701F)	Phu My I	VN	2001	3 on 1	1,090	1	NG/DO
MPCP2(M701F)	AES Parana	AR	2001	2 on 1	740	1	NG/DO
MPCP1(M701F)	AES Haripur	BAN	2001	1 on 1	360	1	NG
MPCP1(M701F)	PPN	IN	2001	1 on 1	360	1	NG/Naphtha
MPCP2(M701F)	Damhead	UK	2001	2 on 1	790	1	NG
MPCP2(M701F)	Port Dickson	ML	2004	2 on 1	730	1	NG/DO
MPCP2(M701F)	Cairo North	EGY	2004	2 on 1	750	1	NG/DO
Total						*14*	
Siemens							
GDU 1. 94.3A	Lujan De Cuyo	AR	1998	1 on 1	380	1	NG/DO
GDU 1. 94.3A	Nehuenco	CH	1998	1 on 1	380	1	NG/DO
GDU 2. 94.3A	Didcot	UK	1998	2 on 1	760	1	NG
GUD 2. 94.3A	Genelba	AR	1999	2 on 1	760	1	NG/DO
GUD 3. 94.3A	Al Taweelah	UAE	2000	3 on 1	1,155	2	NG/DO
GUD 3. 94.3A	Peterhead	UK	2000	3 on 1	1,155	1	NG
GUD 2. 94.3A	Seabank	UK	2000	2 on 1	770	1	NG
GUD 2. 94.3A	Salta	AR	2000	2 on 1	770	1	NG/DO
GUD 3. 94.3A	Al Taweelah	UAE	2001	3 on 1	1,155	2	NG/DO
GDU 1. 94.3A	Porto Marghera	IT	2001	1 on 1	385	1	NG
GDU 1. 94.3A	Verbrande Brug	BE	2001	1 on 1	385	1	NG
GDU 1. 94.3A	–	GR	2001	1 on 1	385	1	NG
GUD 3. 94.3A	Jebel Alik	UAE	2002	3 on 1	1155	2	NG/DO

Table 2 3,000rpm Multi-Shaft Combined Cycle Power Plant Experience (3/3)

Model	Plant Name	Country	Operation Year	Configuration	Unit Capacity(MW)	No. of Unit	Type of Fuel
GUD 1. 94.3A	La Casella	IT	2002	1 on 1	385	5	NG
GUD 1. 94.3A	Hunstown PWR Stat	IR	2002	1 on 1	385	1	NG
GUD 2. 94.3A	Teluk Gong	ML	2002	2 on 1	770	1	NG/DO
GUD 2. 94.3A	Phu My 3	VN	2003	2 on 1	770	1	NG/DO
GUD 2. 94.3A	Knapsack	GR	2004	2 on 1	770	1	NG
GUD 2. 94.3A	Rijnmond	NL	2004	2 on 1	770	1	NG
Total						***26***	

Table 3 Consuruction Cost Comparison

Name of Components	Single-Shaft Combined Cycle Power Plant			Multi-Shaft Combined Cycle Power Plant		
	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
Gas Turbine & Accessaries	41,625	3,963	45,588	51,725	4,925	56,650
Generator & Accessories-Gas Turbine Steam Turbine & Accessaries Generator & Accessories-Steam Turbine	28,776	2,986	31,762	21,805	2,263	24,068
Electrical Systems-Gas Turbine/Generator	1,250	234	1,484	4,322	716	5,038
Electrical Systems-Steam Turbine Generator	5,945	1,189	7,134	3,389	678	4,067
High Voltage Switchyard	2,273	682	2,955	2,386	716	3,102
HRSG & Accessories	18,805	4,870	23,675	18,805	4,870	23,675
Condenser & Accessories	3,421	416	3,837	3,421	416	3,837
Circulating Water System	2,060	1,488	3,548	2,060	1,488	3,548
Water Treatment System	836	621	1,457	836	621	1,457
Waste Water Treatment System	191	94	285	191	94	285
Closed Cooling Water System	527	210	737	527	210	737
Buildings	13,222	8,101	21,323	13,222	8,101	21,323
Fire Protection Ststem	778	500	1,278	778	500	1,278
Fuel Gas Pre-treatment & Compressor Stn.	7,080	2,994	10,074	7,080	2,994	10,074
Bypass Stack & Diverter Damper	0	0	0	2,069	650	2,719
Station & Instrument Air System	510	119	629	510	119	629
Plant Contor and Monitoring System	2,186	296	2,482	2,186	296	2,482
Continuous Emission Monitoring System	503	319	822	503	319	822
Sub-Total	129,988	29,082	159,070	135,815	29,976	165,791
Training of Client's Staff at Factory	153	0	153	153	0	153
Supervisory by Engineers for One (1) Year	878	0	878	878	0	878
Transportation to Site	10,399	0	10,399	10,865	0	10,865
Spare Parts	12,999	0	12,999	13,582	0	13,582
Sub-Total	154,417	29,082	183,499	161,293	29,976	191,269
Price Escalation(3.5%)	5,513	1,038	6,551	5,758	1,070	6,828
Sub-Total	159,930	30,120	190,050	167,051	31,046	198,097
Physical Contingency(8%)	12,794	2,410	15,204	13,364	2,484	15,848
Consulting Service including P/S(3%) & P/C(5%)	4,700	700	5,400	4,700	700	5,400
Grand Total	177,424	33,230	210,654	185,115	34,230	219,345

Unit: 1,000 US$ (132.66JPY/US$)

State Joint Stock Company "Uzbekenergo"

Tashkent Thermal Power Plant Modernization Project

Basic Technical Specifications and Data for Preparation of Tender Documents of 370MW Combined Cycle Power Plant

Documents No. TMP-0006 R1

November 27, 2002

Japan International Cooperation Agency
Tokyo Electric Power Services Co., Ltd.

Foreword

This is to inquire basic technical specifications and data necessary for preparation of Tender Documents for international competitive bidding for Engineering, Procurement and Construction of nominal capacity 370MW Combined Cycle Power Plant. The Plant will be installed in the premise of Tashkent Thermal Power Plant.

Some basic technical specifications and data are already given by the Study Team based on the information which was given at the Feasibility Study Stage, the relevant JICA /JBIC reports and TEPSCO's experience. They will be discussed and finalized with Uzbekenergo during the First On-site Study. The remaining specifications and data will be provided with Uzbekenergo by the beginning stage of the Second On-site Study where the preparation works of the Tender Documents will start.

We would like to solicit for your cooperative support for decision of such basic technical specifications as described in the attached sheets and for our acquisition of the data enquired in the sheets.

Table of Contents

Basic Technical Specifications and Data to be provided and/or clarified by Uzbekenergo

Discription	Specifications and Data
1. Tender Requirements	
(1) Conditions for requirements	
a. Ambient temperature	16 ℃
b. Barometric pressure	96 kPa
c. Alutitude	500 m
d. Relative humidity	52%
e. Cooling water temperature	12 ℃
f. Type of fuel	Bukhara gas (March to Oct.) Shurtan gas (Nov. to Feb.)
g. Supply pressure of natural gas at terminal point	Normal 7.84 bar (g) Mimimum 6.0 bar(g)
h. Supply temperature of natural gas at terminal	14 ℃
I. Type of gas turbine	Single-shaft simple open cycle heavy duty industrial type gas turbine with a firing temperature of 1,350℃class
j. Type of shaft configuration of combined cycle plant	Multi-shaft configuration with one(1) gas turbine
(2) Requirements	
a. Net plant power output	350 MW ~ 380 MW
b. Net plant heat rate at full load on a basis of LHV of natural gas	Max. _____ kJ/kWh
2. Design Conditions and/or Basic Technical Specifications	
(1) Ambient conditions	
a. Temperature range	-15.6 to +41.1℃
b. Design temperature	16 ℃
c. Relative humidity	9 to 73 %
d. Cooling water temperature range	3 to 16 ℃
e. Design cooling water temperature	12 ℃

Discription	Specifications and Data
(2) Service life on ISO 3977 Part 3	25 years
(3) Anticipated operation load range	50 to 100 % load
(4) Anticipated averaged load factor	91.2 % per annum
(5) Minimum controllable load	30%
(6) Anticipated annual operating hours. Total a. At full load	 8000 hours 7980 hours
b. At 50 % load	0 hours
c. At 30 % load	20 hours
(7) Anticipated No. of start-up times per annum	
a. Cold start after stop for more than 36 hours	2 times
b. Warm start after stop for less than 36 hours	times
c. Hot start after stop more than 8 hours	1 times
d. Very hot start after stop for less than 1hour	times
(8) Time required for start-up to full load after pushing start-up button	
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
(9) Plant layout	Consideration of future extension of same size combined cycle power plant
(10) Equipment layout	
a. Gas and steam turbine generators	Installed inside the building with a ventilation system, a lifting crane and laydown space
b. Arrangement of gas and steam turbine generators	Parallel arrangement
c. Control and electrical equipment	Installed in the rooms integrated into the building
d. Natural gas pre-treatment/compressor station	Installed nearby the building

Discription	Specifications and Data
e. New switchyard	Installed adjacent to existing one
f. Cooling water intake	Installed at the end of artificial intake pond
(11) Plant operation	
a. Type of operation	CRT(touch-screen type) operation in the
b. Function of existing control room	Displaying operating conditions with minimum operating parameters
c. Type of shift	3 shifts by 4 regular and 1 training
(12) Operation on oil fuel	**No**
(13) Speed and load control	
a. Automatic frequency control	**yes**
b. Constant load control	**yes**
c. Droop (governor free) operation	**yes**
d. Load limit control	**yes**
d. Overspeed trip device	Equipped with both mechanical and electrical type devices
(14) Gas turbine control	
a. Surge limit control	**yes**
b. Temperature control	**yes**
c. Acceleration speed control	**yes**
d. Inlet guide vane control	**yes**
(15) Frequency variation under which load operation is allowed	50 +/- 1.5 Hz
(16) Full load shedding capability without trip	**yes**
(17) Operating pressure control	Sliding pressure above 60% load Constant pressure below 60% load
(18) Airborne emissions on dry condition (75 - 100% load of gas turbine over all ambient conditions)	
a. NOx	< 25ppmv(dry)

Discription	Specifications and Data
b. SOx	Depends on sulphur contents in natural gas **yes**
b. CO	**yes** < 15ppmv(dry)
c. Particulate	**yes** < 5mg/Nm^3(dry)
(19) Noise emissions on steady state conditions	to be discussed with TEP
a. On power station boundary limit(without background noise)	__dB(A)
b. At a distance of 1m from equipment or enclosure	_dB(A)
(20) Cooling water temperature increase across the condenser	not more than 5℃
(21) Waste efluent water	World bank guide line or Uzbekistan regulation. , whichever is severer.
(22) Black-out start capability	**no**
(23) Type of starting device of gas turbine	The following both types are available: a. A synchronous generator/motor with a thyristor frequency converter b. A squirrel cage motor with a torque converter
(24) Type of steam turbine exhaust direction	Depends on choice of manufacturers
(25) Gas turbine compressor cleaning device	**yes**
(26) Type of heat recovery steam generator	Both types of exhaust gas vertical flow type and lateral flow type are available.
(27) Connection of auxiliary steam line with existing medium pressure steam line(header)	**yes**
Steam condition:	1.0 MPa (gauge) x 270 ℃
(28) Type of cooling method of generator	To be discussed.
(29) Type of bottoming cycle	To be discussed.
(30) Type of 220kV switchyard	Open air type
Opearting voltage	220 kV
Maximum design voltage	_____kV
BIL withstand voltage	_____kV
Low frequency withstand voltage	_____kV
Required minimum clearances:	
Metal- Metal: Phase- Phase	_____mm
Phase-Ground	_____mm
Bus design clearances	
Phase spacing (centerline to centerline)	

Discription	Specifications and Data
Main bus Branch bus Phase height above ground: Main bus Branch bus	_____mm _____mm _____mm _____mm
(31) Bypass exhaust stack for simple cycle operation	**yes**
(32) Exhaust stack height above the ground level	__m (to be determined based on EIA results)
(33) Shaft strength of gas and steam turbines	Shall be designed to withstand the transient torque due to short circuit or out-of-phase synchronization, whichever is greater.
(34) Spare parts	For five (5) years operation
(35) Trainning period of 10 staff at EPC contractor's works	Four (4) weeks
(36) Three(3) resident engineers (mechanical, electrical and control) of EPC contractor during defect liability period	**yes**
(37) 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. 32,000 hours
(38) Ambient air and cooring water temperatures to define the maximum capability of combined cycle power plant	Ambient air temperature 3 ℃ Cooling water temperature 3 ℃
(39) Make-up water treatment equipment	**New ~~or common use of existing one~~**
(40) Waste water treatment equipment	**New ~~or common use of existing one~~**
(41) Continouos airborne emission monitoring system	**yes**
(42) Cooling water discharge channel	~~New or~~ partial reuse of existing concrete culvert for a cooling tower
3. Guarantee Requirements	
(1) Guarantee Conditions	
a. Ambient temperature	16 ℃
b. Barometric pressure	96 kPa
c. Altitude	500 m

Discription	Specifications and Data
d. Relative humidity	52%
e. Cooling water temperature	12 °C
f. Type of fuel	Bukhara gas and Shurtan gas
g. Supply pressure of natural gas	7.84 bar
h. Supply temperature of natural gas	14 °C
i. Blowdown and make-up	0%
j. Power factor, voltage and frequency at generator terminals	Equal to specified values
k.Gas turbine inlet temperature at full load	Equal to specified value
(2) Guaranteed Items	
a. Power output	
a) Gas turbine gross power output	yes
b) Plant net power output	yes
b. Heat rate	
a) Plant net heat rate at full load	yes
b) Plant net heat rate at 75 % load	yes
c) Plant net heat rate at 50 % load	yes
c. Airborne emissions(75 - 100 % load) on dry conditions	
a) NOx	yes
b) SOx	yes
c) CO	yes
e) Particulate	yes
d. Noise emissions	
a) Noise level on the station boundary limit on full load steady state conditions	yes
b) Noise level at a distance of 1m from equipment on full load steady state conditions	yes

Discription	Specifications and Data
e. Two (2) weeks reliability run	yes
4. Technical information and/or data to be provided by Uzbekenergo	
(1) Meteorological data at site area or in the premise of Tashkent Thermal Power Plant	Item 1 in the attached sheets to be filled
(2) Water conditions for raw water for make-up and cooling water	Item 2 in the attached sheets to be filled
(3) Fuel specification	Item 3 in the attached sheets to be filled
(4) Voltage rating for the new power plant	Item 4 in the attached sheets to be filled
(5) Environment protection regulations	Item 5 in the attached sheets to be filled
(6) Data for financial and economical analysis	Item 6 in the attached sheets to be filled
(7) Drawings to show the shapes of site area with dimensions and the site boundaries	To be provided by Uzbekenergo
(8) Drawings to show the terminal points of natural gas	To be provided by Uzbekenergo
(9) Single line diagram of existing 220kV switchyard	To be provided by Uzbekenergo
(10) Drawings to show the steel structure frameworks of 220kV switchyard	To be provided by Uzbekenergo
(11) Drawings to show the cross section of artificial cooling water intake pond around the condidate cooling water intake point for new	To be provided by Uzbekenergo
(12) List of services to be provided free of charge by Uzbekenergo including electric load, fuel, make-up water, potable water during commissioning.	To be provided by Uzbekenergo
(13) List of items to be monitored at the inlet to the exhaust gas stack	To be provided by Uzbekenergo

Discription	Data and/or Information to be provided by Uzbekenergo

1. Meteorological Data

i. Monthly ambient temperature (°C)

	Min.	Mean	Max.
January	−15.6	−0.3	16.6
February	−8.4	−5.3	19.8
March	−2.8	11.9	28.6
April	3.3	17.2	31.5
May	12.2	24.9	38.3
June	11.4	28.2	41.1
July	14.9	27.2	38.8
August	14.4	25.8	38.1
September	2.8	19.7	36.4
October	−1.3	12.8	31.5
November	0.2	10.6	26.4
December	−8.5	4.7	20.5

ii. Monthly Relative Humidity (%)

	Min.	Mean	Max.
January	16	73	—
February	22	66	—
March	11	55	—
April	11	53	—
May	12	40	—
June	10	30	—
July	9	34	—
August	10	39	—
September	12	39	—
October	12	62	—
November	17	68	—
December	18	69	—

iii. Rainfall

Annual averaged 423 mm/year

Hourly maximum — mm/y

Rainy season From Oct to May

Averaged total rainfall in the rainy season 18.3 mm

iv. Snowfall

Maximum 130 mm

Discription	Data and/or Information to be provided by Uzbekenergo

Snowfall days 15

v. Wind data

Maximum speed 4－5 m/s with the recurrence of 2.7%. The usual wind speed is 1m/s with the recurrence of 73.8%

Averaged speed 1.4 m/s

Prevailing direction. The following winds are prevailed:

ENE, E, ESE – 35.7%;

West winds: W, WNW, NW – 25.1 %

From_____to_____in_____season

From_____to_____in_____season

From_____to_____in_____season

vi. Isokeraunic level IKL _____

2. Water Conditions

(1) Raw water for make-up water

i. Source of water

☐ River water ☐ Sea water

☐ Industrial water ☐ Tap water

☒ Canal freshwater

ii. Supply conditions

Available flow rate Max. 230 m^3/h

Temperature Min. 11 ℃

Mean 19.5 ℃

Max. 28 ℃

Pressure 0 Bar(g)

Location of terminal At the end of intake canal

iii. Analysis data

(Fill in Table 1 "Analysis Data of Raw Water")

(2) Cooling Water

i. Type of cooling water

☒ Once-through type ☐ Re-circulation use type

☐ No use type

ii. Source of water

☐ River water ☐ Sea water

Discription	Data and/or Information to be provided by Uzbekenergo

☐ Industrial water ☐ Well water

☒ Canal freshwater

iii. Supply conditions

Available flow rate Max. 44,000 m^3/h

Temperature Min. 3 ℃

Mean 9.5 ℃

Max. 16 ℃

Pressure 0 Bar(g)

Location of terminal

Intake At the end of intake canal

Discharge At the end of existing concrete culvert

iv. Restriction on usage of the water source

Restriction **Yes**

Maximum temperature rise 5 ℃

Maximum discharge temperature. Should not raise more than 5℃.

℃

v. Level of river water at the relevant canal

Elevation of datum level	501.00 m
Normal water level	497.10 m
High water level	498.00 m
Low water level	496.75 m

vi. Analysis data of cooling water

(Fill in Table 2 "Analysis Data of Cooling Water")

3. Fuel

(1) Shurtan Gas

i. Type of gas

☒ Sour natural gas ☐ Sweetened natural gas

☐ Liquified natural gas ☐ Blast furnace gas

☐ Coke oven gas ☐ others

ii. Supply source

Name of supply authority Uztransgaz

iii. Supply conditions at the terminal point

Distance from the new power plant to the terminal point

Discription	Data and/or Information to be provided by Uzbekenergo

_____m

Maximum available supply flow rate for the new power plant except for winter season 75,000 N m^3/d

Temperature

Max. 26 ℃

Min. 2 ℃

Pressure

Max. 0.98 MPa

Nor. 0.78 Mpa

Min. 0.60 Mpa

Max. step change 0.2 MPa

Max. ramp change 0.7 kPa/sec.

Solids

Total _____mg/N m^3

Size range ≧10 μ _____%

≧5 μ _____%

≧1 μ _____%

<1 μ _____%

Dew point _____℃

iv. Compositions (mole %, dry)

	Average	Min.	Max.
CO_2	2.35	2.11	2.66
N_2	0.73	0.61	0.92
O_2	-	-	-
CH_4	91.79	91.23	92.03
C_2H_6	3.89	3.53	4.15
C3H8	0.92	0.76	1.05
i-C_4H_{10}	0.12	0.08	0.19
n-C_4H_{10}	0.13	0.06	0.18
C_5H_{10} + Heavier	-	-	-
H_2S	0.07	0.06	0.09
Total	100.00		
Mercaptan S (gram/m^3)	0.024	0.020	0.029
Density (kg/Nm^3)	0.790		

Discription	Data and/or Information to be provided by Uzbekenergo

Lower cal. value (MJ/ Nm^3) 36.53
Higher cal. value (MJ/ Nm^3) 40.53
Design maximum of H_2S (vol. %) 0.12

(2) Bukhara gas

i. Type of gas

☐ Sour natural gas ☒ Sweetened natural gas
☐ Liquified natural gas ☐ Blast furnace gas
☐ Coke oven gas ☐ others

ii. Supply source

Name of supply authority Uztransgaz

iii. Supply conditions at the terminal point

Distance from the new power plant to the terminal point
_____m

Maximum available supply flow rate for the new power plant 75,000 N m^3/d

Temperature

Max. Ambient ℃
Min. Ambient ℃

Pressure

Max. 0.98 MPa
Nor. 0.78 Mpa
Min. 0.60 Mpa
Max. step change 0.2 MPa
Max. ramp change 0.7 kPa/sec.

Solids

Total _____mg/N m^3
Size range ≧10 μ _____%
≧5 μ _____%
≧1 μ _____%
<1 μ _____%

Dew point _____℃

iv. Compositions (mole %, dry)

Discription	Data and/or Information to be provided by Uzbekenergo

	Average	Min.	Max.
CO_2	1.44	1.18	1.75
N_2	0.45	0.30	0.66
O_2	-	-	-
CH_4	93.12	92.37	93.56
C_2H_6	3.76	3.53	4.02
C3H8	0.99	0.84	1.07
i-C_4H_{10}	0.10	0.07	0.13
n-C_4H_{10}	0.15	0.10	0.27
C_5H_{10} + Heavier	-	-	-
Total	100.00		
H_2S (gram/ m^3)	0.009	0.003	0.014
Mercaptan S (gram/m^3)	0.010	0.005	0.020

Density (kg/Nm^3)	0.777
Lower cal. value (MJ/ Nm^3)	36.97
Higher cal. value (MJ/ Nm^3)	40.92
Design maximum of H_2S (gram/ m^3)	0.02

4. Voltage Rating

i. Voltage rating of power, lighting, instrument and control

Generator	AC 18 kV
Auxiliary power	
150 kW≦P	AC 6,300 V
1 kW≦P≦ 150 kW	AC 400 V
P≦ 1 kW	AC 230 V
Lighting	AC 230 V
Instrument	AC 230 V
Control power	AC 230 V
Control signal	DC 230 V

5. Environment Preservation

i. If the restrictions on the following items are applied for construction of the new power plant by any laws and/or regulations of your country, provide their registered numbers and their complete copies.

			Registered Number
Sulfur oxides	☒ Yes	☐ No	
Nitrogen oxides	☒ Yes	☐ No	
Particulates	☒ Yes	☐ No	

Discription	Data and/or Information to be provided by Uzbekenergo

Smoke(Color)	☐ Yes	☒ No	_____
Noise	☒ Yes	☐ No	_____
Ground vibration	☐ Yes	☐ No	_____
Waste water	☐ Yes	☒ No	_____
Thermal effluent	☒ Yes	☐ No	_____
Disposal waste	☒ Yes	☐ No	_____

1. The list of limited contaminant loads permissible in the atmosphere of populated places of the Republic of Uzbekistan. СанПИН № 0015-94 (Sanitarian rates, rules and hygienic regulations of the Republic of Uzbekistan, 1994).

2. КМК 2.01.08-96 "Noise protection" (State Architecture and Building Committee of the Republic of Uzbekistan, Tashkent, 1999).

   (House Building Regulations).

3. ГОСТ 12.1.003-86. The system of labor safety standards. Noise. General safety requirements (regulations, noise at the work places).

4. КМК 2.07.01-94 (Item-12.39). Grading and building of urban and countryside settlements. Allowed vibration levels.

5. Sanitarian rules and surface water protection regulations. СанПИН № 0056-96, Tashkent, 1996

6. РД 118.0027714.31-94. The order of carrying out the state ecology control at the toxic and industrial waste placements of the enterprises of the Republic of Uzbekistan, Tashkent, 1994.

7. РД 118.0027714.62-97. Waste products handling and demand. Methodical instructions on determining the limits of disposal waste products, Tashkent, 1997.

8. РД 118.0027714.31-94. Waste products handling and demand. Instruction. Engineering and the order of carrying out of waste products inventorying and using on the enterprises.

6. Data for Financial and Economical Analysis

   i. Project life 25 years

Discription	Data and/or Information to be provided by Uzbekenergo

ii. Project cost estimation time As of March, 2002

iii. Currency exchange rate

US$ 1.00 = 132.66 Japanese Yen

_____ = _____ Japanese Yen

iv. Custom duties and taxes 0 % of CIF cost

v. Insurance premium rate _____ % of project cost

vi Annual interest rate during construction

1.8 % for off-shore portion

1.8 % for on-shore portion

vii. Annual escalation rate

1.1 % for off-shore portion

1.1 % for on-shore portion

viii. Terms and conditions of long term loan

Fund source JBIC

Payback period

Construction works 30 years

Consulting services 40 years

Grace period

Construction works 10 years

Consulting services 10 years

Annual interest rate

Construction works 1.8 %

Consulting services 1.8 %

ix. Contingency

Construction works 8 %

Consulting services 5 %

x. Terms and conditions of short term loan (if any)

Fund source _____

Payback period _____ years

Grace period _____ years

Annual interest rate _____ %

xi. Type and period of depreciation of investment cost

Type Straight line

Period 25 years

Discription	Data and/or Information to be provided by Uzbekenergo
	xii. Scrap value of plant after depreciation Value _____US$ or __0__% of total investment cost
	xiii. Power energy sales price at the terminals of power generation _____US cents/kWh or _____Soum/kWh
	xiv. Natural gas cost _____US cents/MJ or Nm^3

Discription	Data and/or Information to be provided by Uzbekenergo

Table 1 Analysis Data of Raw Water

Source of Water : Boz-Su Canal Freshwater

Limit		Min	Max
Temperature	℃	11℃	28℃
pH	℃	7.95	8.2
Conductivity	Micro S/cm	155	245
Turbidity	degree	0	40
Suspended Solid	mg/l	5	348
Total Hardness	mg/l as $CaCO_3$	36.47	52.71
Ca Hardness	mg/l as $CaCO_3$	28.06	43.69
Mg Hardness	mg/l as $CaCO_3$	8.02	14.03
Sulphate	mg/l as SO_4^{2-}	14	22
Nitrate	mg/l as NO_3^-	0.14	2
Iron Ion	mg/l as Fe	0.012	0.47
Chlorine Ion	mg/l as Cl^-	0.5	1.2
Silica	mg/l as SiO_2	5.5	7.5
COD (KMnO4)	mg/l as O	0.4	1.62
Bicarbonate	mg/l as HCO_3		
Total Dissolved Solid	mg/l as HCO_3	118	170
Potassium	mg/l as K^+		
Sodium	mg/l as Na^+	0.36	4.14

Discription	Data and/or Information to be provided by Uzbekenergo

Table 2 Analysis Data of Cooling Water

Source of Water : Boz-Su Canal Freshwater

Limit		Min	Max
Temperature	℃	3℃	16℃
pH	℃	7.95	8.,2
Dissolved Oxygen	Ppm		
Chlorine Ion	mg/l as Cl^-	0.5	1.2
Ratio of SO4/Cl			
Oxygen Demand		0.4	1.14
BOD	Ppm		
COD	Ppm		
Conductivity	Micro S/cm	155	245
Turbidity	Degree		
Suspended Solid	mg/l	5	348

Japan International Cooperation Agency (JICA)

State Joint Stock Company "Uzbekenergo''

The Study Result of Generator Cooling Method

of

370 MW Combined Cycle Power Plant

Document No. TMP-0021E

November,2002

Tokyo Electric Power Services Co.,Ltd.

Selection of Generators Cooling System

In the previous feasibility studies,Uzbekenergo required to apply a water cooled system to both the stator and the rotor of generator. They explained that former Soviet Union era,they experienced serious explosion of hydrogen cooled generator and the guideline to apply water cooled generator has been stipulated.
According to the preceeding investigations by the JICA study team, the following facts about the water cooled technology of the generators have been recognized,

a) Electrosila in St. Petersburg is the only one manufacturer in the world who has a manufacturing experience of generator with both the water cooled stator and rotor.

b) Although some European manufacturers declare to have the capabilities to manufacture water cooled generators in their brochures, they have no supply record.

c) Most of generator manufacturers can supply water cooled generators of larger capacity ,however,the water cooled technology is applied to only stator with larger capacity ,not to any capacity rotor or to the similar capacity stator.

As an alternative to the full water cooled generator without risk of hydrogen explosion,the air cooled type generator is also considered. The multi-shaft arrangement for this combined cycle power plant being selected,the capacities of the generator are approximately 250 MW (300 MVA) for the gas turbine unit and 125 MW(150 MVA) for the steam turbine unit respectively. And in this case, Alstom Power in Switzerland is the only one eligible manufacturer in the world for the pre-qualification for the Tender, having manufacturing experience of at least three (3) units of 250 MW range air cooled generators..(Refer to "Operating Experience of Air Cooled Generators" attached)

Since the manufacturers capable of supplying full water cooled or air cooled generators of the specified rating are very limited,it is difficult to specify the water cooled or air cooled generators for the Plant by reason that the Tender

will be made through International Competitive Bidding using the finance of ODA.

It should be noted that the hydrogen cooled generators have been used since late 1930's and a sufficient experience to justify their use has been accumulated.

From the above observations, it is recommended that the hydrogen cooled type generators could be specified for the International Competitive Bidding for the Plant.

Operating Experience of Air Cooled Generator

Mar 12. 2002
Rev.Jun 26. 2003

TOKYO ELECTRIC POWER SERVICE CO. ,LTD
Overseas Business Center

MELCO : MITSUBISI ELECTRIC
TSB : TOSHIBA
HTC : HITACHI
FUJI : FUJI ELECTRIC
ALS : ALSTOM
SIE : SIEMENS

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated-Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
MELCO (>150MVA)						
JAPAN	Tokyo Electric Power Co,Yokosuka	160	144		1992	
JAPAN	T plant	286	272		1996	
JAPAN	Koa Oil,Osaka	166	150		1997	
JAPAN	Endesa Sanisidro,Chile	162	138		1997	
Australia	AES.Mt.Stuart	172	155		1998	
JAPAN	Nakayama Electric Power Co.,Funamachi	166	150		1998	
JAPAN	Akemi,Power Co.	163	147		1999	
JAPAN	Nakayama Electric Power Co.,Nagoya	166	150		1999	
MEXICO	CEF, Mexico STG	178	160		1999	
MEXICO	CEF, Mexico STG	160	144		1999	
	CONOCO	171	146		2000	
JAPAN	Nippon Steel Co.,Muroran	161	145		2000	
DOMINICA	AES,DOMINICA GTG	219	197		2000	
ALABAMA	ALABAMA	212	191		2000	
MEXICO	TUXPAN GTG	189	170		2000	
MEXICO	TUXPAN STG	210	189		2000	
JAPAN	Osaka Gas Co.,LTD,Torishima	167	150		2001	
	Altamira STG	210	189		2001	
	Altamira GTG	190	171		2001	
	Rio Gen Power Plant GTG	204	173		2001	
USA	AES/Kentucky GREYSTONE GTG	219	197		2001	
	Mirant Co.Wyandotte C/C GTG	232	197		2001	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
	TENASKA C/C GTG	213	192		2002	
	PG&E C/C STG	173	147		2002	
TAIWAN	Chang-Bin/Fong-Der C/C GTG	188	160		2002	
JAPAN	Cosmo Oil Co.,LTD,Yokkaichi	248	223		2003	
	Koa Oil,Maribu	166	149		2004	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
TSB (>100MVA)						
PAKISTAN	COSTAL,SABA	170	136		1998	
JAPAN	Nippon Steel Co.,KAMAISI#1	166	149		1999	
CANADA	NOVA CHEMICAL,JOFFRE	157	133		1999	
SAUDI ARABIA	SWCC,AL KHOBAR3 #6	150	120		1995	
SAUDI ARABIA	SWCC,AL KHOBAR3 #7	150	120		1995	
SAUDI ARABIA	SWCC,AL KHOBAR3 #8	150	120		1996	
SAUDI ARABIA	SWCC,AL KHOBAR3 #9	150	120		1996	
JAPAN	Tokyo Electric Power Co,OI#1	142	128		1993	
MALAYSIA	NEB,PAKA#1	124	105		1986	
MALAYSIA	NEB,PAKA#2	124	105		1987	
MALAYSIA	NEB,PAKA#3	124	105		1987	
USA	FLUOR DANIEL,SALT CITY	107	91		1992	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
HTC (>200MVA)						
Japan	TOA-STG	217		3000	2002	
Korea	Hanwha-4	202		3600	2001	
Korea	Hanwha-3	202		3600	1999	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
FUJI (>100MVA)						
Indonesia	Amoseas Indonesia Inc.Darajat Ⅱ	101		3000	1997	
Indonesia	Mandara Nusantara Ltd.Wayang Windu#1	138		3000	1997	
Taiwan	Formosa Chemical and Fiber Corp. SK-14	174		3600	1998	
Japan	Taiheiyou Cement Itoigawa	166		3000	1998	
Japan	UBE Power Center	240		3600	1998	
India	Venkatesh Coke & Power Ltd.	138		3000	1999	
Bangladesh	AES Haripur Private Ltd.	165		3000	1999	
Taiwan	Formosa Chemical and Fiber Corp. LT72	203		3600	1999	
Taiwan	Chinese Petroleum Corp. #23	125		3600	1999	
Taiwan	Chinese Petroleum Corp. #24	125		3600	1999	
Bangladesh	AES Meghnaghat Ltd.	238		3000	2000	
Taiwan	Formosa Chemical and Fiber Corp. G-8	130		3600	2000	
Malaysia	TNB Gelugor Power Station	130		3000	2000	
Mexico	ENRON Vitro Alcali CCPP	127		3600	2000	
Canada	CALPINE Calgary Energy Center Project	158		3600	2001	
Brazil	Termonorte energia Ltda.	138		3600	2001	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
ALS (>100MVA)						
	Il Var Taranto	129	103		1994	
	Zahrani	185	148		1995	
	Poryong	200	180		1995/96	
	Vasilikos	173	138		1997	
	Hai Fu	208	177		1997	
	Ruwais	210	168		1998	
	Burgin Kentucky	208	177		1998	
	Kerman	200	160		1999	
	Jebel Ali	153	122		1999	
	Hassi Berkine	145	117		1999	
	Pelican Point	210	168		1999	
	Hay Road 8	206	185		2000	
	Birr test center	300	240		1994	
	Karlsruhe	300	240		1995	
	Rocksavage	300	255		1995	
	Beijing	235	200		1997	
	Agawam	280	238		1997	
	La Spezia	290	261		1997	
	Monterrey	280	252		1998	
	Ford/Rouge	280	238		1998	
	Island Cogen	280	238		1998	
	Midlothian	280	238		1998	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
	Coryton	300	255		1998	
	Puerto Rico	300	255		1999	
	Stock generators	280	238		1998/99	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
SIE (>250MVA)						
United Kingdom	Didcot B 51	291.5	233	3000	1996	
United Kingdom	Didcot B 52	291.5	233	3000	1996	
United Kingdom	Didcot B 61	291.5	233	3000	–	
United Kingdom	Didcot B 62	291.5	233	3000	–	
Argentinia	Costanera	257	219	3000	1995	
Argentinia	Generba STG	261	222	3000	–	
Chile	Nehuenco GT	273	232	3000	–	
Austria	KW Theiss 2000	260	221	3000	1999	
Argentinia	CTCC Salta STG 2	270	230	3000	–	
Malaysia	Panglima GTG 11	303	233	3000	–	
Malaysia	Panglima GTG 12	303	233	3000	–	
Ireland	Huntstown GTG	288	230	3000	2002	
Viet Nam	Phu My3-STG 10	292	263	3000	–	
Italy	Priolo Gargallo-Lot 8	288	259	3000	–	
Italy	Priolo Gargallo-Lot 10	288	259	3000	–	
Italy	Termini Lmerese-Lot 9	288	259	3000	–	
Italy	Termini Lmerese-Lot 11	288	259	3000	–	
Italy	ENEL Repowering	288	259	3000	–	
United Arab.Emirates	Shuweihat STG 10	299	254	3000	–	
United Arab.Emirates	Shuweihat STG 20	299	254	3000	–	
United Arab.Emirates	Shuweihat GTG 11	262	223	3000	–	
United Arab.Emirates	Shuweihat GTG 12	262	223	3000	–	

Operating Experience of Air Cooled Generator

Name of Country	Name of Project	Rated Capacity (MVA)	Rated Power Output (MW)	Rotating Speed (rpm)	Start-up Year	Operating Hours
United Arab.Emirates	Shuweihat GTG 21	262	223	3000	–	
United Arab.Emirates	Shuweihat GTG 22	262	223	3000	–	
United Arab.Emirates	Shuweihat GTG 23	262	223	3000	–	
Netherlands	Rijnmond GTG 11	316	265	3000	–	
Netherlands	Rijnmond GTG 12	316	265	3000	–	
Italy	Moncalieri GTG 11	280	252	3000	–	
Germany	Koln Niel Ⅱ GTG	327	262	3000	–	

State Joint Stock Company "Uzbekenergo"

Tashkent Thermal Power Plant Modernization Project

List of Tie-in Points for Utilities and Communications of 370MW Combined Cycle Power Plant

Document No. TMP-0030E

November 28, 2002

Japan International Cooperation Agency
Tokyo Electric Power Services Co., Ltd.

List of Tie-in Points of Utilities/Communications

No.	Item	No.	Description of Tie-in Point	Location	Temp. (℃)	Press. MPa(g)	Flow	Size	Shape	Material	Remarks
1	Natural gas (Shurtan)	1	offset pipe before existing pressure reducing station								
2	Natural gas (Bukhara)	1	offset pipe before existing pressure reducing station								
3	Circulating water intake	1	end part of existing canal								
4	Circulating water discharge	1	end of existing concrete culvert for cooling water discharge of No. 12								
5	Auxiliary steam	1	from existing auxiliary steam header pipe								
6	Hot water in	1									
7	Hot water out	1									
8	Buck-up steam for hot water from existing unit	1									
9	Drain return to existing unit	1									
10	Make-up water (raw water)	1	end part of existing canal								
11	Plant service water	1	from existing header pipe								
12	Drinking water	1	from existing header pipe								
13	Fire-fighting water	2	from existing ring pipe								
15	220 kV outgoing	1	to existing switchyard								
16	6.3 kV interconnection	1	from existing 6.3 kV circuit								
17	Telephone lines (refer to attached)	5	at junction box								
18	Paging lines (refer to attached)	16	at junction box								
19											
20											

State Joint Stock Company "Uzbekenergo"
The Republic of Uzbekistan

Selection of Optimum Cycle of Bottoming System
for
Tashkent Thermal Power Plant
Modernization Project

Document No. TMP-0032E

December 2002

Tokyo Electric Power Services Co., Ltd.

The combined cycle is a combination of "Topping System" (namely gas turbine with Brayton Cycle) and "Bottoming System" (namely boiler-steam turbine with Rankine Cycle). In general, the cycle of the topping system is unchangeable because a gas turbine is a standardized machine. However, the bottoming system is selectable in principal regardless of the gas turbine model, and the selection of bottoming system affects the performance and the cost of the Project.

In general, for the combined cycle with low exhaust gas temperature from the gas turbine, the bottoming system of two pressure/non reheat is selected, on the contrary, for the case that exhaust gas temperature of gas turbine is so high as the case of modern large capacity gas turbine, more complex system, i.e. three pressure/reheat system is usually applied.

In this report, four kinds of bottoming system, i.e. two pressure/non-reheat (2P-NR), two pressure /reheat (2P-R), triple-pressure/non-reheat (3P-NR) and triple-pressure/reheat (3P-R), will be compared in both technical and economic points of view.

1. Base Conditions of Comparison

1.1 Performance Conditions

The following standard site conditions are used:

Ambient temperature	15 ℃
Site elevation above sea	500 m
Atmospheric pressure	95.5 kPa
Cooling water temperature	12 ℃
Used fuel gas	Non-sulphur (Bukhara) gas
Heat supply	Non

1.2 Conditions for Economic Evaluation

Book lifetime	25 years
Interest rate of loan	5.0 % (1.8 % from JBIC)
Price of fuel gas	Variable
Escalation of gas price	2 % p.a.
Escalation of O&M cost	2 % p.a.
Discount rate	5 % p.a.
Exchange rate	1,000 Sum/$

The present gas price is 12,900 Sum/1,000 Nm^3 as of October 1, 2002. This price is extraordinarily low compared with the international marketing prices. Therefore, in this study, the gas price is treated as a variable.

2. Comparison Results

2.1 Comparison of Performance and Construction Cost

Table 1 shows a comparison of performances and construction costs of four bottoming systems. Each system has the same fuel gas consumption but the different power output each other. In comparison of the net plant outputs, the outputs of 2P-R and 3P-NR systems are almost same and by approximately 0.7 % higher than that of 2P-NR system. The output of 3P-R system is the highest and by approximately 1.7 % higher than 2P-NR system.

Table 1 Comparison of Performance and Construction Cost

Item	Unit	2P-Non Reheat	2P-Reheat	3P-Non Reheat	3P-Reheat
Performance Conditions:					
Ambient air temperature	°C		15		
Site elevation	m		500		
Fuel			Bukhara gas		
Heat supply			No		
HP steam pressure at HRSG	kPa abs	10,440	10,440	10,440	12,340
HP steam temperature at HRSG	°C	541	541	541	543
HP steam flow at HRSG	kg/s	88.56	74.49	88.7	69.27
Hot reheat steam pressure at HRSG	kPa abs		2,630		3,130
Hot reheat steam temperature at HRSG	°C		541		543
Hot reheat steam flow at HRSG	kg/s		74.49		84.95
IP steam pressure at HRSG	kPa abs			3,197	3,200
IP steam temperature at HRSG	°C			276	276
IP steam flow at HRSG	kg/s			10.44	15.68
LP steam pressure at HRSG	kPa abs	546	546	546	546
LP steam temperature at HRSG	°C	189	189	189	189
LP steam flow at HRSG	kg/s	17.87	22.63	7.06	9.80
GT gross output	kW	250,055	250,055	249,830	249,830
ST gross output	kW	121,679	123,924	124,680	127,959
Total gross output	kW	371,734	373,979	374,510	377,789
Auxiliary power	kW	10,641	10,362	10,711	10,575
Net power output	kW	361,093	363,617	363,799	367,214
Net plant heat rate (LHV)	kJ/kWh	6,606	6,560	6,556	6,496
Net plant efficiency	%	54.50	54.88	54.91	55.42
Capacity factor	%	90	90	90	90
Annual net power output	MWh	2,846,857	2,866,756	2,868,191	2,895,115
Lower calorific value of gas	MJ/Nm^3		36.97		
Fuel gas consumption	$1000Nm^3/year$	508,700	508,700	508,600	508,700
Total plant cost	10^6 US $	208.3	213.0	214.0	219.3
Unit cost per net output	US $/kW	576.9	585.8	588.2	597.2

Meanwhile, the rate of required cost for upgrading the system against the original cost is rather higher than the rate of power output increase. The 2P-R and 3P-NR systems require the additional costs of 2.3 % and 2.7 % respectively for attaining 0.7 % increase of power output. The 3P-R system requires the additional cost of 5.3 % for 1.7 % increase of power output. In principle, the decision of application of upgraded system depends on judgment whether these discrepancies between the rate of power output gains and the rate of required additional costs could be compensated by improving of thermal efficiency (or increasing of power output) of the systems.

2.2 Economic Evaluation of Systems

Each system is evaluated by the levelized generation costs calculated for the lifetime of 25 years with varying the fuel price.

Table 2 shows the levelized generation cost vs. fuel price for each bottoming system. Table 3 shows the calculation results of levelized generation costs for the case of natural gas price of 13,700 Sum/1,000 Nm^3.

Table 2

Levelized Generation Costs vs. Fuel Prices

(Levelized generation cost: $/MWh)

Fuel Price (Sum/1000 Nm^3)	13,700 (0.354 $/MMBTU)	60,000 (1.54 $/MMBTU)	120,000 (3.10 $/MMBTU)
2 Pressure-Non Reheat	10.37	21.46	34.53
2 Pressure-Reheat	11.42	21.44	34.42
3 Pressure-Non Reheat	11.45	21.46	34.43
3 Pressure-Reheat	11.48	21.40	34.26

Fuel price: as of 2005 year with escalation of 2 %

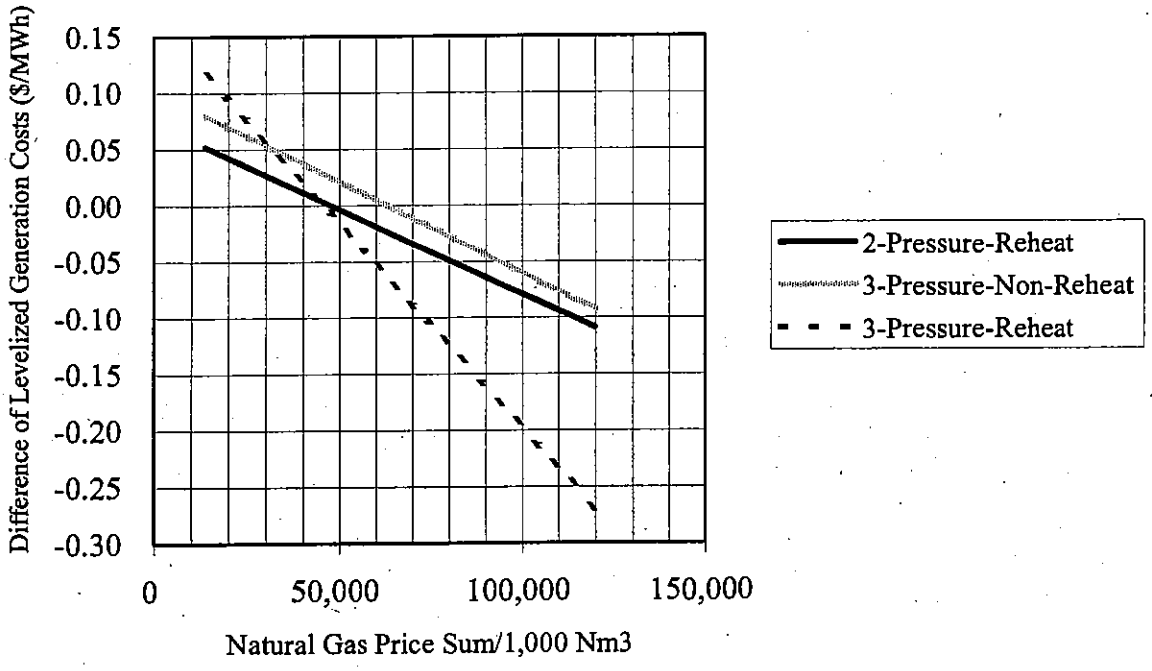
The fuel price of 13,700 Sum/1,000 Nm^3 is a calculated price from 2002 year's price (12,900 Sum/Nm^3) with escalation rate of 2 % p.a. The price of 60,000 Sum/1,000 Nm^3 is almost same as the price used in 400 MW Severnaya GTCC Project, Azerbaijan, in which the price of gas is 60 $/1,000 Nm^3 and 3-Prssure-Reheat system has been selected. The price of 120,000 Sum/1,000 Nm^3 is comparable to the international market prices of natural gases which are

approximately ranged between 2.5 ~ 3.5 $/MMBTU at user end. In this connection, the natural gas for the economical evaluation at the Feasibility Study was 1.16 $/MMBTU (45,000 Sum/$Nm^3$).

Fig. 1 shows the relation of the differences of the levelized generation costs vs. natural gas prices between 2P-NR and other three systems.

Fig. 1

Difference of Levelized Generation Costs vs. Natural Gas Price



At the present price of natural gas 2P-NR system shows the lowest generation cost, and 2nd lowest is 2P-R, 3rd lowest is 3P-NR and the highest is 3P-R system. However, in the range of the price higher than 60,000 Sum/Nm^3, all three systems, i.e. 2P-R, 2P-NR and 3P-R systems give lower generation costs than that of 2P-NR. Especially among of three systems 3P-R system shows the lowest generation cost in the price range over 50,000 Sum.

The difference of levelized generation cost between 3P-R and 2P-NR at the natural gas price of 120,000 Sum/1,000 Nm^3 is 0.27 $/MWh, and the difference between 3P-R and 2P-R/3P-NR is about 0.17 $/MWh. Those would results in annual cost saving of about 0.78 and 0.49 Million US $, respectively.

3. Conclusion and Recommendation

At the present price level of natural gas, most simple cycle, i.e. 2-Pressure-Non-Reheat system, has a benefit in both aspects of economy and operation/maintenance. However, the present price of natural gas is considered to be extraordinarily low in comparison of international market price level of natural gas. The republic of Uzbekistan is in transition from controled economy to open market and liberalization of economy. Therefore the price of natural gas would gradually go up and close to international market prices.

In above mentioned economic evaluation of candidate four systems, 3-Pressure-Reheat system shows the lowest levelized generation cost in the price range of natural gas higher than 50,000 Sum/Nm^3. The price of 50,000 Sum/Nm^3 is enough lower and approximately a half of the international market price of gas.

Therefore, the bottoming system of 3-Pressure-Reheat would be the most recommendable system in spite of somewhat more complexity in system and operation. 3-Pressure-Reheat system has already become the most popular system in the modern large-scale combined cycle power plant. So probable complexity of operation would be overcome by proper control system design. In addition, the highest thermal efficiency of 3-Pressure-Reheat would contribute to reduction of greenhouse gas emission.

Table 3 ECONOMIC EVALUATION ON BOTTOMING SYSTEM (Unit 1000$)

Year	Total	Total (Value at Year 1)	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
2 Pressure Non-Reheat																											
Total Investment Recovery	369,485	218,715	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779	14,779
Fixed O&M Cost	73,962	41,665	2,309	2,355	2,402	2,450	2,499	2,549	2,600	2,652	2,706	2,760	2,815	2,871	2,929	2,987	3,047	3,108	3,170	3,233	3,298	3,364	3,431	3,500	3,570	3,641	3,714
Valiable O&M Cost	164,690	92,774	5,142	5,245	5,349	5,456	5,566	5,677	5,790	5,906	6,024	6,145	6,268	6,393	6,521	6,651	6,784	6,920	7,058	7,200	7,344	7,490	7,640	7,793	7,949	8,108	8,270
Fuel Cost	223,225	125,748	6,969	7,109	7,251	7,396	7,544	7,695	7,848	8,005	8,166	8,329	8,495	8,665	8,839	9,015	9,196	9,380	9,567	9,759	9,954	10,153	10,356	10,563	10,774	10,990	11,210
Total Annual Operation Cost	831,363	478,901	29,199	29,488	29,782	30,082	30,388	30,700	31,019	31,343	31,675	32,013	32,357	32,709	33,067	33,433	33,806	34,187	34,575	34,971	35,375	35,787	36,207	36,635	37,072	37,518	37,973
Annual Power Generation (MWh)	71,171,430	42,129,620	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857	2,846,857
Annual Generation Cost ($/MWh)			10.26	10.36	10.46	10.57	10.67	10.78	10.90	11.01	11.13	11.24	11.37	11.49	11.62	11.74	11.87	12.01	12.14	12.28	12.43	12.57	12.72	12.87	13.02	13.18	13.34
Levelized Generation Cost ($/MWh)		11.37																									
2 Pressure Reheat																											
Total Investment Recovery	377,822	223,650	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113	15,113
Fixed O&M Cost	74,042	41,710	2,312	2,358	2,405	2,453	2,502	2,552	2,603	2,655	2,708	2,763	2,818	2,874	2,932	2,990	3,050	3,111	3,173	3,237	3,302	3,368	3,435	3,504	3,574	3,645	3,718
Valiable O&M Cost	165,685	93,334	5,173	5,276	5,382	5,489	5,599	5,711	5,825	5,942	6,061	6,182	6,306	6,432	6,560	6,692	6,825	6,962	7,101	7,243	7,388	7,536	7,686	7,840	7,997	8,157	8,320
Fuel Cost	223,225	125,748	6,969	7,109	7,251	7,396	7,544	7,695	7,848	8,005	8,166	8,329	8,495	8,665	8,839	9,015	9,196	9,380	9,567	9,759	9,954	10,153	10,356	10,563	10,774	10,990	11,210
Total Annual Operation Cost	840,775	484,441	29,566	29,856	30,150	30,451	30,758	31,071	31,390	31,716	32,048	32,386	32,732	33,084	33,444	33,810	34,184	34,566	34,955	35,351	35,756	36,169	36,590	37,020	37,458	37,905	38,361
Annual Power Generation (MWh)	71,668,911	42,424,101	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756	2,866,756
Annual Generation Cost ($/MWh)			10.31	10.41	10.52	10.62	10.73	10.84	10.95	11.06	11.18	11.30	11.42	11.54	11.67	11.79	11.92	12.06	12.19	12.33	12.47	12.62	12.76	12.91	13.07	13.22	13.38
Levelized Generation Cost ($/MWh)		11.42																									
3 Pressure Non-Reheat																											
Total Investment Recovery	379,596	224,700	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184	15,184
Fixed O&M Cost	74,047	41,712	2,312	2,358	2,405	2,453	2,502	2,552	2,603	2,655	2,709	2,763	2,818	2,874	2,932	2,991	3,050	3,111	3,174	3,237	3,302	3,368	3,435	3,504	3,574	3,645	3,718
Valiable O&M Cost	166,383	93,727	5,195	5,298	5,404	5,513	5,623	5,735	5,850	5,967	6,086	6,208	6,332	6,459	6,588	6,720	6,854	6,991	7,131	7,274	7,419	7,567	7,719	7,873	8,031	8,191	8,355
Fuel Cost	223,225	125,748	6,969	7,109	7,251	7,396	7,544	7,695	7,848	8,005	8,166	8,329	8,495	8,665	8,839	9,015	9,196	9,380	9,567	9,759	9,954	10,153	10,356	10,563	10,774	10,990	11,210
Total Annual Operation Cost	843,251	485,887	29,659	29,949	30,244	30,545	30,853	31,166	31,486	31,812	32,144	32,483	32,829	33,182	33,542	33,909	34,284	34,666	35,056	35,453	35,858	36,272	36,694	37,124	37,563	38,010	38,467
Annual Power Generation (MWh)	71,704,775	42,445,331	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191	2,868,191
Annual Generation Cost ($/MWh)			10.34	10.44	10.54	10.65	10.76	10.87	10.98	11.09	11.21	11.33	11.45	11.57	11.69	11.82	11.95	12.09	12.22	12.36	12.50	12.65	12.79	12.94	13.10	13.25	13.41
Levelized Generation Cost ($/MWh)		11.45																									
3 Pressure Reheat																											
Total Investment Recovery	388,997	230,265	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560	15,560
Fixed O&M Cost	74,056	41,717	2,312	2,358	2,405	2,454	2,503	2,553	2,604	2,656	2,709	2,763	2,818	2,875	2,932	2,991	3,051	3,112	3,174	3,237	3,302	3,368	3,436	3,504	3,574	3,646	3,719
Valiable O&M Cost	167,373	94,285	5,225	5,330	5,437	5,545	5,656	5,769	5,885	6,002	6,122	6,245	6,370	6,497	6,627	6,760	6,895	7,033	7,173	7,317	7,463	7,613	7,765	7,920	8,078	8,240	8,405
Fuel Cost	223,225	125,748	6,969	7,109	7,251	7,396	7,544	7,695	7,848	8,005	8,166	8,329	8,495	8,665	8,839	9,015	9,196	9,380	9,567	9,759	9,954	10,153	10,356	10,563	10,774	10,990	11,210
Total Annual Operation Cost	853,651	492,015	30,067	30,357	30,653	30,955	31,262	31,576	31,897	32,224	32,557	32,897	33,243	33,597	33,958	34,326	34,701	35,084	35,474	35,873	36,279	36,693	37,116	37,547	37,987	38,436	38,893
Annual Power Generation (MWh)	72,377,879	42,843,772	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115	2,895,115
Annual Generation Cost ($/MWh)			10.39	10.49	10.59	10.69	10.80	10.91	11.02	11.13	11.25	11.36	11.48	11.60	11.73	11.86	11.99	12.12	12.25	12.39	12.53	12.67	12.82	12.97	13.12	13.28	13.43
Levelized Generation Cost ($/MWh)		11.48																									

November 28,2002
TMP-0030E

Comparison and Evaluation Method between Bids

This document is to state how to compare and evaluate the proposed bids for review and discussion with Uzbekenergo. Any figures in this document are tentative values and have to be finalized through the discussion with Uzbekenergo.

Comparison and evaluation of Bids will be conducted in two (2) kinds of ways. One is a way to determine whether proposed documents will comply with the requirements by the Tender Documents. This will be performed with a pass or fail of the proposal against each item of the requirements.

The other is a way to compare the total cost through the service life of the project with the price, performance values and completion date declared by Bidders.

The Purchaser reserves the right to reject any or all Bidders and to waive minor formalities if it seems to be of interest for him to do so without giving any reasons.

Bidders are requested not to contact Uzbekenergo or the Engineer on any matters concerning their Bids.

1. Compliance with Bid Documents

1) Responsiveness of Bidder to the Tender Documents.
2) A substantially responsive Bidder is one that complies with the terms, conditions and specifications of the Tender Documents. The determination of responsiveness will be made based on examination of the Bidder itself without rely on external evidence. Bidders are not allowed to revise non-responsive Bid after Bid opening to make them responsive. However, the Bidder may be requested to clarify his Bid.

3) Completeness of proposed documents. It will be determined by whether all the requirements in the Tender Documents will be informed and given in the proposed documents.

4) Suitability of the proposed Unit from the viewpoint of impact on the environment.

5) Reconfirmation of full compliance with all the criteria conditions in the pre-qualification.

6) Full compliance with all the criteria conditions as EPC contractor.

2. Evaluation of Total Cost through Service Life

The evaluation of Bids will be made on a basis of the difference among the present values of the total cost through the unit service life of 25 years. However, it is practically impossible to foreseen the conditions at this stage and it does not always meet the purpose to do so. Therefore, the following costs will be considered for the purpose of evaluation because they can be practically estimated with data given by Bidders. The operating costs incurred during a simple cycle operation and a start/stop will be neglected because the costs are small compared with the total operating costs through the service life. All costs used for the evaluation are to be converted into US $ with the certain exchange rates.

1) The costs to be considered.

(1) The Corrected Bid Price (K_1) after making any corrections of errors in the Bid Specification. The scope to be covered with the price will be defined in the separate section. The mandatory and additionally recommended spare parts required for five (5) years operation will be considered for evaluation. If there is any discrepancy between the amount in figures and in words, the amount in words will govern. If there is any discrepancy between the sum of the unit price and the corresponding total price, the former will govern and the latter will be corrected. Any duties and taxes and provisional sum will be excluded from the scope in consideration

(2) The cost (K_2) to be loaded as the results of adjustment of any unacceptable variations and/or deviations from the Bid Documents. Variations and deviations, which do not comply with spirits of intents of requirements in the Tender Documents, will not be accepted and the costs for exception of them will be loaded in accordance with Purchaser's procedures and methods.

(3) The cost (K_3) to be loaded with the difference among Guaranteed Net Power Outputs declared by Bidders.

(4) The cost (K_4) to be loaded with the difference among Guaranteed Net Heat Rates declared by Bidders.

(5) The cost (K_5) to be loaded with the behind Unit Completion Dates of the gas turbine and combined cycle power plant against the specified Completion Dates of them.

2) Conditions for evaluation

(1)	Evaluation period	25 years
(2)	Annual total operating hours	7,970 hours
	for full power generating operation	5,250 hours
	for cogenerating operation with export of steam	2,720 hours
(3)	Price of fuel to be procured by Uzbekenergo	1.0 $/GJ (LHV)
(4)	Discount rate	10 %
(5)	Present electricity tariff at the outgoing terminal of the TashGRES	0.5 cents/kWh
(6)	Present hot water tariff price at the outgoing terminal of the TashGRES	0.694 $/GJ (= 0.25 cents/kWh)
(7)	Power generation cost by this project	1.0 cents/kWh
(8)	Hot water production cost by this project	1.39 $/GJ (= 0.5 cents/kWh)

3) Cost (K_3) to be loaded with Guaranteed Net Power Output difference

One of the reasons why this project is to be introduced is that the shortage of supply capability against the power demand is foreseen for the future in Uzbekistan. Considering such a situation of Uzbekistan for the balance between the power demand and the supply capability, the cost to be loaded will be estimated on the condition that the combined cycle power plant with the same capacity as the capacity difference against the maximum Guaranteed Net Power Output among the Guaranteed Net Power Outputs declared by Bidders will be additionally constructed for this project.

The attached curve (Figure-1) show the relationship between the unit capacity and the unit price ($/kW) ratio. The curve is made by approximating

data cited from Gas Turbine World 2001-2002 handbook with a method of least square. The unit price ratio is expressed with the ratio of the unit price of the combined cycle power plant to be additionally constructed to the unit price of the combined cycle power plant with a capacity of 370MW.

For example, it is assumed that one Bidder proposes a combined cycle power plant of a capacity of 360MW with a unit price of $600/kW on a basis of the corrected Bid price (K_1) plus the adjustment cost (K_2), while the declared maximum guaranteed net power output is 370MW among the Bidders. In this case, the capacity difference is 10MW. From the curve, the unit price ratios against power outputs of 360MW and 10MW can be founded to be "A" and "B" respectively. Consequently, the cost (K_3) to be loaded could be calculated as US$600×A/B×10×1,000 for this case.

Thus, the costs to be loaded against all other combined cycle power plants than the unit with the maximum Guaranteed Net Power Output could be estimated.

(4) Cost (K_4) to be loaded with difference of Guaranteed Net Heat Rate

The Guaranteed Net Heat Rate of the combined cycle power plant with the maximum Guaranteed Net Power Output among the proposed Bids will be used as it is for the base for evaluation. While, the Guaranteed Net Heat Rate of the combined cycle power plant with less Guaranteed Net Power Output will be revised as the weighted mean of the declared Guaranteed Net Heat Rate and the heat rate of the combined cycle power plant to be added.

The heat rate of the combined cycle power plant to be added can be presumably estimated from the curve (Figure-2) that is made by approximation of data cited from the said Handbook.

In the case as stated in the previous paragraph, if the Declared Net Heat Rate and the heat rate of the combined cycle power plant to be added are designated as "C" and "D" respectively, the revised net heat rate (E) of the combined cycle power plant with less Guaranteed Net Power Output could be calculated as $E = (360 \times C + 10 \times D)/(360+10)$

Thus, the revised net heat rates of all other combined cycle power plants than the unit with the maximum Guaranteed Net Power Output could be estimated.

Therefore, the annual fuel cost difference (J) can be calculated as $J = F \times (E - G) \times H \times I$.

Where,

E. Revised net heat rate of combined cycle power plant in consideration (kJ/kWh)
F. Maximum declared Net Power Output (MW)
G. Net heat rate of combined cycle power plant with maximum declared net power output (kJ/kWh)
H. Fuel cost ($/GJ)
I. Annual operating hours (hours)

The cost (K_4) to be loaded due to the heat rate difference can be obtained as shown below by multiplying the annual fuel cost difference (J) by the factor $((1+0.1)^{25} - 1)/0.1(1+0.1)^{25} = 9.08$ for the discount rate of 10% and the service life of 25 years.

$$K_4 = 9.08 \times J \text{ (US\$)}$$

4) Cost (K_5) to be loaded for late Completion Date

The cost proposal of which declared project completion date is behind against the specifically required completion date will be loaded provided that the loss will be equivalent to the power energy (kWh) and hot water energy (GJ) to be lost due to the late completion of the project. The lost power energy and the hot water energy will be converted into the cost with the sales prices of them. Therefore, the cost (K_5 US$) to be loaded could be calculated as $K_5 = (L \times N/100 + M \times O)$.

Where,

L. Power energy (kWh) to be lost during the considered period
M. Hot water energy (GJ) to be lost during the considered period
N. Equals to the present electricity tariff minus the generation cost by this project.
O. Equal to the present hot water tariff minus the production cost by this project.

3. Evaluation

The totally evaluated price per kW could be calculated by dividing the total amount (K_1+ K_2+ K_3+ K_4+ K_5) of the costs obtained in accordance with such estimation methods as stated above by the maximum declared net power output.

The Bid evaluation will be taken into account on the condition that all the requirements and conditions in the Tender Documents will be fully complied with proposed Bid.

If a Bidder does not declare the guaranteed net output and net heat rate, the Bid will not be considered for evaluation

The Contract will not be bound to be awarded to the Bidder who offers the lowest evaluated Bid or to any Bids. However, it will be expected that the lowest evaluated Bid will award the Contract on the condition that the Bid will pass all the requirements stated in the Tender Documents.

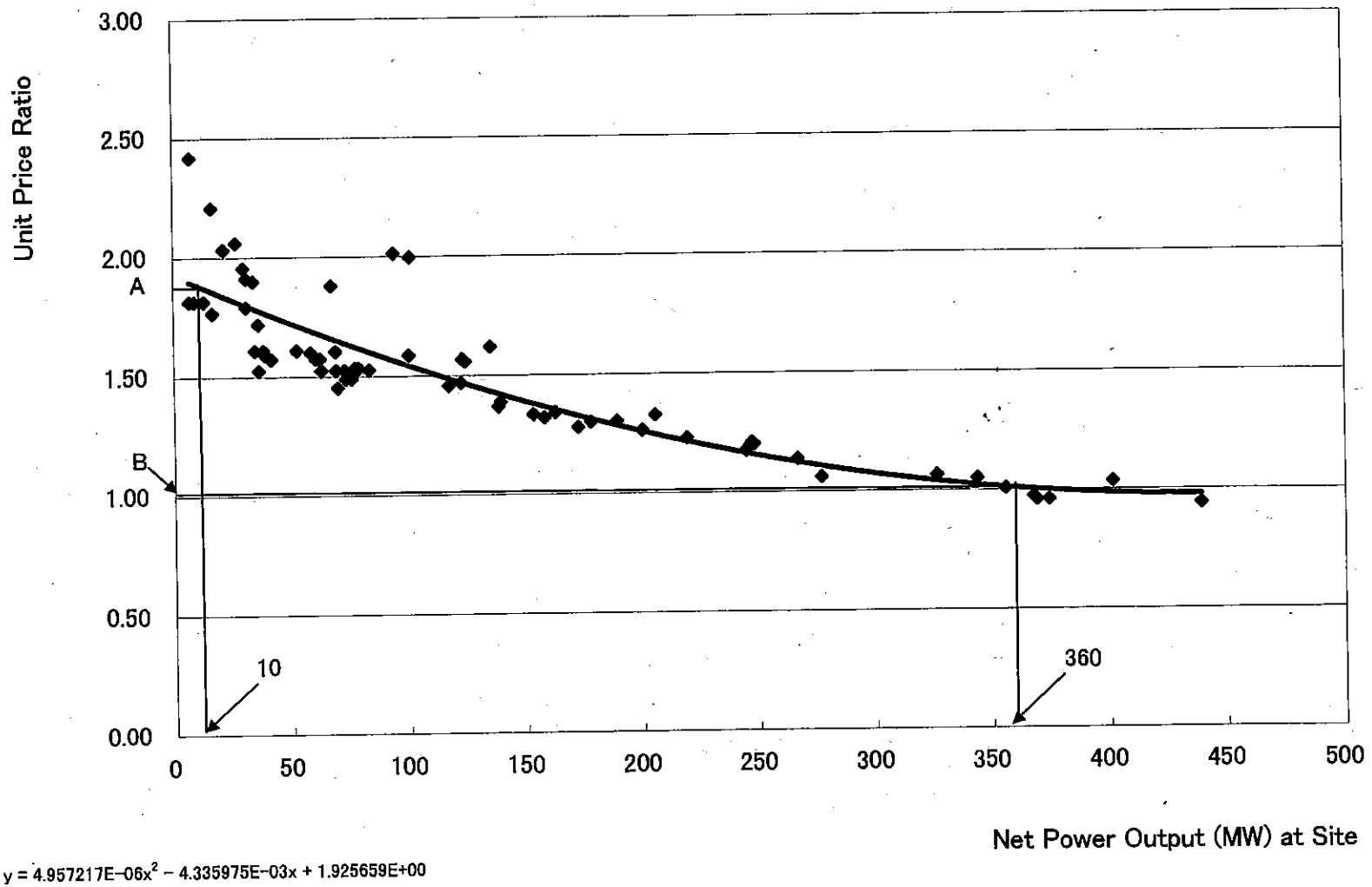


Figure-1 Unit Price Ratio of Combined Cycle Power Plant

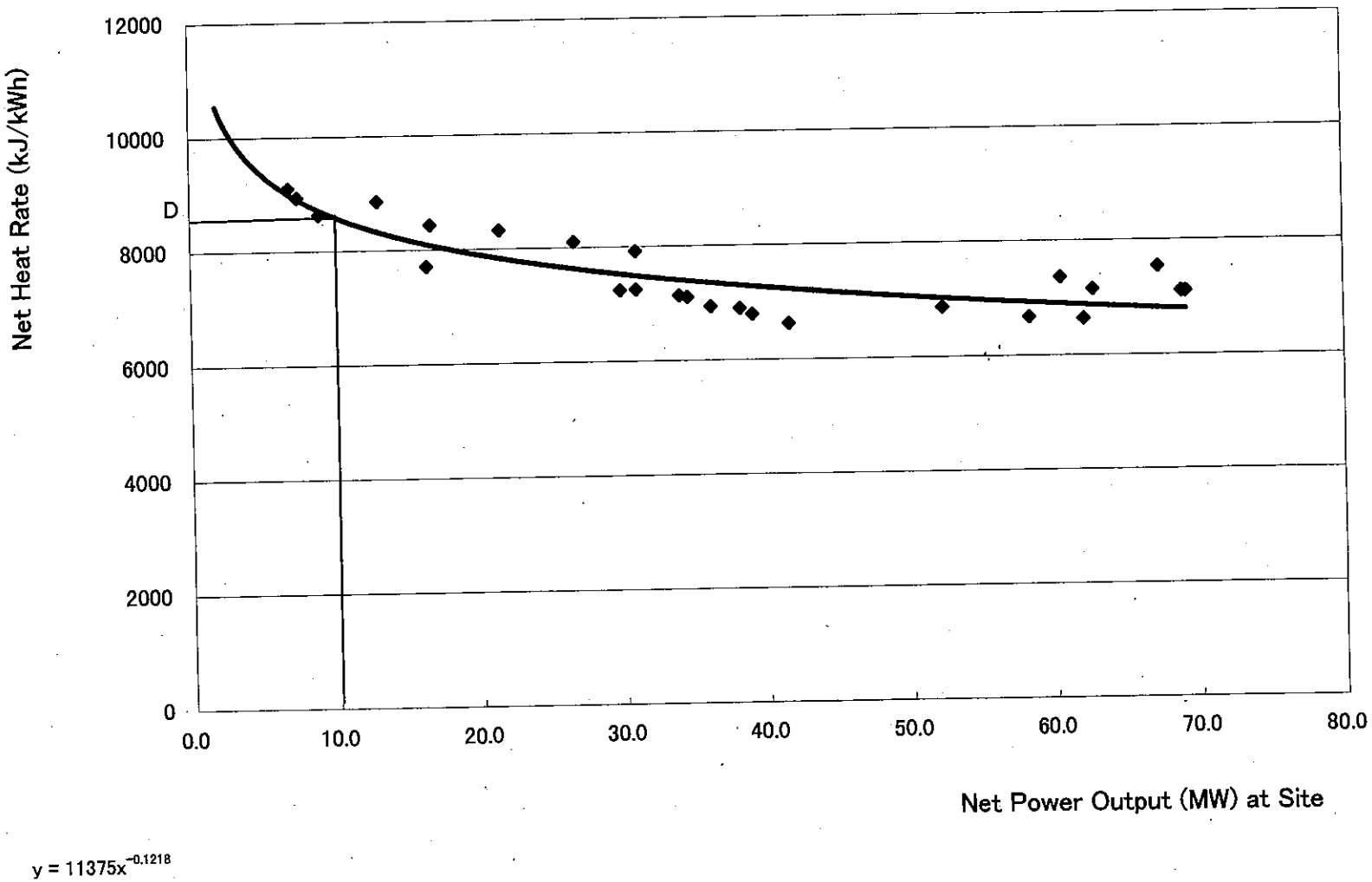


Figure-2 Net Heat Rate of Small Combined Cycle Power Plant

DRAFT
November 26, 2002
TMP-0029E-2

Scope of Services and Works

1. Works and Services to be provided by the Contractor

The works and services to be provided by the Contractor shall include the design, manufacture, fabrication, factory testing, packing, transportation to site, unloading and storage at Site, erection, testing, trial operation, commissioning, reliability run, performance guarantee testing and handing over for commercial operation of the Plant on a full turn-key basis. The main works and services are as follows, but not limited to them.

(1) Gas turbine and its accessories

(2) Gas turbine generator and its accessories

(3) Heat recovery steam generator and its accessories

(4) Hot water supply system

(5) Steam turbine and its accessories

(6) Steam turbine generator and its accessories

(7) Electrical system for gas turbine generator

(8) Electrical system for steam turbine generator

(9) Electrical systems common to the Plant

(10) Mechanical systems common to the Plant

(11) 220kV switchyard system including interconnection lines from generator transformers

(12) Steam turbine condenser and its accessories

(13) Circulating cooling water system

(14) Makeup water treatment system

(15) Waste water treatment system

(16) Closed cooling water system for cooling of lubricating oil and other cooling media

(17) Civil works of equipment and building foundations and concrete structures

(18) Architectural works with necessary facilities

(19) Fire protection system for the Plant

(20) Natural gas pre-treatment and compressor station

(21) Main stack and bypass stack and diverter damper

(22) Station and instrument air supply system

(23) Plant control and monitoring system

(24) Continuous emission monitoring system

(25) Erection works of all equipment in scope of supply

(26) Training of client's staff for six (6) weeks at factory

(27) All necessary documentation related to the operating procedures and maintenance of the power plant

(28) All documents and as-built drawings of the power plant

(29) Computer based plant operation compact simulating device

(30) One (1) year supervision by contractor engineers during the defect liability period

(31) Mandatory spare parts for five (5) years operation

(32) Factory and site inspections and tests

(33) Trial operation and commissioning

(34) Reliability run and performance guarantee tests

2. Works and Services to be provided by Uzbekenergo

The following works and/or services associated with the Plant shall be provided by Uzbekenergo

(1) Makeup water, tap water, service water, service air and steam, auxiliary steam, low and medium voltage electric power for use during construction, commissioning and guarantee and reliability tests.

(2) Detailed Environmental Impact Assessment (EIA) report

(3) Assistance for acquisition of all permits necessary for construction and operation of the Plant.

(4) Topography mapping/surveying.

(5) Site Soil Investigation/Borings.

(6) Natural gas, electric power load, and hot water demand for commissioning and guarantee and reliability tests.

(7) Preparation and leveling of site area including temporary storage area during construction and preparation of access road for carrying-in of heavy components.

(8) Demolition works of any structures on the site surface and underground with compensation, if any.

(9) Relocation works of any structures of "TashGRESstroi" to the new plant site

(10) Relocation of maintenance facilities in existing workshop to the existing building

(11) Relocation of the existing natural gas and hot water pipelines.

(12) Relocation and modification of the existing 35 kV and 220 kV overhead lines.

(13) Space to warehouse the spare parts and special maintenance facilities.

(14) Fencing around the Plant site, access road to equipment and drainages inside the Plant site.

Estimation of Liquidated Damage Rate for Performance Guarantee Test Results and Late Completion

1. Shortfall of one (1) kW of the power output

1) First Scenario

The presently estimated construction price is ¥29.1Billion (US$ 242.5 MM) and the nominal power output is 370MW. Therefore, the power output of (1) kW corresponds to ¥78,600 (US$ 655). The liquidated damage rate shall be such value as makes the EPC Contractor discourage the declaration of the undue estimation of the power output. Increasing the value by 1.5 times considering that the shortfall is a certain kind of retribution, the liquidated damage rate of ¥120,000 (US$ 1,000) could be obtained against the shortfall of one (1) kW.

2) Second Scenario

When the power output of the new plant is less by one (1) kW, the existing plant with a lower thermal efficiency shall be operated at the more output by (1) kW to compensate the power output shortfall of the new plant. As the results, the fuel consumption shall increase by the difference between the fuel consumption of the existing plant and that of the new. The present worth value of the difference of annual fuel consumption through the service life of 25 years could be deemed as the liquidated damage against the power output shortfall.

The present worth value is calculated at ¥63,990/kW (US$ 533/kW) under the following preconditions:

Plant net thermal efficiency of the existing plant	36 % (LHV)
Plant net thermal efficiency of the new plant	56 % (LHV)
Discount rate for conversion to present worth value	12 %
Escalation rate of fuel unit price	1.5 %
Conversion factor to present worth value	8.842
Fuel unit price used for Feasibility Study	¥995/m^3 ($8.29/ m^3)
Annual total operating hours used for Feasibility Study	7,440 hours

Where, increasing the value of ¥63,990 (US$ 533/kW) by 1.5 times considering that the shortfall is a certain kind of retribution, the liquidated damage rate of ¥96,000(US$ 800)

against the shortfall of one (1) kW could be obtained against the shortfall of one (1) kW of plant net power output.

2. Shortfall of one (1) percent of plant net thermal efficiency for full power generation mode
When the plant net thermal efficiency is lower than the declared guarantee value, the fuel consumption increases by the quantity corresponding to the thermal efficiency shortfall. The present worth value of the increased annual fuel consumption during the service life of 25 years could be deemed as the liquidated damage against the shortfall of the plant net thermal efficiency.

The present worth value is calculated at ¥510.3 Million (US$ 4.25 MM) under the following preconditions:

Plant net power output	370 MW
Annual operating hours at full power generation	4,900 hours
Other necessary preconditions	Equal to said values

Where, increasing the value of ¥510.3 Million (US$ 4.25 MM) by 1.5 times considering that the shortfall is a certain kind of retribution, the liquidated damage rate of ¥765 Million (US$ 6.40MM) could be obtained against the shortfall of one (1) percent of plant net thermal efficiency for full power generation.

3. Shortfall of one (1) percent of plant net thermal efficiency for cogeneration
Similarly to the previous paragraph, the present worth value of the increased annual fuel consumption during the service life of 25 years could be deemed as the liquidated damage against the shortfall of the plant net thermal efficiency for cogeneration mode. And present worth value due to the thermal efficiency shortfall of one (1) percent could be calculated under the following preconditions:

Plant net power output	363 MW
Plant net hot water supply energy	30 Gcal/h
Annual operating hours at cogeneration	2,540 hours
Other necessary preconditions	Equal to said values

The calculated value is ¥245.7 Million (US$ 2.05 MM). Therefore, increasing the value of ¥245.7 Million (US$ 2.05 MM) by 1.5 times for the same reason as stated above, the value of ¥368.6 Million (US$ 3.10 MM) could be obtained as the liquidated damage rate

per the shortfall of one (1) percent of the plant net thermal efficiency for cogeneration.

4. Late Completion

When the completion date of the Plant is delayed, the revenue by the sales of the power and hot water shall diminish being equivalent to the amount of the power and hot water to be produced during the delayed period. Therefore, the loss of the revenue could be deemed as the liquidated damage against the late completion. The value of the loss per one (1) day delay could be calculated at ¥5.62 Million (US$ 46,800) with the following preconditions:

Plant net power output	363 MW
Plant net hot water supply energy	30 Gcal/h
Sales price of electricity	¥0.6 /kWh (500 Sum/kWh)
Sales price of hot water	¥540/Gcal (4,500 Sum/Gcal)

Therefore, increasing the value of ¥5.62 Million (US$ 46,800) by 5 times for the same reason as stated above, the value of ¥28.1 Million (US$ 234,000) could be obtained as the liquidated damage rate per one (1) day delay of the completion date of the Plant.

5. Conclusion

As the results of the study as stated above, the following liquidated damage rates should be employed:

1) Shortfall of the plant net power output for full power generation: US$ 1,000kW

2) Shortfall of the plant net thermal efficiency for full power generation: US$-6.50 Million/percent

3) Shortfall of the plant net thermal efficiency for cogeneration: US$ 3.50 Million/percent

4) Late completion of the Plant: US$ 0.25 Million/day

* All calculations are made on the exchange rate of ¥ 120/US$.

Questionnaire about
Design Conditions of New Hot Water Supply System
(Document No. TMPS-1E)

1. Design Condition of Hot Water Supply System

Maximum heat duty	Gcal/h	100
Flow of hot water	tons/h	***2500***
Temperature of water at heat exchanger in	℃	***70***
Temperature of water at heat exchanger out	℃	***110***
Required supply pressure	kPa(g)	***1240***
Pressure at pump inlet	kPa(g)	***100***

2. Operating Conditions of Hot Water Supply System

Maximum flow in ***December*** (Month)	tons/h	***2300***		
Minimum flow in ***August*** (Month)	tons/h	***150***		
Outlet water temp. control range	℃	***70***	to	***110***
Inlet water temperature fluctuation	℃	***50***	to	***70***

Annual average conditions used for performance guarantee of combined cycle

Water flow	tons/h	***875***
Temperature in	℃	***70***
Temperature out	℃	***110***
Supply pressure	kPa(g)	***1140***

3. Confirmation of Scope of Supply

Heat exchangers (50 % capacity per each)	3 sets
Hot water supply pumps (50 % capacity per each)	3 sets
Condensate return pumps (50 % capacity per each)	3 sets
Inlet steam piping	
Cold water piping from the existing header pipe to new pumps	
Hot water supply pipes from hot water heater's outlet to the existing header pipe	
Condensate return piping	
Small capacity hot water supply pump	***2 sets***
Small capacity condensate return pumps	***2 sets***

System Requirements of Hot Water Supply System

Item		Unit	Resident (300 A)	Greenhouse (800 A)
Purpose of use		-	Heating, Shower, Bath, Cooking, etc.	Heating only (no direct use)
Required temperature Supply/Return	Winter	℃	/	***110 / 70***
	Summer	℃	/	*- / -*
Minimum required pressure at consumer	Winter	kg/cm^2g		***12***
	Summer	kg/cm^2g		-
Water flow Max./Min.	Winter	m^3/h	/	***2500 / 150***
	Summer	m^3/h	/	*- / -*
Supply pressure vs. flow of existing plant		kg/cm^2 vs. m^3/h	vs. vs. vs.	***5.1 vs. 1600*** ***4.5 vs. 875*** ***3.5 vs. 150***
Pressure at inlet of hot water supply pump of existing plant		kg/cm^2g	***1.5***	
System spillage flow rate (Supply-Return)/Supply		%		*3 %*

Hot water for residents will be supplied by the existing hot water supply system.

Size of building for new hot water supply system: *12* m W *18* m L *9* mH

Allocation of control and supervisory functions :

Functions		New plant (BCR)	Existing plant
Water temperature at heater outlet		***C, SV***	
Water supply to 300 A	supply temp.	~~SV~~	C, R
	~~supply flow~~	SV	C, R
	return temp	SV	R
	return flow	~~SV~~	R
Water supply to 800 A	supply temp.	***C, SV***	C, R
	supply flow	***C, SV***	C, R
	return temp	***C, SV***	R
	return flow	***SV***	R
Return pressure		***C, SV***	
Make-up water tank level		***C, SV***	
Heater internal pressure		***SV***	
Heater water level		***C, SV***	
Heating steam temp. and press.		***SV***	
Condensate tank level		***C, SV***	
Return condensate temp. and press.		***SV***	
Make-up flow		***SV***	
Make-up water deaerator internal temperature		***C, SV***	
ditto pressure		***C, SV***	

Note: C: Control including measuring element, signal transmitting and control valve
R: Recording
SV: Supervising in BCR (Block Control Room of Combined Plant)

All functional values and data regarding the hot water supply to the greenhouse (800 A supply pipe) shall be controlled and supervised in BCR.

EXISTING HOT WATER SUPPLY SYSTEM

MAKE UP WATER

DEAERATOR

MAKE-UP WATER DEAERATOR

SEAL STEAM

MAKE-UP WATER TANK

MAKE-UP WATER PUMPS

EXTRACTION STEAM

300A

800A

800A

300A

RESIDENTS

GREEN HOUSE

MAIN HOT WATER PUMPS

AUX. HOT WATER PUMPS

HOT WATER HEATERS

RETURN CONDENSATE

AUX. CONDENSATE RETURN PUMPS

CONDENSATE TANK

MAIN CONDENSATE RETURN PUMPS

NEW HOT WATER SUPPLY SYSTEM

BY UZBEKENERGO

BY THE CONTRACTOR

REV.	DATE	DESCRIPTION	BY
0		ISSUED FOR TENDER PURPOSE	

CLIENT :

State Joint Stock Company "Uzbekenergo"

PROJECT :

TASHKENT THERMAL POWER PLANT MODERNIZATION PROJECT

CONTRACT NO:

DRAWING NO: TMP-M-004 REV. 0

CONSULTANT :

TEPSCO TOKYO ELECTRIC POWER SERVICES CO., LTD.

DRAWN	T. SHIOMI	EXAMINED	H. OKANO	SCALE : NTS	
DATE	06.02.03	APPROVED	K. MIKATA	DRG SIZE	A2

TITLE :

FLOW DIAGRAM OF HOT WATER SUPPLY SYSTEM

FILE NAME : REV. : 0

2. PRE-QUALIFICATION DOCUMENT

Tashkent Thermal Power Plant

Modernization Project

Pre-qualification Documents
for
International Competitive Bidding
of
Construction of 370MW Combined Cycle Power Plant

Document No. TMP - 0001E

September, 2003

Republic of Uzbekistan

State Joint Stock Company

Uzbekenergo

Pre-qualification Documents
for
International Competitive Bidding
of
Construction of 370MW Combined Cycle Power Plant

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Republic of Uzbekistan
State Joint Stock Company "Uzbekenergo"

1. Invitation for Pre-qualification

1.1 The Government of the Republic of Uzbekistan has applied (*the application date should be inserted by SJSC "Uzbekenergo"*) for a loan from The Japan Bank for International Cooperation, hereinafter referred to as the JBIC, in the amount of ¥ 24,955,000,000 towards the cost of "Construction of 370MW Combined Cycle Power Plant for Tashkent Thermal Power Plant Modernization Project" hereinafter referred to as the Project. Payments by the JBIC will be made only on the request of Government of Uzbekistan and shall be subject, in all respects, to the terms and conditions of the Loan Agreement including the 'Guidelines for Procurement under JBIC ODA Loans'.

1.2 The object of the Project is the modernization of the existing Tashkent Thermal Power Plant by introduction of the highly efficient current technology of power generation on the basis of the combined cycle system. In this connection, the State Joint Stock Company, UZUBEKENERGO, through its Consultant, intends to pre-qualify the Contractor for the following works under this Project:

1) The Project will consist of a nominal capacity 370MW unfired type combined cycle power plant with a multi-shaft arrangement. The fuel is natural gas, which is supplied at the pressure of approximately 0.7 MPa at the terminal point within the premise of the Tashkent Thermal Power Plant.

2) The Project shall consist of designing, manufacturing, procurement, transportation, constructing, installing, starting-up, commissioning and testing of a complete operable combined cycle power plant to be constructed by an EPC Contractor with a single responsibility on a full turnkey basis in the premise of the Tashkent Thermal Power Plant. The Plant is situated at the distance of approximately 20km in the direction of the northeast from the central area of Tashkent City and at the altitude of 502 m.

1.3 Description of the Project

1) Pursuant to the power generation development plan, SJSC "Uzbekenergo" intends to construct one 370 MW unfired multi-shaft combined cycle power plant. The thermal cycle of the bottoming system will be preferably of triple-pressure reheat type. The power plant uses indigenous natural gas transmitted through the existing pipelines from Bukhara and Shurtan gas fields of Uzbekistan. The power plant consists of one(1) gas turbine/generator, one(1) heat recovery steam generator, one(1) steam turbine/ generator complete with all the associated auxiliary equipment.

2) The plant is normally scheduled to be continuously operated as a combined cycle, while it may be operated as a simple cycle in an emergency when the bottoming system will be out of order due to any reason. During the dry season, the plant will be normally operated to supply the power energy, while it will supply the power and heat energy (the low pressure steam extracted from the steam turbine) during the wet season.

3) The power plant will be located on the area of approximately 150m by 200m at the distance of approximately 50m in the Southeast direction from the existing No.12 conventional type unit. The site layout of the power plant shall be designed considering the future extension of one (1) similar or higher performance power plant. The exhaust steam from the steam turbine will be condensed in a condenser cooled by the fresh water taken from the artificial pond diverged from the Boz-Su canal. The water will be conveyed to the condenser with the pumps, which will be newly built at the end of the extended canal. A new water treatment plant will process the canal water so that it will be suitable for make-up to the heat recovery steam generator. The generator output voltage will be stepped up to 220kV and will be connected to the new switchyard to be built extended adjacent to the existing switchyard.

4) The supply pressure of the natural gas is not sufficiently high to feed it into the gas turbine and the pressure boosting compressors shall be required. The necessary pre-treatment system of the natural gas will be included in the scope of works to provide the gas turbine with it on the proper conditions.

5) The gas turbine/generator, the steam turbine/generator and control and electrical equipment shall be installed in the gas turbine and steam turbine buildings newly built for this Project. The main supervisory operator panels will be located in the Block Control Room in the gas turbine building and the remote operating condition monitoring system will be installed in the existing Central Control Room located adjacent to the existing No.1 conventional type unit.

A detailed description of the Modernization Project is made in Appendix-A.

1.4 Site Description

1) The Project site is in the premise of Tashkent Thermal Power Plant approximately 20 km Northeast of Tashkent City, the metropolitan of Uzbekistan. The site is accessible by rail and road.

2) The area of approximately 150m by 200m is prepared for this Project and the further area could be available depending upon the requirement. The area is nearly plain. The site belongs to the area with No.9 of ISI Seismic Map Zone. All the equipment and structures for this Project are to be designed to withstand the seismic factor.

3) The annually averaged ambient temperature is 16 degrees C with a maximum temperature of +41.1 ℃ and minimum temperature of –15.5 ℃. Annually averaged relative humidity is approximately 52% with 30% in the summer season and 73% in the winter season. Annually averaged rainfall is 405mm with the maximum hourly rainfall of 4 mm.

4) The Project utilizes once-through cooling water system using fresh water taken from the artificial pond diverged from the Boz-Su canal. The discharge of the cooling water will be connected to the existing discharge underground culvert via the new underground steel pipe. The fresh water will be used for the make-up requirements of the Project.

1.5 General Experience

1) Total amount of engineering, procurement and construction contracts associated with more than (1) combined cycle power plant for the last five (5) years must be

more than US$500 millions; and

2) The averaged annual turnover as a prime contractor for works in progress or completed for the last five (5) years will not be less than US$ 250 millions.

1.6 It is expected that Invitation of Bids will be made in the beginning of December, 2003.

1.7 The EPC Contractor will be obligated to guarantee the completion time of the Project and performances of the Plant.

1.8 Pre-qualification is open to firms and voluntarily formed Joint ventures or Consortiums from eligible source countries that are all countries and areas.

1.9 Misprocurement

1) No party other than the Government of Uzbekistan shall derive any rights from the Loan Agreement or have any right to the loan proceeds. The above Loan Agreement will cover only a part of the project cost. As for the remaining portion, the Government of Uzbekistan will take appropriate measures for finance.

2) Goods and services under this Contract shall be procured in accordance with the procedures agreed in the Loan Agreement. The loan allocation for the goods and services that will have been misprocured will be cancelled.

3) In case it is determined that the Bidder recommended for the award of this Contract has engaged in corrupt or fraudulent in competing for the Contract, the proposal for the award will be rejected.

4) The Contractor will be recognized as ineligible when it is determined that he has engaged in corrupt or fraudulent practices in another contract funded with ODA loans of JBIC.

1.10 General information on the climate, geology, geography, Project layout, expected construction period, facilities and services to be provided by SJSC "Uzbekenergo", and scope of works under this Contract are provided in Appendix-A.

1.11 Eligible applicants may obtain the pre-qualification documents by written letter and facsimile to the following address with a remittance certificate reference number of document fee.

Mr.Alisher Ziyaevich SIRADJEV
Deputy Chairman of the Board SJSC "Uzbekenergo"
6, Khorezmskaia Str.,
Tashkent, 700000
Republic of Uzbekistan
Facsimile No. +998 (71) 136 27 00

1.12 The Applicants must clearly state "Request for Pre-qualification Documents" for the "Modernization Project of Tashkent Thermal Power Plant; Construction of 370MW Combined Cycle Power Plant". The documents are available at 12:00 September 15th , 2003.

The Applicants must transfer a non refundable fee of US$ 250 to SJSC "Uzbekenergo" foreign currency (US$) account No 20210840000117832001 at ABN AMRO Bank New York.
Internal number of account for deposit money in Uzbek sum: 5038758
Bank Code: 00831
SWIFT Code: ABNAUZ22
Correspondent Bank: ABN AMRO Bank New York
Correspondent Bank SWIFT: ABNAUS33

SJSC "Uzbekenergo" will promptly dispatch the documents by registered airmail, but will not take the responsibility for late delivery or loss of the documents under any circumstances.

1.13 Submissions of Applications for Pre-qualification must be received in sealed envelopes, which must be either delivered by hand or by registered mail, to the address mentioned below , not later than 12:00 October 24th , 2003 and be clearly marked "Application to Pre-qualify for the "Modernization Project of Tashkent Thermal Power Plant; Construction of 370MW Combined Cycle Power Plant".

All the information to be provided for pre-qualification must be in English language. Additional provision of them in Russian language may be encouraged.

Failure to provide information, which is essential to evaluate the qualifications of the Applicants, or to provide timely clarification or substantiation of the information to have been supplied may result in disqualification of the Applicant. The name and mail address of the Applicant must be clearly marked on the envelopes.

Mr. Alisher Ziyaevich SIRADJEV
Deputy Chairman of the Board SJSC "Uzbekenergo"
6, Khorezmskaia Str.,
Tashkent, 700000
Republic of Uzbekistan
Facsimile No. +998 (71) 136 27 00

1.14 Applicants will be advised, in due course, of the results of their applications. Only firms, Joint ventures or Consortiums pre-qualified under this procedure will be invited to the bid. The Bidder(s) will be defined as the pre-qualified firm(s), Joint Venture(s) or Consortium(s).

2. Instructions to Applicants

Name of the Project:		Modernization Project of Tashkent Thermal Power Plant
Name of the Employer	:	SJSC "Uzbekenergo"
Name of the Borrower	:	Government of Uzbekistan

2.1 General

1) Misprocurement

(1) No party other than the Government of Uzbekistan shall derive any rights from the Loan Agreement or have any right to the loan proceeds. The above Loan Agreement will cover only a part of the project cost. As for the remaining portion, the Government of Uzbekistan will take appropriate measures for finance.

(2) Goods and services under this Contract shall be procured in accordance with the procedures agreed in the Loan Agreement. The loan allocation for the goods and services that will have been misprocured will be cancelled.

(3) In case it is determined that the Bidder recommended for the award of this Contract has engaged in corrupt or fraudulent in competing for the Contract, the proposal for the award will be rejected.

(4) The Contractor will be recognized as ineligible when it is determined that he has engaged in corrupt or fraudulent practices in another contract funded with ODA loans of JBIC.

2) Only firms, Joint Ventures or Consortiums that have been pre-qualified under this procedure will be invited to bid. A qualified firm or a member of a qualified Joint Venture or Consortium may participate in only one bid for the Contract. If a firm submits more than one bid, singly or in joint venture, all bids including the firm shall be rejected. This rule shall not apply for the case where any subcontractors may be used by more than one (1) bidder.

3) Bidders will be required to provide a bid security in the form of a bond, bank guarantee, or other security acceptable to SJSC "Uzbekenergo" for an amount of US$ 4 million, and the successful bidder will be required to provide performance security. Examples of acceptable forms will be supplied with the bid documents. The bid security shall be from a reputable bank located in any eligible Countries, and the bank guarantee for the performance security must be endorsed by an eligible Bank in the "Republic of Uzbekistan".

4) The Uzbekenergo reserves the right to:

(1) amend the scope and value of any Contract to be bid. In such event, the pre-qualification process will be repeated depending upon the extent of the revised scope and value; and

(2) reject or accept any application; and

(3) cancel the pre-qualification process and reject all applications.

The SJSC "Uzbekenergo" shall neither be liable for any such actions nor be obliged to inform the Applicant of the grounds for them.

4) Applicants will be advised in writing by facsimile, within 90 days of the date for Submission of Applications (Sub-clause 1.11 above), of the result of their application, and the names of the pre-qualified applicants, without explanation of any reason for the SJSC "Uzbekenergo's" decision.

2.2 Qualification Criteria

1) Pre-qualification will be made based on the Pass/Fail evaluation form regarding the Applicant's general and particular experience, personnel and equipment capabilities, and financial situation, as demonstrated by the Applicant's responses given in the forms attached to the Letter of Application (specific requirements for Joint Ventures or Consortiums are given under Sub-clause 2.4-1) and 2) below). The SJSC "Uzbekenergo" reserves the right to waive minor deviations, if they do not substantially affect the capability of the Applicant to perform the Contract. Any information regarding Subcontractors shall not be considered in determining the Applicant's compliance with the qualification criteria; and

2) The Bidder shall include a gas turbine manufacturer and comply with the qualification criteria stipulated hereunder and have the experience to have internationally executed such activities as similar to this Project. The gas turbine manufacturer mean any firm, partnership or company which has developed, design and manufactured gas turbines with its own technology and regularly owns, operates and keeps a factory or establishment that produces the equipment and materials required for the Project; and

3) The Bidder must provide accurate information on any litigation or arbitration resulting from contracts completed or under its execution over last two (2) years in accordance with the Application Form (11) A consistent history of awards against the Bidder or any partner of a Joint Venture or Consortium may result in failure of the application; and

4) Total amount of engineering, procurement and construction contracts associated with combined cycle power plants for the last five (5) years must be more than US$ 500 million, and the averaged annual turnover for the last five (5) years will not be less than US$ 250 million; and

   The number of contracts for similar size of combined cycle power plants to the current project must be more than one (1) in the last five (5) years; and

5) The Applicant must demonstrate that it has access, liquid assets, unencumbered real assets, lines of credit, and other financial means sufficient to meet the construction cash flow for a period of 34 months up to the provisional acceptance of the Plant.

6) The audited financial statements for the last five years shall be submitted and must demonstrate the soundness of the Applicant's financial position, showing long-term probability.

7) Any Bidders may participate in the Tender, provided that they have sufficient experience and personnel capable of fulfilling the functions and roles required for the Project and shall associate with the qualified manufacturer of the gas turbine. The manufacturer of the gas turbine in association with them is required to be qualified in accordance with the procedures specified hereunder. They shall have the commitment letter from the manufacturer of the gas turbine for such the

association agreement; and

The gas turbine manufacturer, whichever is associated with a trading firm or the Joint Venture or the Consortium or is singly a Bidder, must have not only supplied gas turbines, but also completed more than one (1) multi-shaft combined cycle power plant (block) with a capacity more than 350MW consisting of natural gas fueled gas turbine/generator(s), unfired heat recovery steam generator(s), and one (1) steam turbine/generator on a full turnkey basis outside its domicile country. The accumulated commercial operating hours of each reference multi-shaft combined cycle power plant (block) shall have amounted to at least 7,500 hours at the Pre-qualification closing date and the plant shall have been operated at the averaged load factor above 75%. The Applicant shall provide written confirmation of satisfactory operation of the combined cycle power plants certified by the Owners; and

8) The proposed 3,000 rpm gas turbine shall be of similar model to the gas turbines, of which more than one (1) gas turbine have the experience of successful commercial operating hours with at least 7,500 hours on the Pre-qualification closing date. The Contractor shall submit the operation data of the said three (3) gas turbines based on attached data forms (Application Form (6)) with written confirmation letter(s) of the Owner(s) of them. The "similar model" shall mean the model, which fully complies with all the following conditions:

   (1) The air compressor: the same type, same number of stages and same inlet air flow with same or better materials and the same rotating speed.

   (2) The combustor: the same number of combustion liners and with same or better materials

   (3) The turbine: the same type, same number of stages, same turbine inlet temperature with same or better materials and the same rotating speed.

9) The Bidder shall identify the manufacturers from whom he intends to procure the gas turbine, steam turbine, heat recovery steam generator and electric generator. Each manufacturer of the above major equipment except the gas turbine shall have the experience with design and manufacturing of more than one (1) equipment for the last five (5) years with similar size and specification to

equipment to be provided for the Project. The experience of the manufacturer with the relevant equipment shall be submitted in accordance with the attached data forms (Application Forms (7), (8) and (9)); and

10) The generator manufacturer shall be qualified as a manufacturer to be able to provide the similar generator to the Project with either of the following two (2) conditions;

(1) The manufacturer has experience with construction of at least three (3) air cooled generators over 260 MVA as per IEC 34 or equivalent standards.

(2) The manufacture has experience with construction of at least three (3) air cooled generators over 150 MVA and at least three (3) hydrogen cooled generators over 500MVA as per IEC 34 or equivalent standards.

The information of the air and hydrogen cooled generators shall be provided with attached Application Form (9); and.

11) The Bidder shall submit the following documents

(1) Experience and performance on multi-shaft type similar or larger sized unfired combined cycle power plants outside its domicile country.

(2) Experience with the construction on a full turnkey basis of more than one (1) combined cycle power plant (block) of which each capacity is not less than 250 MW in Commonwealth of Independent States (CIS) and Turkey with similar climatic, geographical and economical conditions.

(3) Supporting letter(s) from the plant owner(s) to certify that the operating experience of the multi-shaft type combined cycle power plant meets the requirements stated in above Sub-clause 2.2-7).

(4) Experience and performance of the Manufacturers to be engaged for supply of such major equipments as gas turbine, heat recovery steam generator, steam turbine, electric generator required in above Sub-clause 2.2-9).

(5) Copy of the association agreement with the gas turbine manufacturer in case

the Bidder is a trading firm, a Joint Venture, or a Consortium.

(6) Audited annual report of the Bidder for the last five (5) years.

12) The SJSC "Uzbekenergo" reserves the right to cancel the pre-qualification process and to reject any application without informing the applicant of the reason why the pre-qualification process has been canceled or the Bidder has been rejected. Only firms pre-qualified under this procedure shall be invited to bid.

13) The Bidder must have suitably qualified personnel required to perform the Project. The Bidder must submit the information on a prime candidate and on alternate for each of the following personnel. Both of them must meet the experience requirements specified below:

Position	Total Experience (Years)	In similar Works (Year)
Project Manager	25	15
Project Engineer	20	10
Site Manager	20	10
Lead Mechanical Engineer	15	8
Lead Electrical Engineer	15	8
Lead Control Engineer	15	8
Lead Civil/Structural Engineer	15	8

The total experience means the total years when the personnel has been engaged in design, engineering and supervising activities in the equipment manufacturers and/or engineering firms. The similar works mean the experience of the personnel with the design, engineering, and supervising activities in the equipment manufacturers and/or engineering firms similar to their works to be engaged in this Project

2.3 Supporting Data

The Applicant shall append the following supporting documents to the attached Application Forms:

(1) A copy of the business registration certificate by a competent relevant Authority in the domicile country of the Applicant stating the full name of him, the person or persons or board authorized to represent the Applicant, and the date and place of registration as a Contractor. (If the Applicant is a Trading firm, a Joint Venture or a Consortium, the certificate must state the scope, the paid-up capital, the duration and the date of incorporation of the company and the names of all directors of the board. Further, in case of a joint company, the share holding structure of the company shall be stated.); and

(2) Certificate by a public accountant for the Applicant's financial statements; and

(3) Copies of completion certificates issued by the relevant owners or engineers of the projects as listed in the particular experience record (Application Form (3)) to indicate that such projects were satisfactorily completed by the Applicant including each member company of a Joint Venture or Consortium.

2.4 Joint Venture or Consortium

1) Joint Venture or Consortium must comply with the following requirements:

(1) The followings are the minimum qualification requirements for formation of a Joint Venture or Consortium:

(i) The lead partner shall meet not less than forty (40) percent of all the qualifying criteria given in the above paragraphs 2.2.4) and 2.2.5).

(ii) Each of the other partners shall meet individually twenty five (25) percent of all the qualifying criteria given in the above paragraphs 2.2.4) and 2.2.5).

(iii) The Joint Venture or Consortium must satisfy collectively the criteria of the above paragraphs 2.2.5), 2.2.7) to 2.2.11) and 2.2.13). Individual members must each satisfy the requirements of the above paragraphs of 2.2.3) and 2.2.6).

(2) The re-formation of a Joint Venture or Consortium after pre-qualification, and any change in a pre-qualified Joint Venture or Consortium, shall be subject to the written approval of SJSC "Uzbekenergo" prior to the Bid closing date. Such application for approval may be rejected in the following cases:

(i) Partners withdraw from the Joint Venture or Consortium and the remaining partners do not meet the qualification criteria; or

(ii) The new partner(s) to the Joint Venture or Consortium is (are) not qualified, individually or as another Joint Venture or Consortium; or

(iii) The new formation may result in substantial degradation of its competence to perform the Project.

(3) Any Bid shall be signed so as to legally bind all partners, jointly and severally, and shall be submitted with a copy of the Joint Venture or Consortium Agreement, as in Application Form 2A and 2B, providing the joint and several liability with respect to the Contract.

2) The pre-qualification of a Joint Venture or Consortium does not necessarily pre-qualify any of its partners individually or as a partner in any other Joint Venture or association. In case of dissolution of the Joint Venture or Consortium, each one of the constituent firms may be pre-qualified if he comply with all the pre-qualification criteria, subject to the written approval of SJSC "Uzbekenergo".

2.5 Conflict of Interest

The Applicant (including all members of a Joint Venture or Consortium) must not be affiliated (i.e., subsidiary, parent or partner), nor have been affiliated (i.e., subsidiary, parent or partner) in the past, with the consultant or any other entity that will prepare the design, technical specifications, and other pre-qualification and Bid documents for the Project, or that will be employed as an Engineer for the Project. Any such association may result in the disqualification of the Applicant.

2.6 Updating Pre-qualification Information

Bidders shall be required to update the financial statements provided for pre-qualification at the time of submission of their Bids to confirm their continued compliance with the qualification criteria and verification of the information provided. The Bidder shall be rejected if the Applicant's qualification is no longer held at the time of Bid.

Appendix A

Description of Tashkent Thermal Power Plant Modernization Project

1. Project Description

1.1 Project Site

The Project site is located at the distance of approximately 20km Northeast from the central area of Tashkent City, the metropolitan of Uzbekistan. The altitude of the site is 502 m above the averaged sea level of Baltic Sea.

The new combined cycle power plant (hereinafter to be referred as the Plant) will be constructed in the premise of the existing Tashkent Thermal Power Plant, which comprise of 12 units of conventional type thermal power plants fueled with a main fuel of natural gas and a standby fuel of heavy oil. Their installed capacities range from 150 to 165MW and the total installed capacity is 1,860MW. They were installed 32 to 41 years ago and have been superannuated. After the new power plant will have been put into commercial service, the existing No.11 and 12 units will be used for a standby purpose for a while and will be demolished in near future.

The land of the existing power plant is owned by SJSC "Uzubekenergo". The premise of the existing power plant is approximately 146 hectares. The area for installation of the new combined cycle power plant is tentatively 150m×200m including the area necessary for installation of all auxiliary facilities including a fuel gas compressor station, a fuel gas pre-treatment system, a make-up water treatment and a waste water treatment systems, two (2) main transformers and overhead connection lines. The site is accessible by railway

The site is roughly classified into three layers of the first, second and third layers starting the ground surface. The first surface is primarily a clay and silt (loam) layer with 9 to 12 m thickness, which partly contains two to three sandy clay (sandy loam) layers with 2 to 3 m thickness. The second layer is a conglomeratic layer of 2 to 3 m thick, on the top of which lies a sand layer containing conglomerates with 0.6 to 1 m thickness. The third layer, below more than 15 m under the ground surface, forms a relatively hard lime-type clay (loam) layer. The ground water level exists between 2 to 3 m below the ground surface. The site is in seismic zone 9 on a 12-magnitude scale.

1.2 Plant Description

The Plant will be a nominal 370 MW multi-shaft combined cycle power plant with one (1) gas turbine/generator, one (1) unfired type heat recovery steam generator, one (1) steam turbine/generator and two (2) main transformers complete with associated equipment and accessories. The bottoming cycle system will be of triple-pressure reheat type. The steam turbine shall be designed so that the low-pressure steam can be

extracted from it as a heat source to produce the hot water for export during the wet season. The plant shall be normally operated on the CRT consoles located in the Block Control Room to be installed in the gas turbine or steam turbine building. The control panel in the existing Central Control Room will be equipped for monitoring of the operating conditions of the Plant. The cooling system of the generators is of an air cooled type. The specific description of the Plant is shown in the Table 1

The cooling water system for the steam turbine condenser and for plant auxiliary equipment will be of a once through freshwater cooling system. The water pumped up from Bozsu canal will be used as a cooling medium. The site cooling water temperatures are shown in Table 2. Make-up water to the plant will be the treated canal water.

The natural gas supply pressure at the terminal points is scheduled to be 0.7MPa and is not high enough to feed the gas turbine. Therefore, natural gas compressors are required with the proper pre-treatment system consisting of filters and a knockout drum.

1.3 Plot Plan

The site area incorporates a turbine building, an outdoor heat recovery steam generator, a natural gas pre-treatment system and compressor station, a water treatment building, main transformer yards, and overhead transmission connection lines. The turbine building houses a gas turbine/generator, a steam turbine/generator with associated supporting mechanical/electrical equipment, a control room, an electrical switchgear room, a battery room, miscellaneous offices and a warehouse. An overhead travelling crane is provided to lift the main components for maintenance. There is a necessary lay-down area for disassembled components in the turbine building. The water treatment equipment building will house the demineralized water system and the pretreatment system. Wastewater from the Plant will be processed by the new wastewater treatment system prior to being discharged into the circulating water discharge channel.

The circulating water pumps are installed with a lifting device in the pump house located at the extended end of the existing water intake canal.

The 220kV sub-station is located adjacent to the existing sub-station.

1.4 Natural Gas Supply System

The gas turbine shall be designed for natural gas without backup oil fuel. Gas compressors shall be used to boost the gas pressure of 0.7MPa at terminal point to approximately 4 MPa, which may be changed depending the types of gas turbines. Any proper pre-treatment system consisting of filter/separators and a knockout drum shall be facilitated to clean the natural gas to the extent that it will be used for the gas turbine without any difficulties. Typical composition of the natural gas is shown in the Table 3.

1.5 Water Supply System

The water taken from Bozsu canal will be used as makeup water to the Plant.

The city water will be used as drinkable water, fire protection water and miscellaneous service water.

The water to be diverged from the existing ring pipe line will be used for fire protection of the Plant.

1.6 Demineralizer System

The demineralizer system shall be newly provided for makeup of the water with acceptable quality to the HRSG. The system comprises of a pre-treatment system consisting of a coagulator and a filter, a demineralizer system and a chemical storage/regeneration equipment.

1.7 Wastewater System

Wastewater from the plant will consist of neutralized regeneration waste from the makeup demineralizer system, waste from the pretreatment system, HRSG blowdown, floor drains from the turbine building, potentially contaminated yard drains from the transformer area, and sanitary wastewater.

All wastewaters will be separately transferred to the existing wastewater treatment plants suitable for treatment of them.

1.8 Electrical System

The electrical 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 Plant.

The existing 220 kV switchyard system is of air insulated outdoor type. The bus switching arrangement utilizes double bus bars radically feeding load or receiving generation via a circuit breaker. There are nineteen (19) circuit breaker bays of one (1) bus coupler, seven(7) outgoing transmission line bays, eight (8) receiving generation, one (1) interconnection with 500 kV switchyard, one (1) voltage transformer bay, one (1) reserve.

The voltage of the power output from the gas turbine and steam turbine generators will be stepped up to 220 kV via individual transformers. The switchyard steel structure to be extended adjacent to the existing structure for the Plant will be designed to accommodate two (2) bays to connect the power output of the Plant. One bay is for connection of the power output from the gas turbine generator, while the other is for that from the steam turbine generator. The 220 kV switchyard system for the Plant will be of also air insulated outdoor type.

The power output via the main transformers will be transmitted to the 220kV switchyard with overhead lines.

The Plant auxiliary loads will be fed from either the gas turbine generator via the auxiliary transformer or the external network via the startup transformer. The auxiliary and startup transformers will be connected to two (2) medium voltage switchgear buses via independent circuit breakers. The auxiliary power will be distributed from these medium voltage switchgear buses (6.3 kV).

1.9 Operation and Control System

A Block Control Room will be accommodated in the gas turbine or steam turbine building of the Plant and be equipped with a modern DCS control system so that the export heat and power can be automatically controlled to meet the demands of them. CRTs for monitoring of conditions and keyboard panels for operation of the Plant will be installed in the room.

The operating conditions can be also monitored through the Plasma Display Type Screen in the Block Control Room and the existing Central Control Room. The CRT operation will be employed to make a man-machine interface easier and to facilitate

easier monitoring and operation and higher operating reliability. The CPU shall be of duplicate configuration using the standby redundant system to ensure the reliability of the control system.

2. Scope of Works

2.1 Works and Services to be provided by the Contractor

The works and services to be provided by the Contractor shall include the design, manufacture, fabrication, factory testing, packing, transportation to site, unloading and storage at Site, erection, testing, trial operation, commissioning, reliability run, performance guarantee testing and handing over for commercial operation of the Plant on a full turn-key basis. The main works and services are as follows, but not limited to them.

(1) Gas turbine and its accessories

(2) Gas turbine generator and its accessories

(3) Heat recovery steam generator and its accessories

(4) Steam turbine and its accessories

(5) Steam turbine generator and its accessories

(6) Electrical system for gas turbine generator

(7) Electrical system for steam turbine generator

(8) 220kV switchyard system including interconnection lines from main transformers

(9) Electrical systems common to the Plant

(10) Mechanical systems common to the Plant

(11) Steam turbine condenser and its accessories

(12) Circulating cooling water system

(13) Makeup water treatment system

(14) Water treatment system

(15) Closed cooling water system for cooling of lubricating oil and other cooling media.

(16) Hot water supply system

(17) Civil works of equipment and building foundations and concrete structures.

(18) Architectural works with necessary facilities.

(19) Fire protection system for the Plant

(20) Natural gas pre-treatment and compressor station

(21) Main stack and bypass stack and diverter damper

(22) Station and instrument air supply system

(23) Plant control and monitoring system

(24) Continuous emission monitoring system

(25) Erection works of all equipment in scope of supply of the Contractor

(26) Training of SJSC "Uzbekenergo's" staff at manufacturer's factory

(27) Training of SJSC "Uzbekenergo's" staff at site

(28) All necessary documentation related to the operating procedures and maintenance of the Plant.

(29) All documents and as-built drawings of the Plant

(30) Personal computer based plant simulation device for training of operators

(31) Six (6) months supervision by three (3) contractor engineers for operation and maintenance support

(32) Spare parts for five (5) years operation

(33) Factory and site inspections and tests

(34) Trial operation and commissioning

(35) Reliability test and performance guarantee tests

(36) Application and acquisition of permits and certificates for the Plant

(37) Necessary modification works of existing buildings to be reused for the Plant

(38) Standard and special tools

2.2 Works and Services to be provided by SJSC "Uzbekenergo"

The following works and/or services associated with the Plant will be provided by SJSC "Uzbekenergo"

(1) Tap water, service water, auxiliary steam, low and medium voltage electric power for use during construction, commissioning and guarantee and reliability tests.

(2) Detailed Environmental Impact Assessment (EIA) report

(3) All necessary environmental permits for construction and operation of the plant.

(4) Topography mapping/surveying.

(5) Site Soil Investigation/Borings.

(6) Natural gas and back feed electric power for commissioning and guarantee

and reliability tests from 220kV transmission line.

(7) Preparation and leveling of site area including temporary storage area during construction and preparation of access road for carrying-in of heavy components

(8) Demolition of any structures on the site surface and underground, if any.

(9) Relocation of the existing natural gas and hot water pipelines.

(10) Relocation and modification of the existing 35 kV and 220 kV overhead lines

(11) Relocation of maintenance facilities in existing workshop to the existing building

(12) Space to warehouse the spare parts and special maintenance facilities

(13) Fencing around the Plant site, access road to the equipment and drainages inside the Plant site.

(14) Labours, facilities and tools available at the site for the inspection at the end of Defect Liability Period

(15) Accommodation fees, daily allowance and traveling and transportation fees for witness of inspection and test at factories of equipment

(16) Periodic provision of operation and maintenance record data and information during the Defect Liability Period to the Contractor and the Consultant.

3. Utility Services/Connections

Utility connection interfaces shall consist primarily of the followings:

(1) Interconnections to existing 220 kV switchyard.

(2) Natural gas fuel supply line.

(3) Condenser circulating water discharge connection

(4) Auxiliary steam for start-up of the steam turbine

(5) HRSG makeup water

(6) Waste water

(7) Potable water

(8) Service water

(9) Fire fighting water

(10) Service air

(11) Service steam

(12) Extracted steam to the steam/hot water converter

(13) Return steam drain from steam/hot water converter

(14) Instrument air

(15) 6.3kV electric power for interconnection

(16) Low voltage electric power for construction

4. Climate

According to the ambient temperature data during the past 20 years, the average annual temperature is calculated at 16.0 ℃ with a maximum temperature of 41.1 ℃ and minimum temperature of – 15.5 ℃. Annual average relative humidity is 52.0 % with higher value during winter season and lower value during summer season. Averaged annual rainfall is 405mm with the maximum hourly rainfall of 3mm.

The site ambient temperature conditions and design conditions are shown in Table 1.

5. Design Criteria

The design criteria for the Plant will conform to the International codes and Standards. Environmental considerations such as air quality, thermal discharge, and wastewater effluent quality will be in compliance with Uzbekistan environmental standards.

Plant equipment will be in compliance with the internationally acceptable codes and standards. Civil and architectural works will conform to Uzbekistan standards.

6. Project Completion Date

The combined cycle will be completed and ready for commercial operation within 34 months from the date of Proceed to Notice, which is expected to be May 1, 2007. The advanced commercial operation of the gas turbine/generator package will not be considered.

Table 1 Specific Description of the Plant

1.	Plant Specification	
	Type	Unfired Multi-shaft Type Combined Cycle Cogeneration Plant with Bypass Stack
	Nominal Power Output Capacity without Steam Extraction	370MW on 16 ℃ ambient temperature, 52% of relative humidity and 12 ℃ of cooling water temperature
	Heat Export Capacity with Steam Extraction	Maximum 100 Gcal/h on 3 ℃ of ambient temperature and 6 ℃ of cooling water temperature
	Fuel	Natural Gas
	Number of Units	One (1)
	Plant Configuration	The main components are : One (1) Gas Turbine One (1) Heat Recovery Steam Generator One (1) Extraction Condensing Steam Turbine One (1) Generator for Gas Turbine One (1) Generator for Steam Turbine Two (2) Main Transformers
2.	Gas Turbine	
	Type	Simple Open Cycle Heavy Duty Single-shaft
	Gas Temperature at 1st Stage Nozzle	1,300 ℃ Class inlet temperature Speed 3,000 rpm
	NOx emission	25 ppm vol. (15% O_2 dry)
3.	Heat Recovery Steam Generator	
	Type	Unfired Gas Lateral or Vertical Flow Natural or Forced Circulation
	Steam Generation	Approximately 330 t/h
	Pressure (nominal)	High pressure 10 MPa

	Intermediate pressure	2.5 MPa
	Low pressure	0.5 MPa
Temperature (nominal)	High pressure	540 ℃
	Intermediate pressure	540 ℃
	Low pressure	260 ℃

4. Steam Turbine

Type	Reheat, extraction/condensing, two (2) cylinders, downward exhaust with surface condenser
Speed	3,000 rpm
Exhaust pressure	8 kPa

5. Circulating Water Pump

Type	Motor driven vertical mixed flow type
Number	One (1)

6. Intake Water System

Type	From intake canal through trash rack and travelling screen

7. Electrical Equipment

7.1 Generators for gas turbine and steam turbine

Type	Horizontal cylindrical rotor, rotating field synchronous generator
Rated Nominal Capacity	300 MVA/150 MVA
Rated Frequency	50 Hz
Synchronous Speed	3,000 rpm
Rated Voltage	22 kV
Power Factor	0.85 lagging
Cooling Method	Air cooled
Excitation Method	Thyrister static with a separated back-up exciter system.
Insulation Class	Class F with Class B temperature rise

7.2 Switchyard

Type	Air insulated outdoor type

Bus system	Double bus and reserve bus with single feeder circuit breaker for load or generation
Nominal Voltage	220 kV
Incoming Bays	Two (2)

Table 2 Site Temperature of Air and Water and Humidity

Ambient Air (monthly average) Temperature

	Dry Bulb℃
January	- 0.3
February	- 5.3
March	11.9
April	17.2
May	24.9
June	28.2
July	27.2
August	25.8
September	19.7
October	12.8
November	10.6
December	4.7
Minimum air temperature:	- 15.5℃
Maximum air temperature:	41.1℃
Yearly average temperature:	16.0℃

Ambient Air (monthly average) Relative Humidity (%)

January	73
February	66
March	55
April	53
May	40
June	30
July	34
August	39
September	39
October	62
November	68
December	69
Minimum humidity:	9
Yearly average humidity	52

Cooling water

Maximum water temperature:	16℃
Minimum water temperature:	3℃
Average water temperature:	9.5℃

Table 3 Typical Properties of Natural Gas (Shurtan)

Properties Compositions	Volume Percent (%)
Methane	91.79
Ethane	3.89
Propane	0.92
Normal Butane	0.13
Isobutane	0.12
Nitrogen	0.73
Carbon Dioxide	2.35
Hydrogen Sulfide	0.07(Max. 0.12)
Total	100.0
Specific Energy	MJ/Nm^3 kg
Gross specific energy	40.53
Net specific energy	36.53
Specific Gravity	0.7903 kg/Nm^3
Temperature	Min. 2℃, Max. 26℃
Pressure	0.6 MPa

Attachment A

Application Forms

LIST OF FORMS

[Letterhead paper of the Applicant, or partner responsible for a joint venture, including full postal address, telephone no., fax no., telex no., and cable address]

Date .....

To: (name of Employer)

Sirs,

1. Being duly authorized to represent and act on behalf of .....
.....
(hereinafter to be referred to as "the Applicant"), and having reviewed and fully understood all the pre-qualification information provided, the undersigned hereby apply to be pre-qualified as a bidder of the following Contract for (name of Project) .

Contract Number	Contract Name
No.	(Insert name of Contract)

2. Attached to this letter are copies of the following original documents defining[1]:

   (a) the Applicant's legal status;

   (b) the principal place of business; and

   (c) the place of registration and the nationality of the Owners (for applicants who are partnership or individually-owned firms).

3. Your agency and its authorized representatives are hereby authorized to conduct any inquires or investigations to verify the statements, documents, and information submitted in connection with this application, and to seek clarification from our bankers and clients regarding any financial and technical aspects. This Letter of Application will also serve as authorization to any individual or authorized representative of any institution referred to in the supporting information, to provide such information deemed necessary and requested by yourselves to verify statements and information provided in this application, or with regard to the resources, experience, and competence of the Applicant.

---

(1) For applications by a joint venture or consortium, all the information required as pre-qualification documents shall be provided as the joint venture or the consortium. The lead partner shall be clearly identified. Each partner in the joint venture or the consortium shall sign the letter.

4. Your Agency and its authorized representatives may contact the following persons for further information:

General and managerial inquiries	
Contact 1	Telephone 1
Contact 2	Telephone 2

Personnel inquiries	
Contact 1	Telephone 1
Contact 2	Telephone 2

Technical inquiries	
Contact 1	Telephone 1
Contact 2	Telephone 2

Financial inquiries	
Contact 1	Telephone 1
Contact 2	Telephone 2

5. This application is made under the understanding that;

   (a) all information submitted for pre-qualification will be subject to verification at the time of bidding;

   (b) your Agency reserves the right to:
   - amend the scope and value of any Contract to be bid. In such event, the pre-qualification process will be repeated depending upon the extent of the revised scope and value; and
   - reject or accept any application, cancel the pre-qualification process, and reject all applications; and

   (c) your Agency shall not be liable for any such actions and shall be under no obligation to inform the Applicant of the grounds for them.

6. Appended to this application, we give details of the participation of each party, including capital contribution and profit/loss agreements, in the joint venture or consortium. We will also specify the financial commitment in terms of the percentage of the value of the Contract, and the responsibilities for execution of the Contract.

7. We confirm that the bid as well as any resulting Contract will be:

   (a) signed so as to legally bind all partners, jointly and severally; and

   (b) submitted with a joint venture or a consortium agreement providing the joint and several liability of all partners in the event the contract is awarded to us.

8. The undersigned declare that the statements made and the information provided in the duly completed application are complete, true, and correct in every detail.

Signed	Signed
Name	Name
For and on behalf of (name of Applicant or lead partner of a joint venture or a consortium)	For and on behalf of (name of partner)

Signed	Signed
Name	Name
For and on behalf of (name of partner)	For and on behalf of (name of partner)

Signed	Signed
Name	Name
For and on behalf of (name of partner)	For and on behalf of (name of partner)

Application Form (1)

General Information

All individual firms and each partner of a joint venture or a consortium applying for pre-qualification are requested to complete the information in this form. Nationality information to be provided for all owners or applicants who are partnerships or individually owned firms.

Where the Applicant proposes to use subcontractors for critical components of the works, or for work contents in excess of 25 percent of the value of the whole works, the following information should also be supplied for such subcontractor(s).

1.	Name of firm	
2.	Head office address	
3.	Telephone	Contract
4.	Fax	Telex
5.	Place of incorporation/registration	Year of incorporation/registration

Nationality of owners [1]		
	Name	Nationality
1.		
2.		
3.		
4.		
5.		

[1] To be completed by all owners of partnerships or individually-owned firms

Application Form (2)

General Experience Record

Name of Applicant or partner of a joint venture or a consortium

All individual firms and all partners of a joint venture or a consortium are requested to complete the information in this form. The information supplied should be the annual turnover of the Applicant (or each member of a joint venture or a consortium), in terms of the amounts billed to clients for each year for work in progress or completed, converted to U.S. dollars at the rate of exchange at the end of the period reported.

Use a separate sheet for each partner of a joint venture or a consortium.

Annual turnover data (construction only)		
Year	Turnover	US$ equivalent
1.		
2.		
3.		
4.		
5.		

Application Form (2A)

Page of Pages

Joint Venture or Consortium Summary

Names of all partners of a joint venture or a consortium
1. Lead partner
2. Partner
3. Partner
4. Partner
5. Partner

Total value of annual construction turnover, in terms of work billed to clients, in US$ equivalent, covered at the rate of exchange at the end of the period reported:

Annual turnover data (construction only; US$ equivalent)						
Partner	Form 2 Page no.	Year 1	year 2	Year 3	Year 4	Year 5
1. Lead Partner						
2. Partner						
3. Partner						
4. Partner						
5. Partner						
6. Partner						
Totals						

Application Form (2B)

Joint Venture or Consortium Agreement

To: _____

_____
(*name and address of the Employer*)

The undersigned of this declaration of cooperation are by means of attached Power of Attorney legally authorized to act with regard to _____ _____(*name of the Project*) and on behalf their organizations.

They hereby declare:

1. that they will legalize a Joint Venture or Consortium Agreement in case that a Contract for the _____ (*name of the Project*) is awarded to their group;

2. that they have nominated _____ (*name of the lead partner*) as the Sponser Firm of the group for the purpose of this Bid;

3. that they authorized Mr./Ms._____ (*name of the person who is authorized to act as the Representative on behalf of the Joint Venture or Consortium*) to act as the Bidder's Representative in the name and on behalf of their group.

4. that all partners of the Joint Venture or Consortium shall be liable jointly and severally for the execution of the Contract;

5. that this Joint Venture or Consortium is an association constituted for the purpose of the execution of _____ (*name of the Project*) under this Contract;

6. that if the Employer accepts the Bid of this Joint Venture or Consortium, it shall not be modified in its composition or constitution until the completion of the Contract without the prior consent of the Employer;

7. that each partner's share of the Work, stated as percentage of the total contract amount, shall be as follows:

Name of Partner	Share of the Work (as percentage of the contract amount)
1. Lead partner	
2. Partner	
3. Partner	
4. Partner	

Name of Partner	Share of the Work (as percentage of the contract amount)
Total	100

Give names and positions of the proposed Joint Venture or Consortium Representatives, as well as organization's names and addresses:

1.	Name:	Signature:
	Position:	Date:
	Representative of :(Organization's Name)	

2.	Name:	Signature:
	Position:	Date:
	Representative of :(Organization's Name)	

3.	Name:	Signature:
	Position:	Date:
	Representative of :(Organization's Name)	

4.	Name:	Signature:
	Position:	Date:
	Representative of :(Organization's Name)	

5	Name:	Signature:
	Position:	Date:
	Representative of :(Organization's Name)	

Application Form (3)

Page of Pages

Particular Experience Record

Name of Applicant

The Applicant shall be required to pass the specified requirements applicable to this form, as set out in the "pre-qualification Instructions to Applicants".

On a separate page, using the format of Form (3A), each applicant or partner of a joint venture or a consortium is requested to list all contracts of a value equivalent to or more 250 Million USD, of similar combined cycle power plants to the contract for which the Applicant wishes to qualify, undertaken during the last five (5) years. The value should be based on the currencies of the contracts converted into US dollars, at the date of substantial completion or for current contracts at the time of award. The information is to be summarized using Form (3A), for each contract completed or under execution by the Application or by each partner of a joint venture or a consortium.

Application Form (3A)

Page of Pages

Contracts of Power Plants

Name of Applicant or partner of a joint venture or a consortium

Use a separate sheet for each contract.

1.	Number of contract
	Name of contract
	Country
2.	Name of employer
3.	Employer address
4.	Type of power plants and special features relevant to the contract for which the Applicant wishes to pre-qualify
5.	Contract role (check one) ☐ Sole Contractor ☐ Subcontractor ☐ Partner in a joint venture or a consortium
6.	Value of the total contract (in specified currencies at completion, or at date of award for current contracts). Currency Currency Currency
7.	Equivalent value US$
8.	Date of award
9.	Date of completion
10.	Contract duration (years and months) _____ years _____ months

Application Form (4)

Page of Pages

Summary of Current Contracts of Power Plants in Progress

Name of Applicant or partner of a joint venture or a consortium

The Applicant and each partner to the application shall provide information on their current commitments to all contracts of similar power plants that have been awarded, or for which a letter of intent or acceptance has been received.

Name of contract	Value of contract (current US$ equivalent)	Expected completion date
1.		
2.		
3.		
4.		
5.		
6.		

Application Form (5)

Page of Pages

Multi-shaft Combined Cycle Power Plants (Blocks)

Name of Applicant

The Applicant shall provide adequate information to demonstrate clearly that it meets the requirements shown in Sub-clause 2.2-7) of Instruction to Applicants. A separate Form (5) shall be prepared for each combined cycle plant (block) at most five (5) plants (blocks).

Descriptions	Data
Name of Purchaser	
Location of Installation	
Country of Installation	
Type of Shaft Configuration	
Number of Gas Turbines for Block	
Power Block Site Rated Capacity MW	
Date of Commercial Operation Start	
Gas Turbine Model Number/Supplier	
Country of Gas Turbine Manufacture	
Type of Main Fuel	
Type of Standby Fuel (if applicable)	
Gas Turbine Capacity at ISO Conditions MW	
Gas Turbine Capacity at Site Conditions MW	
Gas Turbine Rotating Speed RPM	
Name of Generator Supplier	
Type of Cooling Method of Generators	
Country of Generator Manufacture	
Generator Rating for Gas Turbine MVA	
Generator Rating for Steam Turbine MVA	
Name of Steam Turbine Supplier	
Country of Steam Turbine Manufacture	
Steam Turbine Capacity at Site Condition MW	
Steam Turbine Configuration/Type	

Descriptions	Data
HP Turbine Inlet Steam Pressure bar	
HP Turbine Inlet Steam Temperature ℃	

Combined Cycle Power Block	Data
Steam Turbine Rotating Speed RPM	
Name of HRSG Supplier	
Country of HRSG Manufacture	
HRSG HP SH Steam Outlet Pressure bar	
HRSG HP SH Steam Outlet Temperature℃	
HRSG Total Steam Flow Kg/sec	
Maximum Export Heat Energy Capacity (if applicable) Gcal/h	
Pressure of Steam Extracted for Heat Energy Export bar	
Temperature of Steam Extracted for Heat Energy Export ℃	
Annually Averaged Power Block Reliability for Last Five (5) Years	
Reliability Factor (ISO 3977-9) %	
Availability Factor (ISO 3977-9) %	
Operating Hours Hours	
Scheduled Maintenance Hours Hours	
Forced Outage Hours Hours	
Accumulated Commercial Operating Hours on Main Fuel as of Tender Closing Date Hours	
Accumulated Commercial Operating Hours on Standby Fuel as of Tender Closing date Hours	
Accumulated Power and Heat Energy in Commercial Operation as of Tender Closing Date for Both Fuels GWh	

Application Form (6)

Page of Pages

Gas Turbines

Name of Applicant

The Applicant shall provide adequate information to demonstrate clearly that it meets the requirements listed in Sub-clause 2.2-8) of **Instruction to Applicants**. A separate Form (6) shall be prepared for each similar gas turbine at most five (5) units.

Descriptions		Data
Name of Purchaser		
Location of Installation		
Country of Installation		
Model Number		
Name of Supplier		
Country of Manufacture		
Type of Main Fuel		
Type of Standby Fuel (if applicable)		
Capacity at ISO Conditions	MW	
Capacity at Site Conditions	MW	
Plant Configuration		
Number of Stages – HP Turbine		
Number of Stages – LP Turbine		
Turbine Inlet Temperature to 1st Stage Stationary Blade of HP and LP Turbine	℃	HP Turbine LP Turbine
Exhaust Gas Temperature at ISO Conditions	℃	
Rotating Speed of Gas Turbine	RPM	
Type of Compressor		
Number of Stages		
Inlet Air Flow at ISO Conditions	kg/s	
Compressor Discharge Pressure at ISO Condition	bar	
Type and Number of Combustion Liners		

Descriptions		Data
Annually Averaged Reliability for Last Five (5) Years		
Reliability Factor (ISO 3977-9)	%	
Availability Factor (ISO 3977-9)	%	
Operating Hours	Hours	
Scheduled Maintenance Hours	Hours	
Forced Outage Hours	Hours	
Date of Commercial Operation Start		
Accumulated Commercial Operating Hours on Main Fuel as of Tender Closing Date	Hours	
Accumulated Commercial Operating Hours on Standby Fuel as of Tender Closing Date	Hours	
Accumulated Power Energy in Commercial Operation as of Tender Closing Date for Both Fuels	GWh	

Application Form (7)

Page of Pages

Heat Recovery Steam Generators

Name of Applicant

The Applicant shall provide adequate information to demonstrate clearly that it meets the requirements listed in Sub-clause 2.2-9) of **Instruction to Applicants.** A separate Form (7) shall be prepared for each similar heat recovery steam generator at most five (5) units.

Descriptions	Data
Name of Purchaser	
Location of Installation	
Country of Installation	
Model No. of Gas Turbine coupled with the HRSG	
Type of fuel(s) used in the Gas Turbine	
Type of Flow Direction of Exhaust Gas	
Type of Steam Cycle	
Type of Deaerator	
Steam Temperature at Outlet of HRSG	
High pressure ℃	
Intermediate pressure ℃	
Low pressure ℃	
Steam Pressure at Outlet of HRSG	
High pressure bar	
Intermediate pressure bar	
Low pressure bar	
Steam Flow Rate at Outlet of HRSG	
High pressure t/h	
Intermediate pressure t/h	
Low pressure t/h	
HRSG Inlet Gas Temperature ℃	
HRSG Exit Gas Temperature ℃	
Annually Averaged Reliability for Last Five (5) Years	

Descriptions		Data
Reliability Factor (ISO 3977-9)	%	
Availability Factor (ISO 3977-9)	%	
Operating Hours	Hours	
Scheduled Maintenance Hours	Hours	
Forced Outage Hours	Hours	
Date of Commercial Operation Start		
Accumulated Commercial Operating Hours on the exhaust gas with main fuel as of Tender Closing Date	Hours	
Accumulated Commercial Operating Hours on the exhaust gas with standby fuel as of Tender Closing Date	Hours	

Application Form (8)

Page of Pages

Steam Turbines

Name of Applicant

The Applicant shall provide adequate information to demonstrate clearly that it meets the requirements listed in Sub-clause 2.2-9) of **Instruction to Applicants**. A separate Form (8) shall be prepared for each similar steam turbine for Combined Cycle Power Plant at most five (5) units.

Descriptions		Data
Name of Purchaser		
Location of Installation		
Country of Installation		
Type of Steam Cycle		
Type of Steam Turbine Configuration		
Type of Plant where Steam Turbine is Used		
Site Rated Power Output	kW	
Steam Temperature at Inlet to Turbine		
High pressure	℃	
Intermediate pressure	℃	
Low pressure	℃	
Steam Pressure at Inlet to Turbine		
High pressure	bar	
Intermediate pressure	bar	
Low pressure	bar	
Steam Flow Rate		
High pressure	t/h	
Intermediate pressure	t/h	
Low pressure	t/h	
Extracted Steam Conditions		
Pressure	kPa	
Temperature	℃	
Flow	kg/h	
Exhaust Pressure	kPa	

Descriptions		Data
Annually Averaged Reliability for Last Five (5) Years		
Reliability Factor (ISO 3977-9)	%	
Availability Factor (ISO 3977-9)	%	
Operating Hours	Hours	
Scheduled Maintenance Hours	Hours	
Forced Outage Hours	Hours	
Date of Commercial Operation Start		
Accumulated Commercial Operating Hours as of Tender Closing Date	Hours	

Application Form (9)

Page of Pages

Generators

Name of Applicant

The Applicant shall provide adequate information to demonstrate clearly that it meets the requirements listed in Sub-clauses 2.2-9) and 2.2-10) of **Instruction to Applicants**. A separate Form (9) shall be prepared for each similar generator(*) for Combined Cycle Power Plant at most five (5) units.

Descriptions	Data
Name of Purchaser	
Location of Installation	
Country of Installation	
Model Number/Frequency/Number of Phase	
Name of Supplier	
Country of Manufacture	
Site Rated Power Output kW	
Rated Power Factor	
Rated Rotating Speed rpm	
Rated Voltage KV	
Rated Current A	
Rated Field Current A	
Excitation Voltage V	
Cooling Type and Cooling Medium	
Basic Cooling Medium Temperature (℃)	
Rated Cooling Medium Pressure MPa	
Year of Manufacture	
Type of Excitation	
Standard Applied	
Type of Insulation and Temperature Rise Limit (℃)	
Annually Averaged Reliability for Last Five (5) Years	
Reliability Factor (ISO 3977-9) %	
Availability Factor (ISO 3977-9) %	

Descriptions		Data
Operating Hours	Hours	
Scheduled Maintenance Hours	Hours	
Forced Outage Hours	Hours	
Date of Commercial Operation Start		
Accumulated Commercial Operating Hours as of Tender Closing Date	Hours	

(*): The generator manufacturer will be qualified as a manufacturer to be able to provide the similar generator to the Projectwith either of the following two (2) conditions;

1. The manufacturer has experience with construction of at least three (3) air cooled generators over 260 MVA as per IEC 34 or equivalent standards.

2. The manufacture has experience with construction of at least three (3) air cooled generators over 150 MVA and at least three (3) hydrogen cooled generators over 500MVA as per IEC or equivalent standards. The information of the hydrogen cooled generators shall be also provided with above Application Form (9).

Application Form (10)

Page of Pages

Financial Capability

Name of Applicant or partner of a joint venture or a consortium

Applicants, including each partner of a joint venture or a consortium, should provide financial information to demonstrate that they meet the requirements stated in the Instructions to Applicants. Each applicant or partner of a joint venture or a consortium must fill in this form. If necessary, use separate sheets to provide complete banker information. A copy of the audited balance sheets should be attached.

Banker	Name of banker	
	Address of banker	
	Telephone	Contact name and title
	Fax	Telex

Summarize actual assets and liabilities in U.S. dollar equivalent (at the rates of exchange current at the end of each year) for the last five (5) years. Based upon known commitments, summarize projected assets and liabilities in U.S. dollar equivalent for the next two (two) years.

Billion US $

Financial information in US$ equivalent	Actual; Last five (5) years					Projected: next two (2) years	
Year	-5	-4	-3	-2	-1	1	2
1. Total assets							
2. Current assets							
3. Total liabilities							
4. Current liabilities							
5. Profit before taxes							
6. Profit after taxes							

Application Form (11)

Page of Pages

Litigation History (including ODA related contracts)

Name of Applicant or partner of a joint venture or a consortium

Applicant, including each of the partners of a joint venture, should provide information on any history of litigation or arbitration resulting from contracts executed in the last two (2) years or currently under execution. A separate sheet should be used for each partner of a joint venture or a consortium.

Year	Award for or against Applicant	Name of client, cause of litigation, and matter in dispute	Disputed amount (current value, US$ equivalent)

Attachment B

Pass/Fail Evaluation Form

Sub-clause to be referred to	Requirements	Pass	Fail	Remarks
2.2-3)	· Provision of accurate information on any litigation or arbitration.			
2.2-3)	· A consistent history of awards against the Bidder or any partner			
2.2-4)	· Total amount of EPC contracts of combined cycle power plants for the last five (5) years more than US$ 500 million.			
2.2-4)	· Averaged annual turnover for the last five (5) years minimum US$ 250 million.			
2.2-5)	· Provision of financial capabilities of Applicants in accordance with the attached Application Form (10).			
2.2-6)	· Provision of audited financial statements for the last five (5) years.			
2.2-4)	· The number of contracts for similar size of combined cycle power plants to the current project are more than one (1) in the last five (5) years			
2.2-7)	· Association agreement between the gas turbine manufacturer and the Applicant.			
2.2-7)	· Applicant and/or the GT manufacturer completed on a full turnkey basis more than (1) multi-shaft combined cycle power plant (block) with output larger than 350MW outside			

Sub-clause to be referred to	Requirements	Pass	Fail	Remarks
	its domicile country. · Application Form (5) to be used.			
2.2-7)	· The each combined cycle plant (block) has the experience with commercial operation more than 7,500 hours at Pre-qualification closing date. · Application Form (5) to be used.			
2.2-7)	· Written confirmation of successful operation of more than one (1)combined cycle power plant certified by the plant owners.			
2.2-8)	· The proposed GT is similar with more than one (1) natural gas fired gas turbines with a low NOx combustion system, which have the experience of successful commercial operation with at least 7,500 hours on the pre-qualification closing date. · Application Form (6) to be used.			
2.2-8)	· The Applicant provides written confirmation on the operating experience certified by the plant owners of the gas turbines.			
2.2-9)	· Identification of names of manufacturers of Gas Turbine Steam Turbine			

Sub-clause to be referred to	Requirements	Pass	Fail	Remarks
	Heat Recovery Steam Generator Electric Generator Main transformer			
2.2-9)	· The manufacturer has five (5) years experience in the manufacture of the heat recovery steam generator, steam turbine, electric generator and main transformer.			
2.2-9)	· The manufacturer has the experience in the manufacture more than (1) unit of the heat recovery steam generators (Application Form (7)), steam turbines (Application Form (8)), electric generators (Application Form (9)) and main transformers (Free form available) of similar size.			
2.2-10)	· Participation of qualified air-cooled generator manufacturers			
2.2-11)	· Bidder submitted the following documents; a. Experience and performance on multi-shaft type similar or larger size combined cycle power plants. b. Construction on a full turnkey basis experience with more than one (1) combined cycle power plant (block) over 250 MW in CIS and Turkey with similar climatic, geographical and economical conditions. c. Supporting letter(s) from Owners. d. Experience and performance of manufacturers to be			

Sub-clause to be referred to	Requirements	Pass	Fail	Remarks
	engaged for supplying the major equipment. e. Association agreement letter with gas turbine manufacturer. f. Audited annual report for the last five (5) years.			
2.2-13)	· The Bidder has qualified personnel a. Project Manager b. Project Engineer c. Site Manager d. Documentation e. Lead Mechanical Engineer f. Lead Electrical Engineer g. Lead Controls Engineer h. Lead Civil/Structural Engineer			
2.3-(1)	· A copy of business registration certificate submitted.			
2.3-(2)	· Certificates by public accountants to the Applicant's financial statements submitted.			
2.3-(3)	· Completion certificates submitted.			
2.4-1)-(1)-(i)	· The lead partner of the Joint Venture or Consortium meets the qualifying criteria.			
2.4-1)-(1)-(ii)	· Each of the other partners of the Joint Venture or Consortium meets individually the qualifying criteria.			

Sub-clause to be referred to	Requirements	Pass	Fail	Remarks
2.4-1)-(1)-(iii)	· The Joint Venture or Consortium meets collectively the qualifying criteria.			
2.4-1)-(3)	· Signing of any Bid to legally bind all partners and submission of Joint Venture or Consortium Agreement			
2.5	· The Applicant does not have any conflict of interest.			
Application Forms	· All Application Forms requested by this Pre-qualification Documents are fully completed.			

3. ROUTE SURVEY REPORT FOR TRANSPORTATION OF NEW POWER PLANT EQUIPMENT

Route Survey

Over-dimensional Project cargo transportation.

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Turkmenbashi Port, Turkmenistan -
Tashkent Power station, Uzbekistan
2,420 kilometers

Route

- Tashkent
- Samarkand
- Navoiy
- Bukhara
- Pitnak
- Bayramaly
- Mary
- Tejen
- Ashgabat
- Nebitdag
- Turmenbashi

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Route Survey report:
Tashkent to Turkmenbashi Port

Purpose of survey.

To investigate the route from Turkmenbashi Port to Tashkent Power station for transportation of Over-dimensional Project cargo.

General information:

Loading point:	**Turkmenbashi Sea Port, Turkmenistan**
Offloading Point :	**Tashkent Power Station, Uzbekistan**

Survey is for information on general conditions only.

Unless otherwise stated all roads are of asphalt black top, of 7m width, of category 1 and in suitable condition for transport of heavy cargo.

Visually inspection only has been made on Bridges.

Bridges of single 6m sections not considered in report unless problematic.

Domestic and communication lines have not been considered.

All transportation of heavy and oversize cargo is subject to routing approved by the relevant authorities in Turkmenistan and Uzbekistan.

Uzbekistan authority will certainly consider a survey report from their own transport engineering department, based on full cargo details, from which a routing will be authorised. They will recommend all repairs and insist on power line shut downs in accordance with safety clearances.

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High tension Power line clearances are as follows:

35kv:	2.0m
110kv:	2.5m
220kv:	3.5m
500kv:	4.5m

- Rail line de-energising for lifting is by arrangement and usually in daylight hours.
- There is no restriction on night movement but camels are frequently encountered on all roads.
- Temperatures can be very high and this has to be taken into consideration for transit timing.
- Both countries are divided into Districts and in most cases there are police checks at each demarcation point.

In Uzbekistan at many of these checkpoints lane restrictions are in place which are generally made up of concrete central reservation barriers around one meter height.

- Bridges are far below the standards encountered in Europe and in many cases assumed condition is based on previous crossings with excessive weight. It is not known how much damage has been done by previous overweight transports.
- The decision on granting a permit of transportation should only be taken After the actual supporting capacity of bridges is ascertained thorough investigation by engineers with appropriate equipment.

Overall recommendation:

Subject to authorisation from the relevant authorities and repairs as noted
Maximum cargo weight to be considered should not exceed 125 metric tons and such weights must be transported on minimum 14 axle lines.
Any transports should be kept to axle weights within 13 mtons
Maximum transport height on route considered is 5.6 metres.
Maximum width should be kept within 6 metres.

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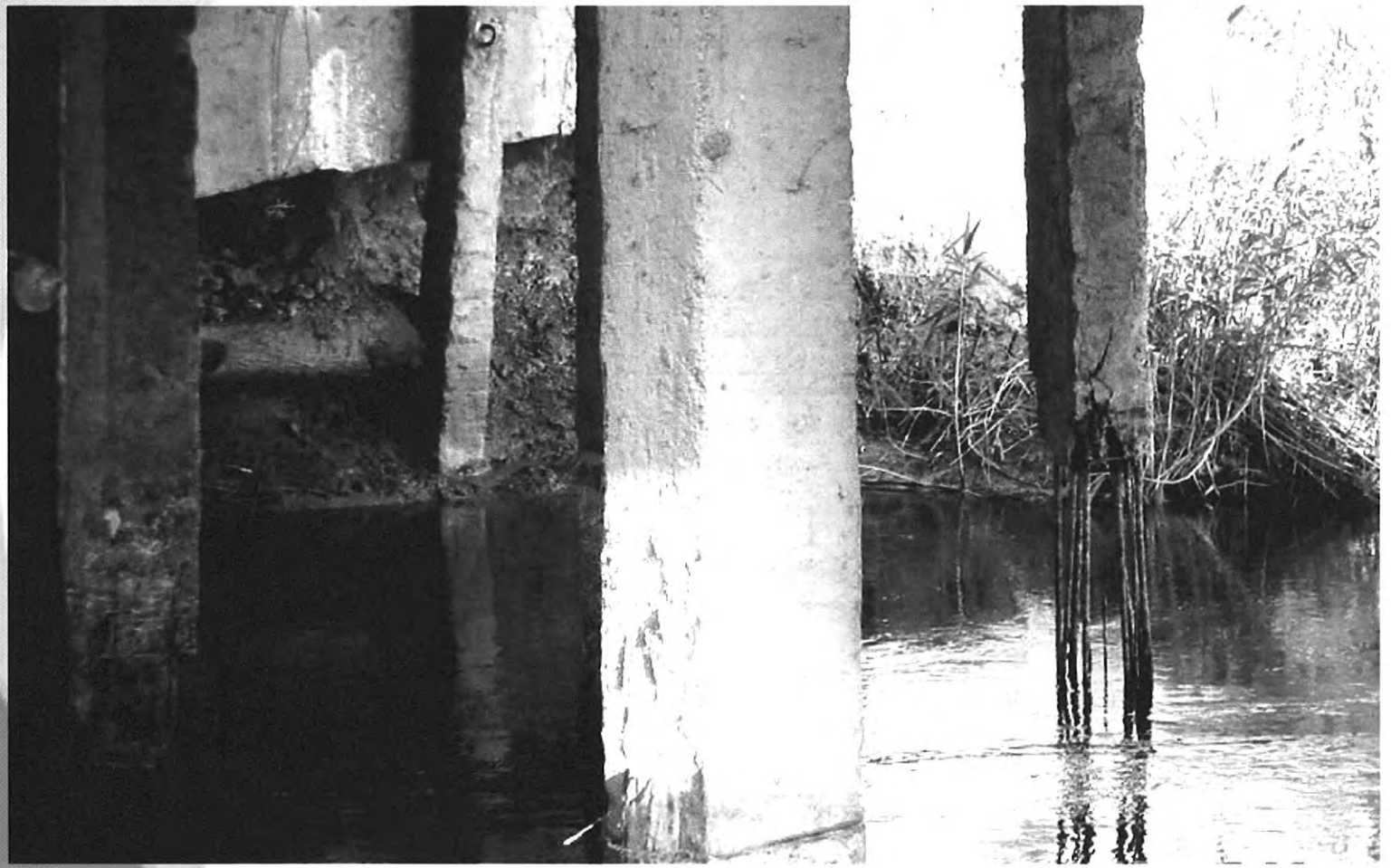
It should always be noted that there are several hundred bridges on this route and many Of the bridge pier support columns are poorly constructed and of unknown quality. Visual inspection above ground/water only has been made and this report cannot rule out situations as shown below where no inspection can take place.



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ODC TRANSPORT DATA SHEET. Recommended maximum

A	**EQUIPMENT CONSIDERED**	14	AXLE LINES		SPACE	63.00	m/2
		1	PRIME MOVER		WEIGHT	20.00	ton
B	**LOAD DIMENSIONS**	LENGTH	15.00	m	SPACE	90.00	m/2
		WIDTH	6.00	m	VOLUME	414.00	m/3
		HEIGHT	4.60	m	WEIGHT	125.00	ton
C	**WEIGHTS :**						
	MULTIWHEEL WEIGHT		53.20	ton			
	SPACER		0.00	ton			
	TRANSPORT BEAMS OR SADDLE			ton			
	TURNTABLE			ton			
	TOTAL MULTIWHEEL WEIGHT		53.20	ton			
	MOVERS WEIGHT .		20.00	ton			
	MOVERS BALLAST		18.00	ton			
	TOTAL MOVER WEIGHT		38.00	ton			
	LOAD WEIGHT		125.00	ton			
	TOTAL TRANSPORT PLATFORM WEIGHT		**178.20**	ton			
	LOAD CARRIED BY AXLE		**12.73**	ton			
	LOAD CARRIED BY WHEEL		**1.59**	ton			
	LOAD APPLICATION m/2		**2.83**	ton			
D	**DIMENSIONS :**		**SINGLE LINE**				
	CONVOY LENGTH		**31.70**	m			
	CONVOY WIDTH		**6.00**	m			
	NVOY HEIGHT		**5.60**	m	(5.5 for under obstacle only)		

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Turkmenistan Transport regulations

Over Dimensional Cargo: - Obtaining Special Transport Permit

General Information:

A. Normal dimensions. Meters

Length	20.0 truck + 1 trailer/semi trailer
	24.0 truck + 2 or more trailers
Width	2.5
Height	4.0 (foreign trucks 4.5 without permit)

If cargo exceeds more than two meters beyond rear platform of trailer.

B. Normal weight. mt.

Gross weight t/trailer	36.0
Axle load: Single axle	10.0 (6.0 for roads category 2 and under)
Double axle	16.0 (10.0 " " " ")
triple axle	22.0 (13.0 " " " ")

C. Normal / police escort req.

	Self	Police
Width	3.5	4.0
Length	24.0	30.0

D. Minor Authority coordination req.

Railway

Height	4.5 (and Energy and communication)
Width	5.0
Length	24.0

Municipal for crossing residential areas.

General procedure:

Road police Department:
Permission Issuing authority, Ashgabat.
- Application
- Schematic of vehicle and cargo and route.

Payment depends on distance and police convoy necessity.
"Turkmenavtoyollary" State concern.
Road/road facilities maintenance authority, Ashgabat.
- Application
- Permission issued by Road police for approval.

Payment depends on distance/weight/dimensions.
Turkmentelecom.
Communication lines maintenance authority, Ashgabat.
- Application
- Schematic of vehicle and cargo and route.

Payment depends on distance and no. of cut offs.
Ministry of Energy and Industry.
- Application
- Schematic of vehicle and cargo and route.

Payment depends on distance and no. of cut offs.
Railways.
Ashgabat.
- Application
- Schematic of vehicle and cargo and route.

Payment depends on number of crossings.

In case of over-height local com and energy enterprises have to be alerted to transportation separately

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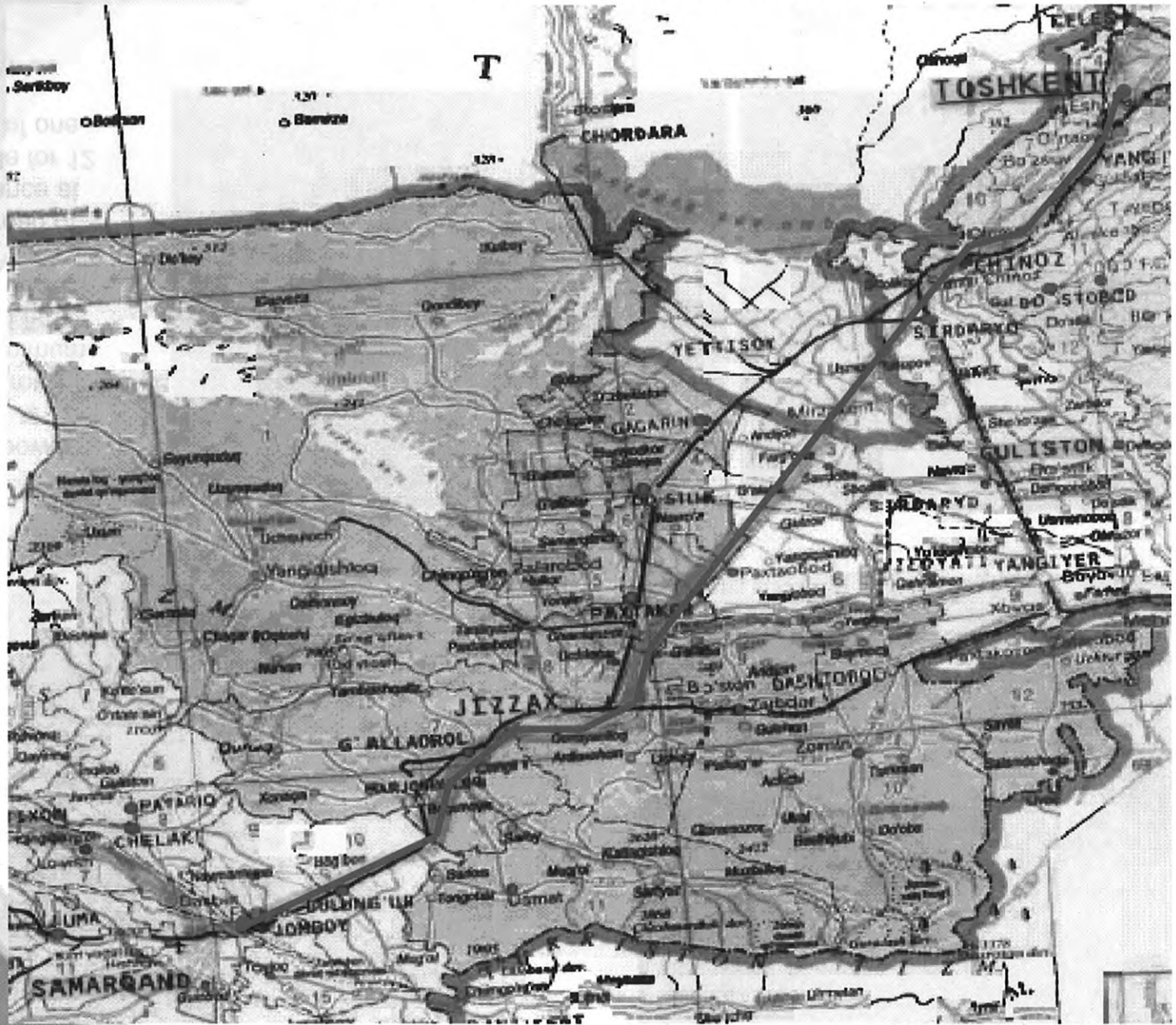
Section 1: Tashkent to Samarkand 327Kms



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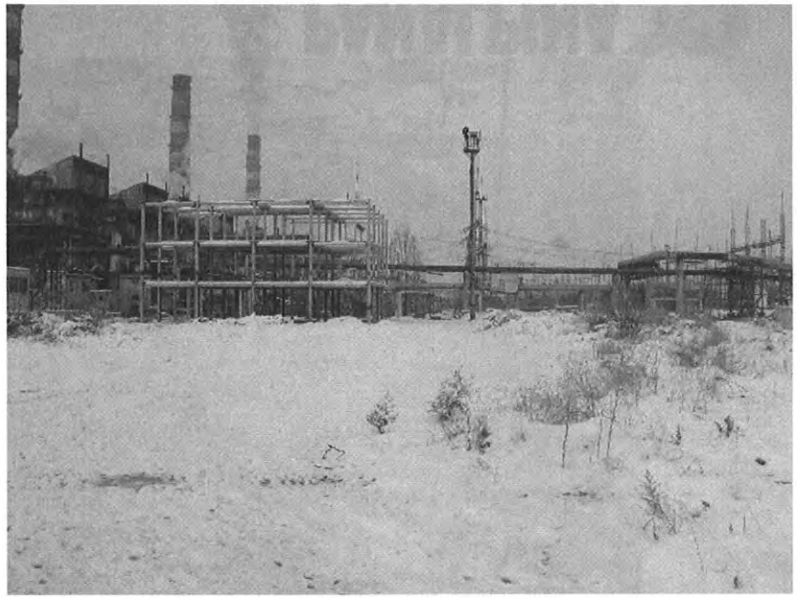
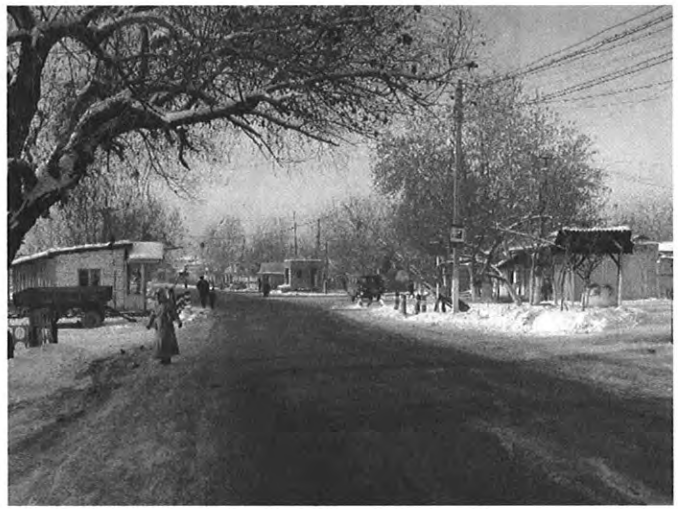
Tashkent Power station
41 22.68N
69 22.33E



Km 0
Proposed site for power station extension.
Access is through road 250m long with minimum 7m clear width and 6m height under various overhead pipes.
Turning left from road of 13m width. Clearance at corner/turn suitable for 12 axle with removal of one tree.



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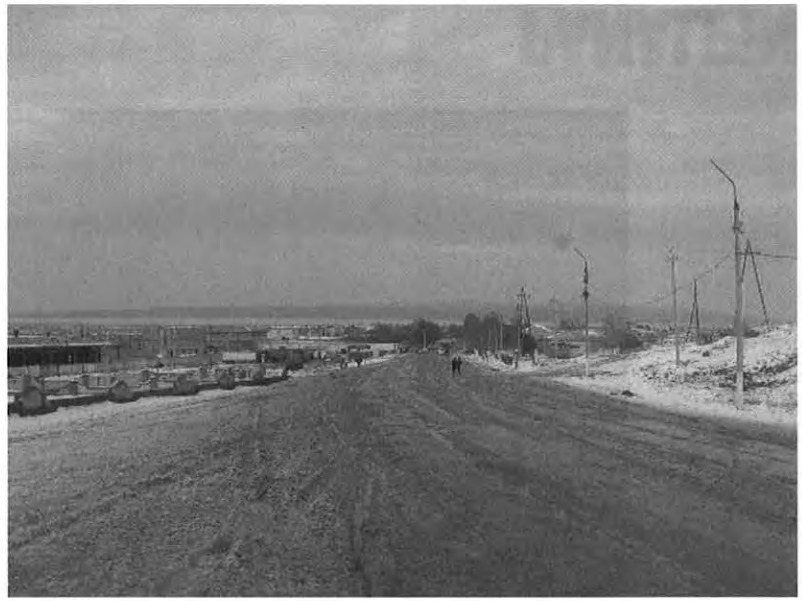
From site entrance road goes through **suburban area**.
Km 2.3 two x 60mm domestic gas lines at 5m ht.
Km 3.9 non electric rail crossing.
Km 5.5 HT line 220kv.
Km7.7 km before joining main Tashkent ring road.
Km 8.5 HT line 110kv

Km 9.2 Bridge 25m span 1.5m T beams 125cm top section 25cm bottom.



Km 16.5 Ht line 10m+

Km 20 Railway bridge
3 x 25m sections

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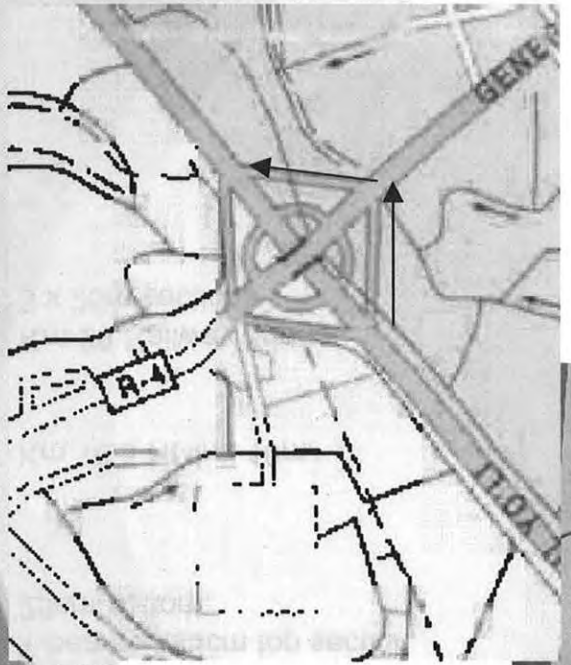
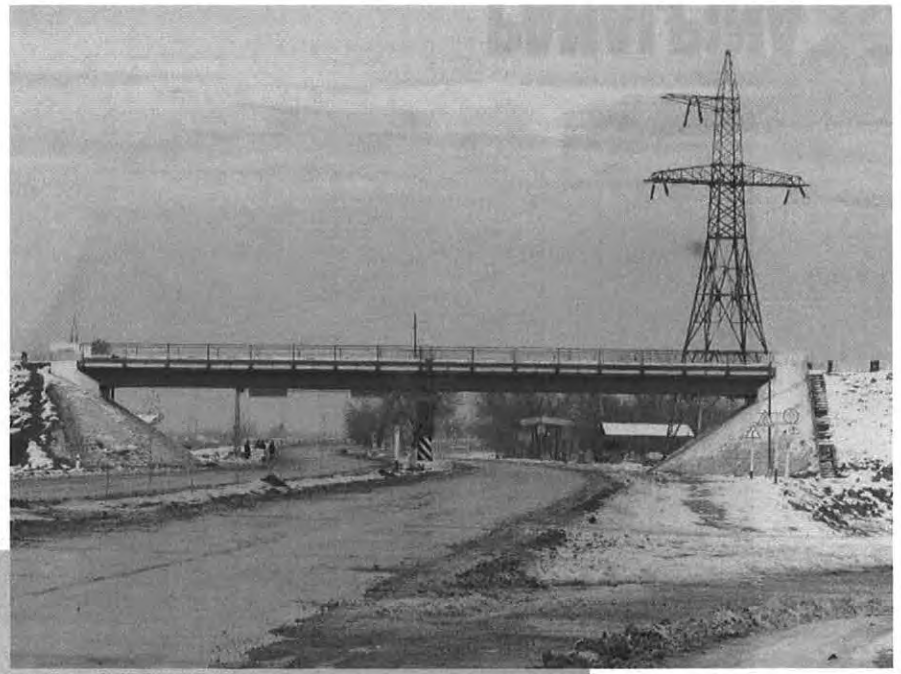
Km 21 Overhead bridge 5m clearance
Ht line 220kv 10m+
By pass using slip roads as shown.





Km24 Bridge 1 section x 25m
Followed by 3 section x 25m
followed by Ht line 110kv

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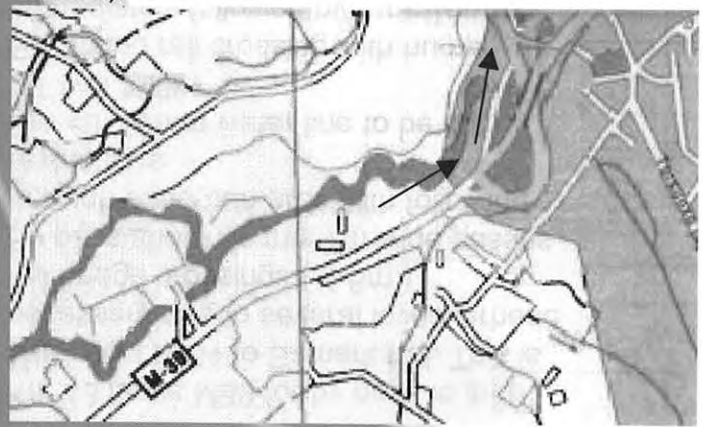
Km 27 Ht line 220kv 8m+
Km 30 several Ht lines 220kv 10m+
110 kv 8m+

Km 32 Bridge 25m single span.

Km 35 bridge 3 section followed by
2 x 220kv at only 8m ht.

Km39 leave ring road to join M39.
(coming into Tashkent this road has to be taken going against the flow of traffic as shown)



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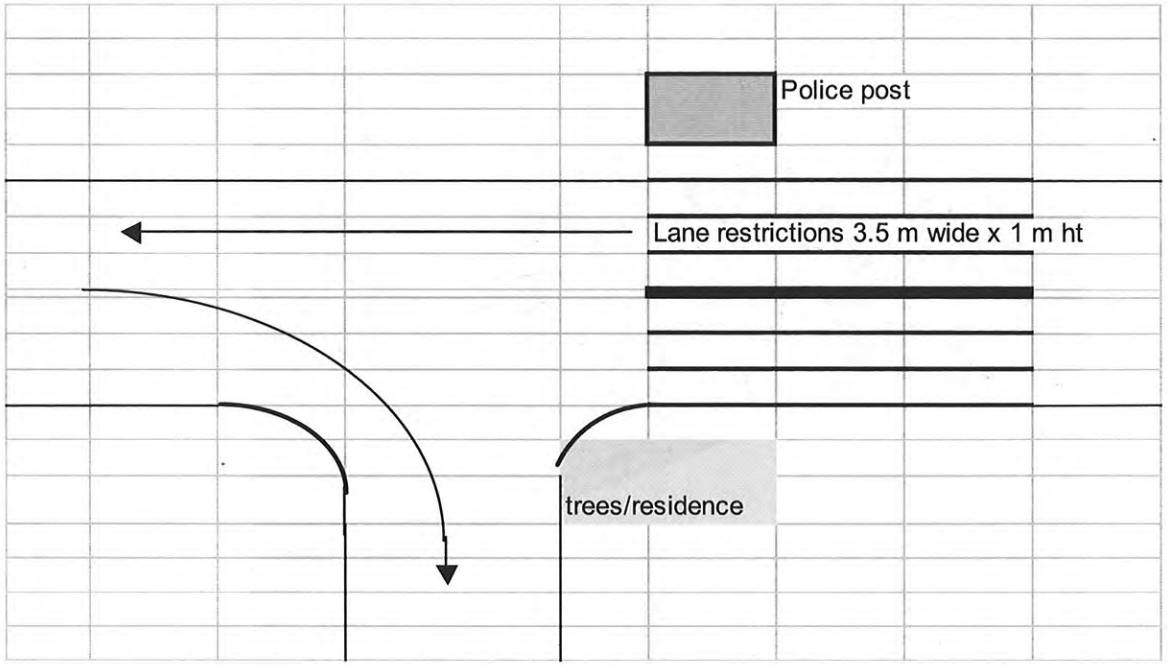
Km 43 leave M39 for by pass to join "old" road M 34 to Samarkand. This is necessary due to several low overhead rail bridge crossings (-4.6m.)
By pass shown is min 7m wide passes through suburban area with following restrictions.
Km 49 50mm water line to be cut.
HT line 220kv
Electrified rail crossing with hump immediately followed by **junction to M39 with police block which will require dismantling or a change of platform driving direction for long transports.**

Km 50 bridge single span 20m long road width 12m.



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Km 58 Bridge 3 section
12,24,12m width 10m.

Km 67 various HT lines 9m+

Km 69 low 35kv lines

Km 80 Controlled electrified rail crossing
With hump followed by 50mm overhead
waterline at 5.5m.

Km 83 steel beam construction at 5.9m
Km 91 50mm waterline
Km 91.5 controlled double electrified rail
line crossing.

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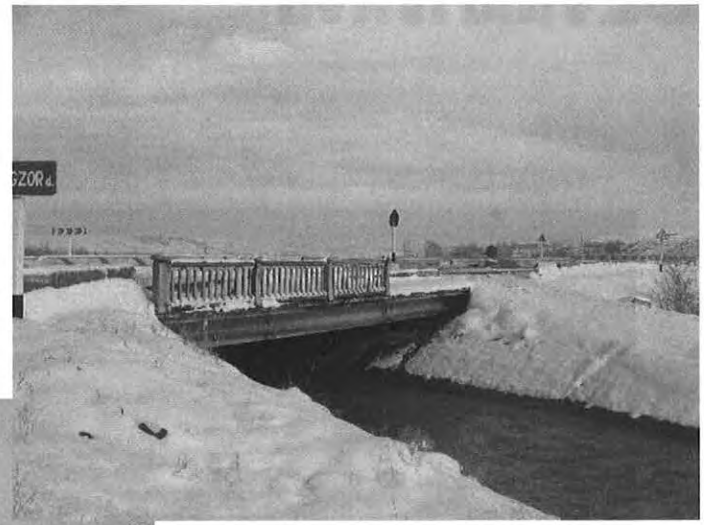
Km 97 Bridge single span 10m 12m wide.

Km 100 town of Chinaz with overhanging trees and one water line.
Km 102 Unmanned single line rail crossing.



Km 106 Main river crossing.
Bridge 9 section 35m 20m wide

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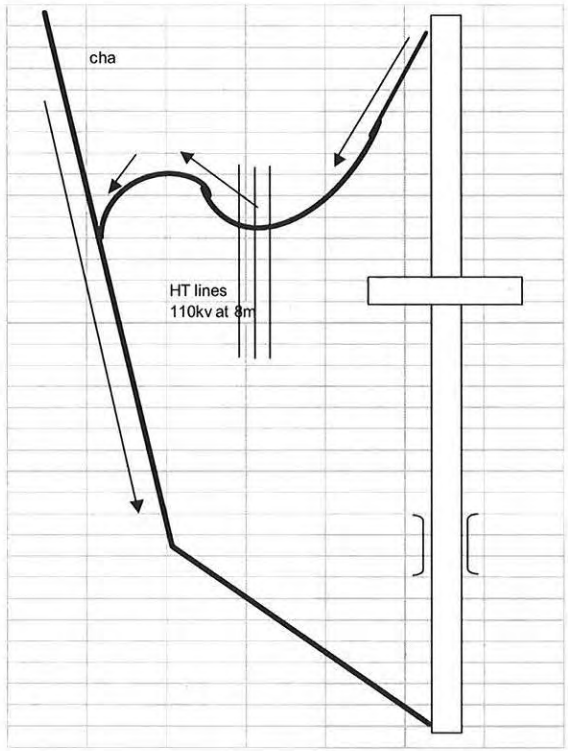
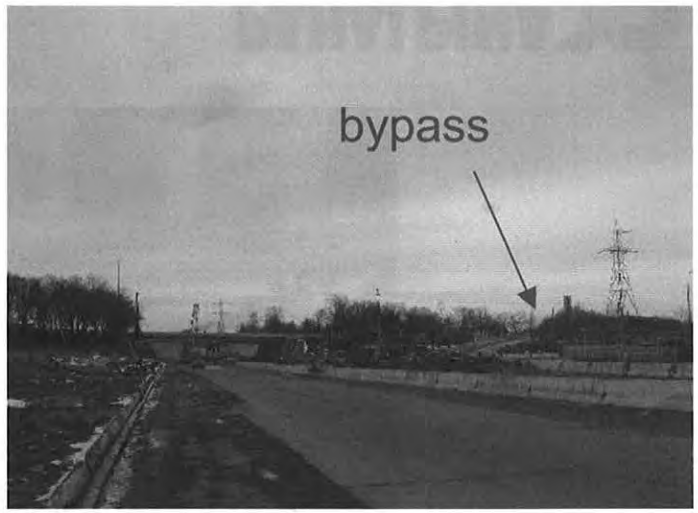
Km 109 HT line 110kv

Km 111 overhead railway bridge (5.2m) By pass as sketch and pics.

Signboard frame 5.8m with under sign clearance 5.5m





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Km116 Railway bridge
3 section 25m 12 width
Km 118 overhead road sign
as previous with 5.5
clearance.

Km 119 HT 7-8m 35kv x 2

Km 121 Bridge 1 x 25m
section
Km 125 bridge 1 x 9m
section

Km 128 bridge
5 section 23m built 1970

Km 132 overhead road
sign 5.7m clearance.
Km 137 single span
diagonal bridge 20m

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Km 144 Bridge 3 section 23m

Km 157 Police check point with division of road into 3m lanes. Two overhead sign posts 5m+ only. Unable to take exact measurement.

Km 160 2 x canal crossing bridge.
Single section 35m heavy duty T beams 1.7m depth.

Km 166 road overhead sign.
Km 170 2 x canal crossing as above.

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Km 178 bridge3 x 14m section

Km179 police post with road division

Km 188 150mm gas line 6.1m clearance.

Km 193 canal crossing as previous heavy duty 35m single section.
Built 1981
Km 194 road sign 5.7m
Km 197 road sign 5.6m welded construction.
Km 200 canal crossing heavy duty 35m single section.

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Km 221 elevated road bridge (with by pass)
3 section x 25m 1.2m beam depth
Road width 12m.
Immediately followed by railway crossing bridge same beams 5 x 25m sections.

Km 225 low bridge with no apparent by pass.
Clearance 5.8m on tarmac 5.9m off with 6m side clearance.

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From Km 235 to Km 248 the routing goes through a mountainous area with several accents and descents for up to 2km including stretches of 10 and 12% gradients for up to 200 m.
It will be necessary to use two movers for this section for very heavy cargoes and delay will be unavoidable negotiating this part of routing. This area on route from KRW starts at junction for Jizzac.

Km 243 Ht lines 220 and 110 kv.

Km 251 bridge 3 x 9m section.

Km 253 HT line 500kv at 10m+
Km 254 2 x ht lines 110kv at 8m
Km 259 HT lines 110 and 35kv
KM 264 HT line 35kv 7m

Km 269 bridge 3 section.
Eastbound lane is completely filled in as shown. Road width 12m each lane.

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Km 272 HT lines 2 x 110kv 9m

Km 273 Police check post with lane restriction.

Km 277 Police check post with lane restriction.

Km 281 Bridge over rail line 6 section x 18m

Km 296 HT lines 3 x 35kv at 7m.
Km 300 HT line 110kv 8m
Km 312 Ht line 110 kv 9m
And bridge 1 x 20m section.

Km 316 bridge 3 section x 36m
Beams 1.2m depth. Road width 12m

Km 317 Sarafshon river bridge
7 x 20m section.

Km 319 overhead road sign 5.5m
Km 323 HT line 35kv 8m
Km 327 turn right to by pass Samarkand.

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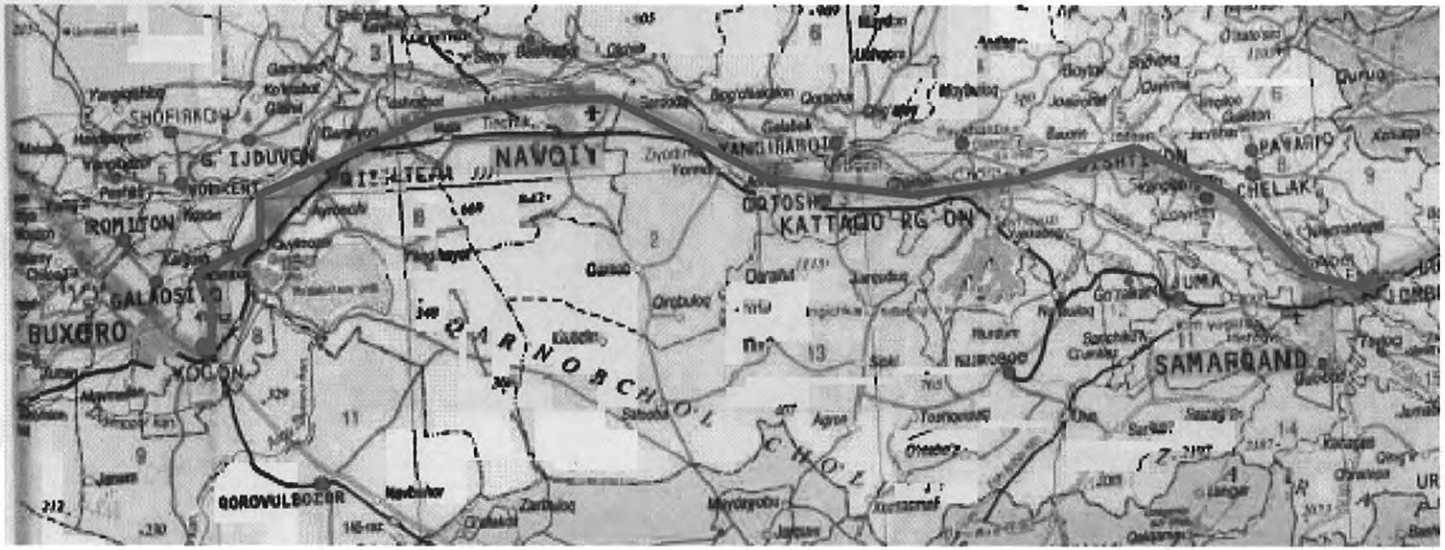
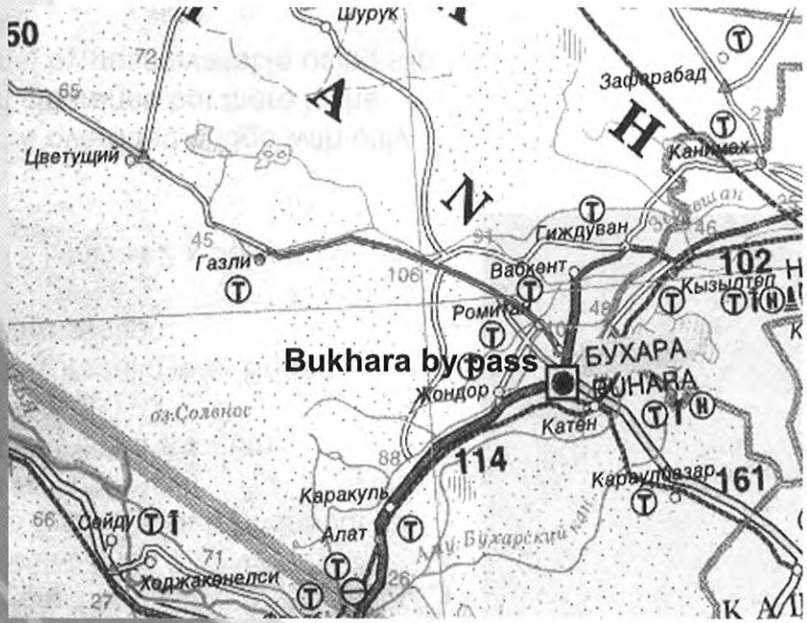
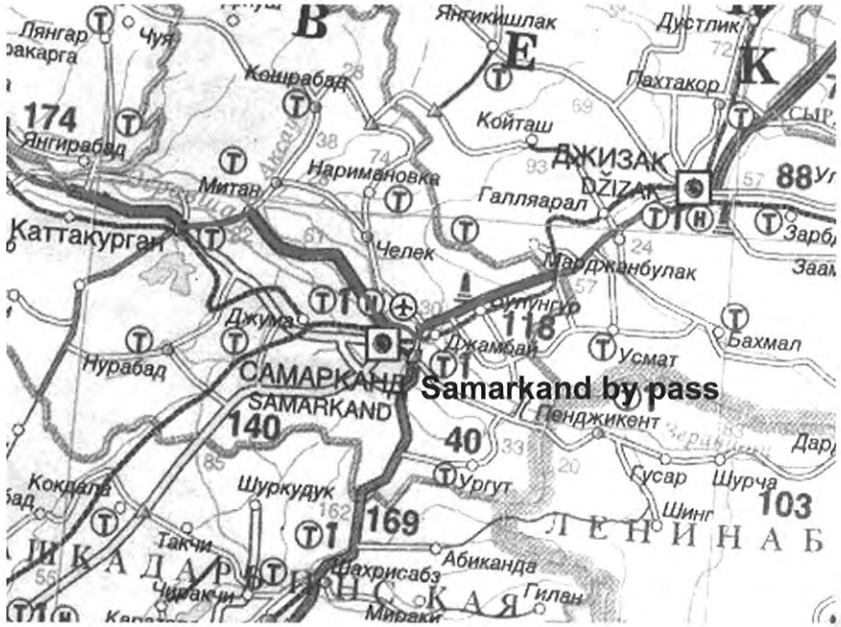
Section 2 Samarkand to Bukhara - Kms 285







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By pass for Samarkand road
category 1 two lanes of 7m width.
Km 3.5 Ht lines 220kv 10m
K m 5 turn right at roundabout for
road to Bukhara.
Km 6 HT line 110kv 9m

Km 7 Koradalio river Bridge
7 x 25m section.

Km 12 Ht lines 2 x 35kv

Km 14 overhead bridge with only
5.5m clearance but there is the
normal by pass available using slip
roads.

Km 18 single span bridge 19m
Built 1990. Road width 12m

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Km 32 Ht lines 2 x 35 kv 9m

Km 33 Mass steel telegraph type communication lines at 5.5m. These lines generally consist of around 20+ lines, are low and due to their material they are tight between poles and difficult to lift.

Km 36 same as above.
Km 40 same as above
Km 46 same as above
Km 47 Ht line 110 kv 9m+
Km 61 Ht lines 2 x 220kv 8-9m
Km 62 single span bridge.16m
Km 69 Mass telegraph lines

Km 70 bridge 3 x 24 m section 12m road width.

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Km 71 Two consecutive bridges of 3 x 14m sections.

Km 72 Ht line 1 x 110kv at 9m+
Km 74 overhead road sign 5.6m
Km 78 Ht line 110kv at 9m

Km 79 Bridge 4 section 1 x 9m,3 x 19m
Road width 16m.

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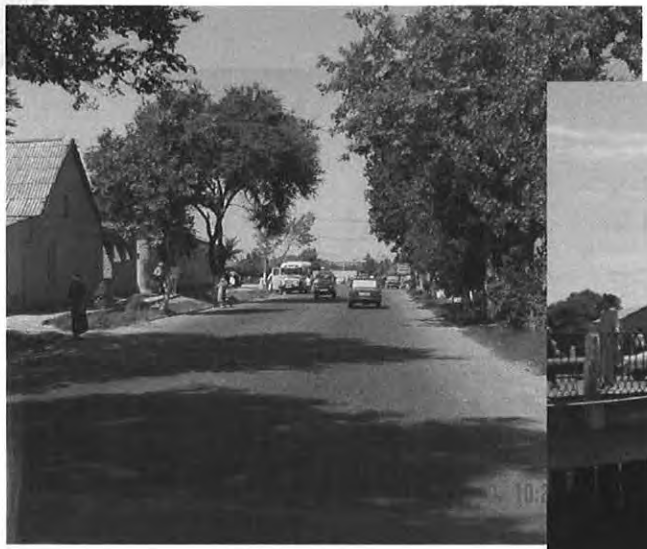
Km 80 enter town of Kataqurghon
Cross over 3 x 12m section bridge 16m wide.through busy market area. Most likely this will require a night passage.

Km 81 Ht line 110kv 8m+



Km 85 Bridge 3 section 6,16,6m
Short sections are solid slab type beams only 30cm depth overlayed by 20cm of concrete and asphalt.
Centre section depth of beams 70cm.
Road is dual carriage way of 10m each side

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Km 129 Bridge 3 section 9,19,9m.

Km 133 mass telegraph lines
Km 135 Ht line 110kv at 9m
Km 136 ht lies 2 x 110kv at 10m.
Mass telegraph lines.
Km 139 mass telegraph lines.
Km 150 police check with lane restriction.

Km 151 single section bridge 12m 60cm depth solid concrete beam.
Km 156 single span 14m as above
Km 158 Navoiy by pass road. 4 lane highway20m wide.

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Km 166 Navoiy power station.
At this point there is an overhead pipeline Construction. Lowest point is 5.65m.
This is immediately followed by many Ht line crossings from the power station. All heights appear to be above 9m but not accurately checked.
Authorisation to pass this area may be difficult to obtain and there does not appear to be a by pass available due to heavy industrialisation in the area with above ground pipe line obstructions on all routes.

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Km 174 Bridge 5 x 25 m sections.

Km km 187 single span bridge 10m
And Ht lines 2 x 110 kv at 9m+

Km 206 Overhead bridge with clearance of 5.55 but can be by passed by slip roads.

Km 208 single span bridge 18m solid concrete beams 75cm depth.
Road width 20m
Km 210 roundabout turn left if coming from Bukhara.

Km211 Bridge 6 x 9m section just before police check with low overhead signboard. Appr 5.7m

Km 224 ht line 220kv

Km 242 Bridge 3 section x 12m

Road width 18m.

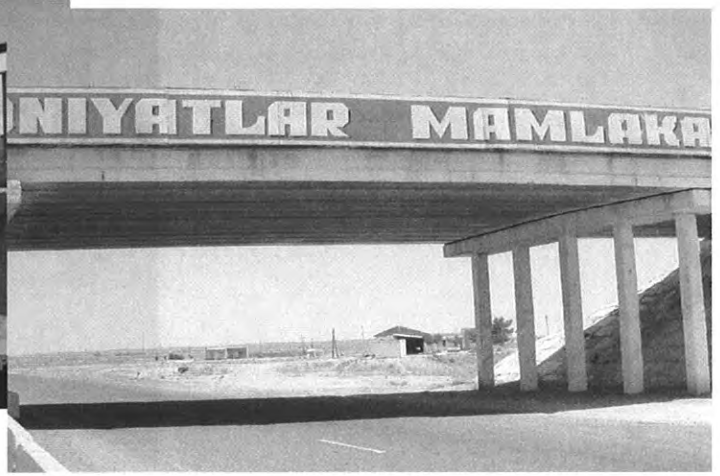
Km 145 Bridge 3 section x 12m

Km 254 Bridge 3 section x 12m

Km 258 Bridge single section 14m

Km 262 Bridge 3 section 6,9,6m

Road width 20m



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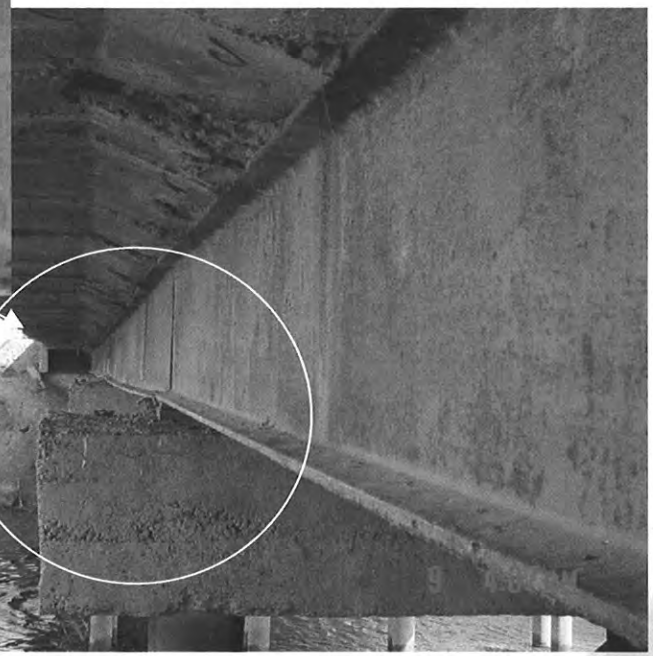
Km 266 turn right onto road for Bukhara by pass road to Urgench
Km 268 Bridge single section 14m road width 20m
Km 269 Ht line 110kv at 9m+
Km 270 Bridge single section 14m

Km 280. This is the Zarafshon bridge which is the not in good condition.
This bridge was previously reinforced for the Shurtan cargo of 218tons using additional steel plating and mid section concrete block supports.
Bridge is 7 sections of 10m steel construction.
3 x Main longitudinal 550mm x 165mm x 15mm.



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