National Electric Power Regulatory Authority

Islamic Republic of Pakistan

Registrar

2nd Floor, OPF Building, G-5/2, Islamabad.
Ph : 9207200 Ext : 330 —— Fax : 9210215
E-mail : office@nepra.isb.sdnpk.org
Direct Phone : (051) 9206500

No. NEPRA/R/LAG 05/4553-55

November 18, 2002

Corporate Secretary,
M/s. Karachi Electric Supply Corporation Ltd.
Aimai House, Abdullah Haroon Road,
Karachi.

Subject: **Grant of Generation Licence GL/04/2002**
M/s. Karachi Electric Supply Corporation Ltd. (KESC)

Please refer to your application No.SECK/EL/00/802, dated 11th September 2000 for a Generation Licence.

2. Enclosed here is Generation Licence No. GL/04/2002 granted by the Authority to M/s. Karachi Electric Supply Corporation Ltd. The Licence is granted to you pursuant to Section 15 and Section 25 of the Regulation of Generation, Transmission and Distribution of Electric Power Act (XL of 1997).

3. Please quote above mentioned Generation Licence No. in your future correspondence with the Authority.

DA/As above.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

18.11.02

(Mahjoob Ahmad Mirza)

CC for information to:

1. Managing Director, Karachi Electric Supply Corporation Ltd., Karachi.
2. Director General, Pakistan Environmental Protection Agency, 44-E, Office Tower, Blue Area, Islamabad.

National Electric Power Regulatory Authority (NEPRA)

Islamabad - Pakistan

GENERATION LICENCE

NO. GL/04/2002

In exercise of the Powers conferred on the National Electric Power Regulatory Authority (NEPRA) under Section 15 and Section 25 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (XL of 1997), the Authority hereby grants a Generation Licence to:-

THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

Incorporated under Act No. VI of 1882
of the Legislative Council of India
under Certificate of Incorporation
No. Nil dated at Bombay 13th day of September, 1913

to engage in generation business subject to and in accordance with the Articles of this Licence.

Given under my hand this 18th day of November, Two Thousand & Two, and expires on 17th day of November, Two Thousand & Twenty Seven.

18.11.02

Signed

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Article 1

Definitions

In this Licence:

"Act" means the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (XL of 1997);

"Authority" means the National Electric Power Regulatory Authority constituted under Section 3 of the Act;

"Licensee" means The Karachi Electric Supply Corporation Limited; and

"Rules" means the National Electric Power Regulatory Authority Licensing (Generation) Rules, 2000.

Words and expressions used but not defined herein bear the meaning given thereto in the Act or in the Rules.

Article 2

Application of Rules

This Licence is granted subject to the provisions of the Rules, as amended from time to time.

Article 3

Generation Facilities

The location, size, technology, interconnection arrangements, technical limits, technical functional specifications and other details specific to the generation facilities of the Licensee are set out in Schedule I to this Licence.

The net capacity of the generation facilities is set out in Schedule II hereto.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Article 4

Term

This Licence is granted for a term of **Twenty-Five (25) years.**

Article 5

Licence Fee

The Licensee shall pay to the Authority the licence fee in the amount and manner and at the time specified in the National Electric Power Regulatory Authority (Fees) Rules, 2002.

Article 6

Competitive Trading Arrangement

(1) The Licensee shall participate in such measures as may be directed by the Authority from time to time for development of a Competitive Trading Arrangement. The Licensee shall in good faith work towards implementation and operation of the aforesaid Competitive Trading Arrangement in the manner and time period specified by the Authority:

Provided that, any such participation shall be subject to:

(a) any contract entered into by and between the Licensee and another party prior to the enactment of the Act and for the due performance of which a sovereign guarantee has been provided by the Government of Pakistan; or

(b) any contract entered into by and between the Licensee and another party subsequent to the enactment of the Act with the approval of the Authority.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

(2) Any variation or modification in the above-mentioned contracts for allowing the parties thereto to participate wholly or partially in the Competitive Trading Arrangement shall be subject to mutual agreement of the parties thereto and such terms and conditions as may be approved by the Authority.

Article 7

Maintenance of Separate Accounts

For the purpose of the competitive trading arrangement, pursuant to Article 6 and the Second tier supply business, the licensee shall be considered as a separate company in relation to the Transmission and Distribution Business of KESC. Accordingly and pursuant to Rule 15, the Licensee shall maintain separate accounting and financial reporting arrangements for each of its separate businesses as if it were a separate company.

Article 8

Cross Subsidy between Generation, Transmission and Distribution

The Licensee may in terms of sub-rule 4 of Rule 13, with the prior approval of the Authority give cross-subsidy to, or receive cross-subsidy form the transmission and/or distribution business of The Karachi Electric Supply Corporation.

Article 9

Maintenance of Records

For the purpose of sub-rule (1) of Rule 19, copies of records and data shall also

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

be retained in electronic form and all such records and data shall, subject to just claims of confidentiality, be accessible to authorized officers of the Authority.

Article 10

Compliance with Performance Standards

The Licensee shall conform to the relevant rules on performance standards as may be prescribed by the Authority from time to time.

Article 11

Compliance with Environmental Standards

The Licensee shall conform to the environmental standards as may be prescribed by the relevant competent authority from time to time.

Article 12

Provision of Information

Without prejudice to the obligation of the Licensee to comply with any call for information made by the Authority from time to time under section 44 of the Act, the Licensee shall submit to the Authority the following statements of availability of the generation facilities:

(1) Within three (3) months of the beginning of a financial year, the licensee shall prepare and submit before the Authority for its approval, the criteria upon which the licensee will:

(a) determine the duration and timing of planned outages of generation units;

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY REGISTRAR (NEPRA)

(b) determine which hours of the day and days of the week a generation unit which is not subject to a planned outage will be sufficiently manned to be capable of being made available;

(c) determine its policy for making available generation units which are not subject to planned outages; and

(d) determine its policy for the temporary or permanent closure of generation units.

(2) No later than one (1) month before the end of a financial year, the licensee shall submit to the Authority a written forecast for each generation unit expected to operate in the following financial year stating:

(a) the net capacity of the unit;

(b) the planned outage schedule of each unit;

(c) best estimates of unplanned outages for each unit;

(d) the means by which the unit will be fuelled or expected to be primarily fuelled in the case of dual firing units;

(e) best expectation of any unplanned outages; and

(f) the factors known to the licensee likely to affect the number of outages.

(3) No later than six (6) months into each financial year, the licensee shall submit to the Authority any changes to the best estimates submitted to the Authority under Article 12(2) above with respect to the remainder of the financial year.

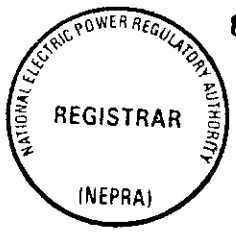
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

(4) Within three (3) months of the beginning of each financial year, the licensee shall submit to the Authority a statement of actual availability of each generation unit during the previous financial year. The said statement shall compare forecasts and plans made for the previous financial year against outturns.

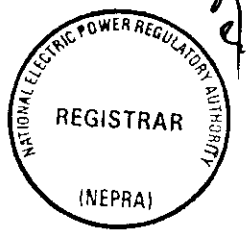
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

SCHEDULE - I

- The location, size (capacity to MW), technology, interconnection arrangements, technical limits, technical functional specifications and other details specific to the generation facilities of the licensee.



INTRODUCTION



The Karachi Electric Supply Corporation Limited
Interdepartmental Memo

From : OIC (Personnel) To : Corporate Secretary

Ref. No : OIC-89/2000/12257 Dated: 22 May, 2000.

SUBJECT :- GENERATION LICENCE UNDER THE NEPRA ACT 1997 (XL OF 1997).

REF. NO :- SECR/EL/00/432 DATED: 25/04/2000.

The requisite information as asked for vide above referred letter is given below :

Regulation 3 (5)

b. The applicant is a Joint Stock Company registered in 1913 under companies ordinance as amended to date. It is engaged in the generation transmission and distribution of electricity to the residents and factories situated in Karachi and Uthal/Bela (Baluchistan Province).

At present it has about 12000 employees on roll. The Middle Management staff of the applicant consist of :-

30 Deputy Chief Engineers/equivalent
120 Superintending Engineers/equivalent.

They possess degrees of BE (Elect. Mech. Electronics & Post Graduation from accredited universities). Their average working experience ranges between 20 to 30 years.

c. The curriculum Vitae of the applicant's Sr. Management, Technical and professional staff is given below :

S.NO	N A M E	DESIGNATION	EDUCATION	EXPERIENCE
1.	Akhlaquillah	General Manager	B.E. (Mech)	23 Years
2.	Muneeruddin Siddiqui	G. M.	B.E. (Mech)	32 Years
3.	A. R. Abbasi	G. M.	B.E. (Elect.)	31 Years
4.	Iqbal Muhammad	C.E. (Civil)	B.E. (Civil)	34 Years
5.	N. H. Burney	C.E. (TP&G)	B.E. (Elect.)	31 Years
6.	Khalid Iqbal	C.E. (Dist.)	B.E. (Elect.)	30 Years
7.	Aqil Noor	C.E.	B.E. (Elect.)	34 Years
8.	Shaikh M. [illegible]	C.E.	B.E. (Mech.)	30 Years
9.	S. A. Bashir	C. E.	B.E. (Mech)	31 Years
10.	Muhammad Yousuf	C.M. (Coord.)	A.C.M.A.	39 Years
11.	Oswald Pearl	Corporate Secy.	M.B.A.	25 Years

MAJOR
OIC (PERSONNEL)
(SHAHEED HUSSAIN)

CC: Managing Director - With Compliments.
CC: OIC (A & S) - -do-
CC: M.F.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

The Karachi Electric Supply Corporation Limited (KESC) Generation Units

1. BIN QASIM POWER STATION

Unit No.	Expected Life (Years)	Commissioned
# 1	13	1983
# 2	14	1984
# 3	19	1989
# 4	20	1990
# 5	21	1991
# 6	27	1997

2. KORANGI THERMAL POWER STATION

Unit No.	Expected Life (Years)	Commissioned
# 1	2	1965
# 2	-	1966
# 3	3	1970
# 4	7	1977

3. KORANGI TOWN GAS TURBINE POWER STATION

Unit No.	**Expected Life (Years)**	**Commissioned**
# 1	Not Available	1978
# 2	—	1978
# 3	—	1978
# 4	—	1978

4. S.I.T.E. GAS TURBINE POWER STATION

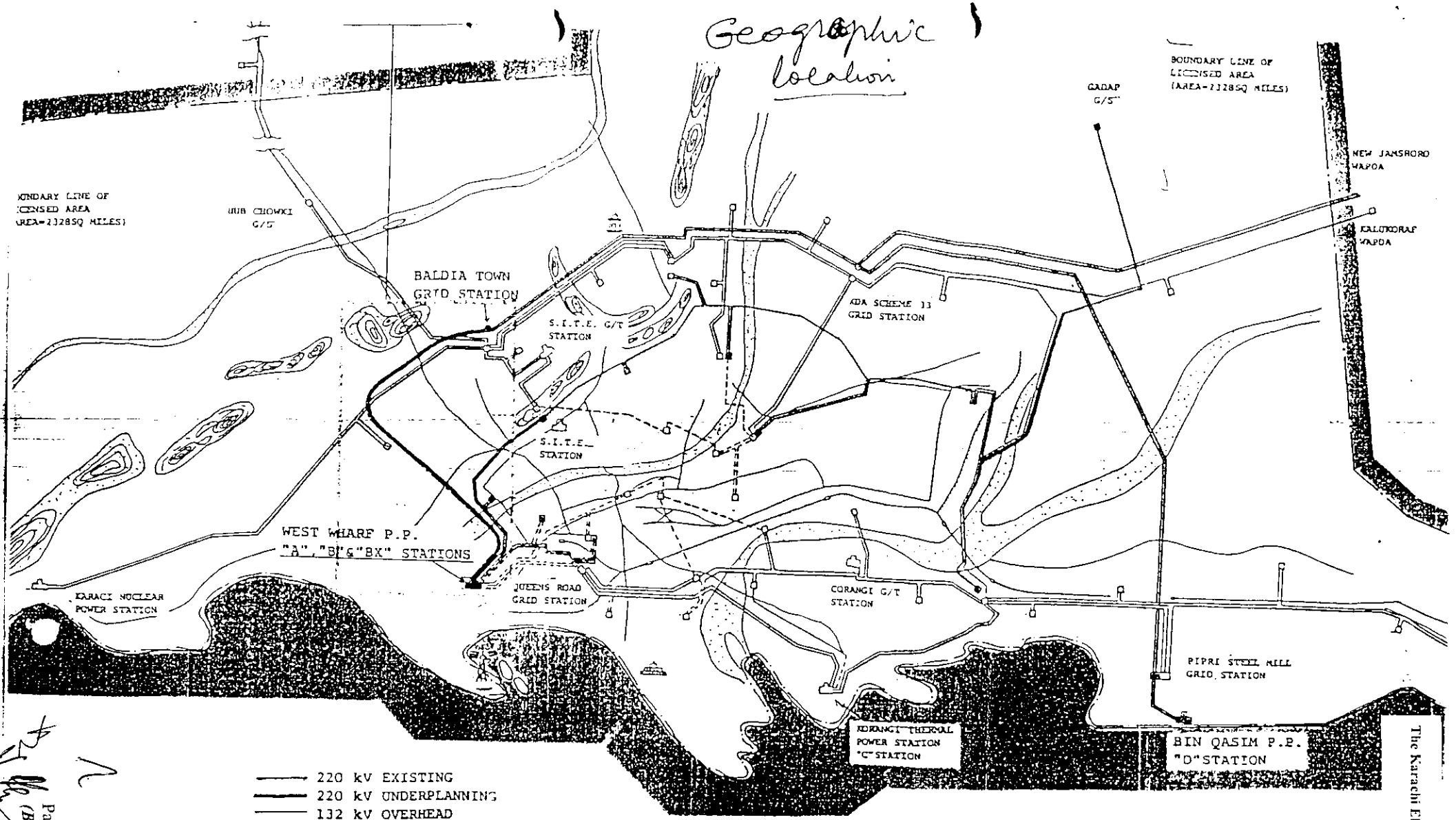
Unit No.	**Expected Life (Years)**	**Commissioned**
# 1	4 - 5 Years	Not Available
# 2		—
# 3		—
# 4		—
# 5		—

Recommended term of the licence = 25 Years.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

BIN QASIM POWER STATION

LOCATION
&
SITE PLAN



BIN QASIM POWER STATION

EXISTING GENERATION FACILITES

THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

BIN QASIM POWER STATION

EXISTING GENERATION FACILITIES
(AS REQUIRED BY NEPRA)

SCHEDULE III

1. **Location map, site map.**
   Enclosed

2. **Technology, number of units.**

Unit	Boiler	Turbine	Generator
No. 1	ELPASO type Single drum, Natural Circulation, Single Reheat Steam: 680 t/h, 145 bar,530 C Manufacturer: Hitachi-Babcock	Capacity: 210 MW Tandem Compound Double Flow Stages: HP-8, IP-6, LP-2X5 Steam condition: 140 bar,525 C Manufacturer: Hitachi	248 MVA,21 KV Type: TFLQQ Stator: H_2O cooled Rotor: H_2 cooled Manufacturer: Hitachi
No. 2	ELPASO type Single drum, Natural Circulation, Single Reheat Steam: 680 t/h, 145 bar,530 C Manufacturer: Hitachi-Babcock	Capacity: 210 MW Tandem Compound Double Flow Stages: HP-8, IP-6, LP-2X5 Steam condition: 140 bar,525 C Manufacturer: Hitachi-Japan	248 MVA,21 KV Type: TFLQQ Stator: H_2O cooled Rotor: H_2 cooled Manufacturer: Hitachi
No. 3	ELPASO type Single drum, Natural Circulation, Single Reheat Steam: 680 t/h, 145 bar,530 C Manufacturer: Deu-Babcock	Capacity: 210 MW Tandem Compound Double Flow Stages: HP-9, IP-7, LP-2X6 Steam condition: 140 bar,525 C Manufacturer: Ansaldo Italy	248 MVA,18 KV Type: SGTHC Stator: H_2 cooled Rotor: H_2 cooled Manufacturer: Ercole Marelli Nouva EGM Italy
No. 4	ELPASO type Single drum, Natural Circulation, Single Reheat Steam: 680 t/h, 145 bar,530 C Manufacturer: Deu-Babcock	Capacity: 210 MW Tandem Compound Double Flow Stages: HP-9, IP-7, LP-2X6 Steam condition: 140 bar,525 C Manufacturer: Ansaldo Italy	248 MVA,18 KV Type: SGTHC Stator: H_2 cooled Rotor: H_2 cooled Manufacturer: Ercole Marelli Nouva EGM Ital
No. 5	ELPASO type Single drum, Natural Circulation, Single Reheat Steam: 680 t/h, 145 bar,530 C Manufacturer: Hitachi-Babcock	Capacity: 210 MW Tandem Compound Double Flow Stages: HP-8, IP-6, LP-2X5 Steam condition: 140 bar,525 C Manufacturer: Hitachi-Japan	248 MVA,18 KV Type: TFLQQ Stator: H_2 cooled Rotor: H_2 cooled Manufacturer: Hitachi
No. 6	ELPASO type Single drum, Natural Circulation, Single Reheat Steam: 680 t/h, 145 bar,530 C Manufacturer: Hitachi-Babcock	Capacity: 210 MW Tandem Compound Double Flow Stages: HP-8, IP-6, LP-2X5 Steam condition: 140 bar,525 C Manufacturer: Hitachi-Japan	248 MVA,18 KV Type: TFLQQ Stator: H_2 cooled Rotor: H_2 cooled Manufacturer: Hitachi

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

3. **Fuel: Type Imported/indigenous, suppliers, logistics, pipe line etc.**

Type	Source	Supplier	Logistics
Furnace oil	Imported	PSO	Pipe line
LDO	Imported /local	PSO	Tank-lorry
Natural Gas	Indigenous	SSGC	Pipe line

4. Emission Values

Data for the year 1995 and 1996 enclosed. Since than Emission Monitoring System is out of order. (see annex-A)

5. **Cooling water source: tube well, sea, river, canal**

Sea water

. **Interconnection with national grid company, distance and name of nearest grid, voltage level (single line diagram)**

Bin Qasim Power Station is linked with the transmission system at three grid stations. Generation voltages are stepped up to **220KV**

Grid-1: Pipri West	Distance from station: 8.70 (KM Circuit No. 1 & 2) 8.57 (KM Circuit No. 3)
Grid-2: ICI	Distance from station: 0.35 (KM Circuit No. 4)
Grid-3: Korangi West	Distance from station: 36 (KM Circuit No. 5 & 6)

(Line diagram: see annex-B)

7. **Installed capacity, De-rated capacity, Expected remaining life.**

Unit no.	Installed capacity	De-rated capacity	Expected remaining life
U # 1	210 MW	190 MW	13 years
U # 2	210 MW	190 MW*	14 years
U # 3	2 10 MW	120 MW	19 years
U # 4	210 MW	140 MW	20 years
U # 5	210 MW	190 MW	21 years
U # 6	210 MW	210 MW	27 years
Total	1260 MW	1040 MW	

* Presently unit is in outage for major overhaul and rehabilitation work. Load shown is the expected load, after re-commissioning of the unit in June 2000.

8. **Due diligence report**

The report prepared by the consultants M/s Mott MacDonald (Technical sub-consultants to UBS for KESC privatization) is attached herewith. (see annex- C)

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

9. **Rehabilitation Plan, Previous Rehabilitation Plan.**

Rehabilitation program launched first time in 1999. A phased plan was prepared for the rehabilitation of de-rated units.

Unit # 1 remained shut down from November 1, 1999 to February 24, 2000 (116days) for this purpose. Major work carried is as under.

- Boiler:
  1- Replacement of Re-heater Coils
  2- Replacement of complete rotor and heating elements of Air pre-heater A & B
  3- Rehabilitation of soot blowers
  4- Replacement of Hanger bellows
  5- Repair of refractory
  6- Repair of burners
  7- Lapping of safety valves
  8- Replacement of damaged parts of drum internals
  9- Rehabilitation of sealing air system
  10- Replacement of damaged man hole covers
  11- Replacement of corroded flue gas duct
  12- Tuning of combustion system of boiler

- Turbine/ Generator
  1- Overhauling of complete turbine.
  2- Inspection of generator and tightening of wedges
  3- Replacement of exciter slip ring of the generator

- Balance of Plant
  1- Overhauling of Circulating Water Pumps
  2- Overhauling of Boiler Feed Pumps
  3- Overhauling of BFP Sealing Water Pumps
  4- Overhauling of Fuel Pumps
  5- Order has been placed for Debris Filters having on line cleaning facility. After the delivery, these will be installed at the inlet of condensers.
  6- Overhauling of GIS circuit breakers of unit # 1 & 2 , feeders # 1 & 2 and of start up transformer
  7- Replacement of roof plates of HFO tank # 3

Unit # 2 shut down on March 16, 2000 for the implementation of the rehabilitation and major overhauling program. Major work being carried out is as under.

- Boiler:
  1- Replacement of Re-heater Coils
  2- Replacement heating elements of Air pre-heater A & B

3- Rehabilitation of soot blowers
4- Replacement of Hanger bellows
5- Repair of refractory
6- Repair of burners
7- Lapping of safety valves
8- Replacement of damaged parts of drum internals
9- Rehabilitation of sealing air system
10- Replacement of damaged man hole covers
11- Replacement of corroded flue gas duct
12- Tuning of combustion system of boiler
13- Rehabilitation of the gas firing system

- Turbine/ Generator

1- Overhauling of complete turbine.
2- Inspection of generator and tightening of wedges

- Balance of Plant

1- Overhauling of Circulating Water Pumps
2- Overhauling of Boiler Feed Pumps
3- Overhauling of BFP Sealing Water Pumps
4- Overhauling of Fuel Pumps
5- Installation of Debris Filters at the inlet of condensers

Unit # 3 rehabilitation and overhauling has tentatively been scheduled from November, 2000 to January, 2001. Major work to be carried out is as under.

- Boiler

1- Replacement of damaged Air Pre-heater
2- Replacement of heating elements of the Air Pre-heaters
3- Replacement of Super heater # 1
4- Replacement / repair of the boiler furnace bottom
5- Rehabilitation of gas firing system
6- Tuning of the combustion system

- Turbine/Generator

1- Overhauling of Turbine
2- Overhauling of generator

- Circulating Water Pumps

Modification as suggested by the manufacturer M/s Thermomacanica of Italy, in the existing pump to make it more robust has been made. The modified pump has been received and the same will be installed by the manufacturer specialist soon.

After the successful trail operation of the modified pump other pump will be modified.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Unit # 4 boiler also needs to be rehabilitated. Its outage for this purpose is envisaged in the year 2001, after the successful completion of unit # 3 rehabilitation work.

Circulating Water Pumps of unit # 4 will also be modified after the successful trial operation of the modified pump of unit # 3.

(Schedule of Rehabilitation and major overhaul attached)

10 **Operational record including environmental monitoring data for the last five years, constraint in dispatching.**

Operational record for the last five years enclosed at Annex-E. The available Environmental Monitoring Data enclosed. (see annex-A)

Constraints in Dispatching

Against the installed capacity of 1260 MW, presently station is dispatching max. 850 MW from 5 of its 6 units. Unit # 2 is in outage for major overhauling and rehabilitation work. After the completion of the work in June 2000, the unit will be ready for about 190 MW. The firm capacity of the station would be then around 1040 MW. Unit # 3 & 4 are the units having capacity much below the installed capacity i.e. 120MW and 150 MW respectively. Major causes of the de-ration of these units are as under.

Unit no. 3

- Weak Super Heater # 1 because of high temperature corrosion.
- Weak water wall tubes near furnace bottom due to pitting on the out side.
- Non-availability of one Circulating Water Pump.

Arrangements for the procurement of material for the revamping of the unit are under way. The unit is scheduled to shut down in November 2000 for the implementation of major overhauling and rehabilitation program.

Unit no. 4

- Weak Super Heater # 1 because of high temperature corrosion.
- Non-availability of one Circulating Water Pump.

Rehabilitation work on Boiler and CWP will be carried out in year 2001 after successful completion of the similar work at unit # 3.

11 **Project cost, information regarding sources and amounts of equity and debts.**

See annex-D

NATIONAL ELECTRIC POWER REGULATORY
REGISTRAR
(NEPRA)

12 **Plant characteristics, Generation Voltages, Frequency, Power factor, Automatic generation control, Ramping rate, Alternative fuel, Auxiliary consumption, Times required to synchronize with the grid.**

Plant characteristics	Unit # 1	Unit # 2	Unit # 3	Unit # 4	Unit # 5	Unit # 6
Generation voltage	21 KV	21 KV	18 KV	18 KV	18 KV	18 KV
Frequency	50 HZ	50 HZ	50 HZ	50 HZ	50 HZ	50 HZ
Power factor	0.85	0.85	0.85	0.85	0.85	0.85
Auto Gen. Control (MW control is the general practice)	MW/HZ	MW/HZ	MW/HZ	MW/HZ	MW/HZ	MW/HZ
Ramping rate						
Light mode	1 %	1 %	1 %	1 %	1 %	1 %
Medium mode	3 %	3 %	3 %	3 %	3 %	3 %
Heavy mode	5 %	5 %	5 %	5 %	5 %	5 %
Alternative fuel	Fur oil/ Gas	Fur oil/ Gas	Fur oil/ Gas	Fur oil/ Gas	Fur oil/ Gas	Fur oil/ Gas
Aux. Consumption (Depending upon load)	6~8 %	6~8 %	6~8 %	6~ %	6~8 %	6~8 %
Synchronization time &Time for full load	Hours	Hours	Hours	Hours	Hours	Hours
Ambient cold start	22 + 2	22 + 2	09+ 3.5	09+ 3.5	22 + 2	22 + 2
Cold start mode	07 + 2	07 + 2	do	do	07 + 2	07 + 2
Worm start mode	03 + 1.5	03 + 1.5	3.5+3.5	3.5+3.5	03 + 1.5	03 + 1.5
Hot start mode	2.25+0.5	2.25+0.5	1.3+2.3	1.3+2.3	2.25+0.5	2.25+0.5
Very hot mode	0.25+0.5	0.25+0.5	do	do	0.25+0.5	0.25+0.5

13 **Training and Development.**

Training Center

Recruitment is made in the corporation by inviting applications from the candidates through the advertisement in press. The candidates are required to appear in a written tests followed by an interview. The selected candidates undergo an ON-THE-JOB training program of duration depending upon the trade and grade. After completion of the training they have to appear in a written test followed by an interview in case of engineers while for the staff the respective departments forward their report. The successful trainees are awarded with the certificates. Vacant posts are filled from among with these trainees.

Recruitment of the trainees is done by the Training Center after which they are sent for the ON-THE-JOB training to different departments. **Trade apprentices** (basic qualification Matriculation), **Diploma Holder Trainees** (basic qualification Diploma), and **Apprentice Engineers** (basic qualification Graduate Engineers) are given three years, one year and one year ON-THE-JOB training respectively.

Since last 10 years recruitment in KESC is banned. Therefore the Training Center is not functional these days.

Training Simulator

A Simulator Training Center was established in 1987 at Bin Qasim Power Station. The center consists of two simulators one for the Power Plant and the other for the Net Work. The simulators are of general-purpose type i.e. not specific for any power plant or grid of KESC).

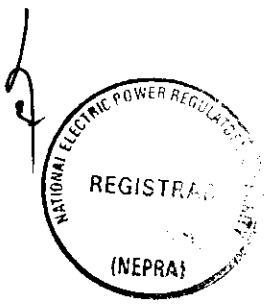
These simulators are also not functional these days because of the computer problem. Back up technical support from the manufacturers is not available owing to obsolescence of the technology.

Special Training

Engineers are sent abroad for training, especially for the new projects. Most of the senior engineers at power plants have been trained in Japan, Germany, Italy, UK, USA etc, at the manufacturing facilities of the major power plants equipment. In addition to that engineers are sent on scholar ships offered by different countries/ agencies. Some of the officers have also been trained in local institutions such as NIPA, NILAT and WADA academy.

BIN QASIM POWER STATION

EMISSION DATA



Date: 5.03.97

EMISSIONDATA BOILER 2

Y E A R P R O T O C O L for 1995

Month	NO2		SO2		DUST		OIL	TEMP	O2
	mg/Nm3	kg/h	mg/Nm3	kg/h	mg/Nm3	kg/h	m3/h	K	Vol.%
01.95	N	N	N	N	N	N	-3	-3	-3.0
02.95	460	130	5001	1408	42	11	14	362	15.1
03.95	505	210	5057	2069	105	46	34	428	9.4
04.95	463	207	5121	2289	338	152	43	421	4.8
05.95	393	144	5337	1951	632	226	35	426	6.3
06.95	302	81	5028	1359	567	154	28	438	7.4
07.95	290	77	5307	1410	399	106	27	441	7.8
08.95	257	67	5329	1382	573	149	26	431	7.2
09.95	295	66	5008	1151	523	125	7	339	19.9
10.95	579	268	5357	2485	67	31	46	406	6.2
11.95	596	275	5179	2391	40	18	45	436	4.3
12.95	559	244	4657	2014	79	36	43	437	0.8
MIN	257	66	4657	1151	40	11	-3	-3	-3.0
MAX	596	275	5357	2485	632	226	46	441	19.9
YMV	427	--------	5126	--------	306	--------	29	379	7.2
YE t	--------	969.8	--------	11082.4	--------	639.5	-3.0	-3.0	-3.0

YMV: YEARMEANVALUE YE: YEAR EMISSION

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Date: 5.03.97

EMISSIONDATA BOILER 3

Y E A R P R O T O C O L for 1995

Month	NO2 mg/Nm3	NO2 kg/h	SO2 mg/Nm3	SO2 kg/h	DUST mg/Nm3	DUST kg/h	OIL m3/h	TEMP K	O2 Vol.%
:01.95 :	N	N	N	N	N	N	-3	-3	-3.0
:02.95 :	463	0	4877	0	26	0	0	311	2.2
:03.95 :	470	94	5018	1129	99	33	20	432	7.7
:04.95 :	357	129	4861	1759	261	96	36	440	4.2
:05.95 :	308	107	4996	1736	267	93	34	436	4.5
:06.95 :	0	0	0	0	0	0	0	310	21.0
:07.95 :	385	112	5937	1744	306	90	10	351	17.5
:08.95 :	397	116	5333	1554	160	47	25	420	10.3
:09.95 :	372	114	5568	1712	595	183	31	436	8.3
:10.95 :	433	132	5349	1628	346	105	30	436	7.7
:11.95 :	363	106	4594	1343	200	59	29	366	4.0
:12.95 :	400	107	4377	1176	147	39	27	304	3.0
: MIN :	0	0	0	0	0	0	-3	-3	-3.0
: MAX :	470	132	5937	1759	595	183	36	440	21.0
: YMV :	359	---------	4628	---------	219	---------	20	353	7.3
:YE t :	---------	594.2	---------	8111.6	---------	473.8	-3.0	-3.0	-3.0

YMV: YEARMEANVALUE YE: YEAR EMISSION

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Date: 5.03.97

EMISSIONDATA BOILER 4

YEARPROTOCOL for 1995

Month	NO2 mg/Nm3	NO2 kg/h	SO2 mg/Nm3	SO2 kg/h	DUST mg/Nm3	DUST kg/h	OIL m3/h	TEMP K	O2 Vol.%
01.95	N	N	N	N	N	N	-3	-3	-3.0
02.95	658	0	3700	0	6	0	0	427	9.4
03.95	464	93	4709	982	105	23	4	336	18.3
04.95	487	157	4909	1575	124	41	31	419	5.7
05.95	474	172	5100	1857	405	147	34	430	5.1
06.95	555	193	4913	1704	651	228	35	436	5.3
07.95	511	170	5110	1694	206	70	31	435	6.4
08.95	523	179	5259	1806	336	115	34	439	6.5
09.95	442	141	5183	1651	347	110	21	404	10.9
10.95	442	144	5208	1701	258	86	28	436	7.5
11.95	488	161	5213	1720	29	10	32	436	5.4
12.95	507	161	4833	1536	16	5	31	434	6.6
MIN	442	0	3700	0	6	0	-3	-3	-3.0
MAX	658	193	5259	1857	651	228	35	439	18.3
YMV	505	---	4922	---	226	---	23	386	7.0
YE t	---	1009.5	---	10341.7	---	509.3	-3.0	-3.0	-3.0

YMV: YEARMEANVALUE YE: YEAR EMISSION

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

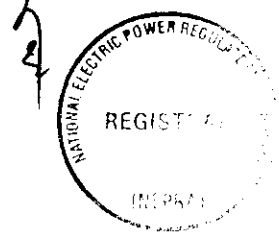
Date: 5.03.97

EMISSIONDATA BOILER 5

YEARPROTOCOL for 1995

Month	NO2 mg/Nm3	NO2 kg/h	SO2 mg/Nm3	SO2 kg/h	DUST mg/Nm3	DUST kg/h	OIL m3/h	TEMP K	O2 Vol.%
:01.95 :	N	N	N	N	N	N	-3	-3	-3.0
:02.95 :	494	0	4118	0	39	0	0	408	6.5
:03.95 :	579	135	4691	1329	82	37	28	431	3.3
:04.95 :	426	190	4867	2153	238	103	42	417	3.4
:05.95 :	403	179	5029	2231	479	213	43	427	2.9
:06.95 :	439	195	5030	2223	410	181	44	433	3.0
:07.95 :	424	180	5200	2194	505	215	42	434	3.2
:08.95 :	433	185	5329	2270	436	188	42	436	3.3
:09.95 :	416	172	5242	2161	363	152	40	437	3.3
:10.95 :	420	168	5280	2111	239	96	38	438	4.1
:11.95 :	417	168	5414	2185	234	95	25	391	10.7
:12.95 :	377	113	4908	1456	0	0	18	359	20.3
: MIN :	377	0	4118	0	0	0	-3	-3	-3.0
: MAX :	579	195	5414	2270	505	215	44	438	20.3
: YMV :	439	--------	5009	--------	275	--------	30	383	5.1
:YE t :	--------	1078.0	--------	12816.0	--------	893.5	-3.0	-3.0	-3.0

YMV: YEARMEANVALUE YE: YEAR EMISSION



Date: 5.03.97

EMISSIONDATA BOILER 1

Y E A R P R O T O C O L for 1996

Month	NO2		SO2		DUST		OIL	TEMP	O2
	mg/Nm3	kg/h	mg/Nm3	kg/h	mg/Nm3	kg/h	m3/h	K	Vol.%
01.96	484	193	4928	1965	0	0	39	440	16.3
02.96	425	160	4986	1863	0	0	38	440	15.9
03.96	506	199	4934	1941	89	37	38	438	8.9
04.96	531	226	4890	2075	290	125	42	441	6.5
05.96	491	206	4781	1995	318	136	42	440	7.0
06.96	418	170	4722	1918	247	103	40	440	8.9
07.96	504	197	5295	2075	271	108	38	426	6.6
08.96	0	0	0	0	0	0	0	302	21.0
09.96	0	0	0	0	0	0	0	304	21.1
10.96	578	226	4987	1872	157	59	36	423	9.9
11.96	0	0	0	0	0	0	39	430	20.7
12.96	0	0	0	0	0	0	6	232	1.6
MIN	0	0	0	0	0	0	0	232	1.6
MAX	578	226	5295	2075	318	136	42	441	21.1
YMV	328	--------	3293	--------	114	--------	30	396	12.0
YE t	--------	193.3	--------	1574.8	--------	77.2	--------	--------	--------

YMV: YEARMEANVALUE YE: YEAR EMISSION

NATIONAL ELECTRIC POWER REGULATORY
REGISTRAR
(NEPRA)

Date: 5.03.97

EMISSIONDATA BOILER 2

Y E A R P R O T O C O L for 1996

Month	NO2 mg/Nm3	NO2 kg/h	SO2 mg/Nm3	SO2 kg/h	DUST mg/Nm3	DUST kg/h	OIL m3/h	TEMP K	O2 Vol.%
:01.96	576	262	4560	2064	53	24	45	437	2.0
:02.96	587	212	4854	1974	72	28	41	436	3.9
:03.96	594	256	5066	2135	91	39	42	435	4.3
:04.96	619	289	4943	2299	135	64	47	439	5.4
:05.96	501	236	4284	2007	209	98	47	448	2.8
:06.96	509	244	4543	2178	119	57	48	448	1.1
:07.96	507	231	4949	2210	161	72	31	485	7.7
:08.96	501	232	5021	2318	153	71	46	416	2.1
:09.96	487	222	4732	2142	247	115	46	272	8.6
:10.96	492	226	4759	2175	263	121	45	434	2.3
:11.96	489	216	4145	1827	230	104	44	437	2.1
:12.96	422	186	4131	1818	229	101	44	436	1.5
: MIN :	422	186	4131	1818	53	24	31	272	8.6
: MAX :	619	289	5066	2318	263	121	48	448	7.7
: YMV :	517	---	4665	---	164	---	44	419	3.8
:YE t :	---	693.4	---	6608.2	---	266.9	---	---	---

YMV: YEARMEANVALUE YE: YEAR EMISSION

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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(NEPRA)

5(a)

Date: 5.03.97

EMISSIONDATA BOILER 3

Y E A R P R O T O C O L for 1996

Month	NO2*		SO2		DUST		OIL	TEMP	O2
	mg/Nm3	kg/h	mg/Nm3	kg/h	mg/Nm3	kg/h	m3/h	K	Vol.%
01.96	447	87	5272	1009	277	38	7	388	15.3
02.96	0	0	0	0	398	0	0	434	13.7
03.96	464	130	5186	1465	350	87	24	439	8.4
04.96	451	148	5137	1682	210	70	23	401	12.1
05.96	458	142	5426	1713	222	72	30	436	9.3
06.96	958	326	5399	1847	273	94	33	413	7.5
07.96	852	288	5138	1740	225	77	17	365	12.7
08.96	861	316	5590	2051	413	153	36	435	7.8
09.96	781	265	5515	1852	264	91	23	355	9.4
10.96	639	227	5325	1894	436	153	32	228	8.2
11.96	843	299	4822	1709	0	0	26	216	0.0
12.96	853	297	5174	1804	30	10	33	277	2.4
MIN	0	0	0	0	0	0	0	216	0.0
MAX	958	326	5590	2051	436	153	36	439	15.3
YMV	633	---	4832	---	258	---	24	365	8.2
YE t	---	391.1	---	2584.6	---	153.4	---	---	---

YMV: YEARMEANVALUE YE: YEAR EMISSION

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Date: 5.03.97

EMISSIONDATA BOILER 4

YEARPROTOCOL for 1996

	NO2		SO2		DUST		OIL	TEMP	O2
Month	mg/Nm3	kg/h	mg/Nm3	kg/h	mg/Nm3	kg/h	m3/h	K	Vol.%
01.96	519	158	4717	1445	16	5	29	433	8.6
02.96	523	154	5147	1509	18	5	20	480	10.9
03.96	475	171	5024	1812	131	49	27	488	9.2
04.96	445	161	4900	1771	104	38	36	437	4.8
05.96	419	151	4956	1798	142	53	35	438	9.2
06.96	418	160	5098	1965	237	94	37	438	12.6
07.96	375	144	5452	2090	196	77	38	437	6.5
08.96	340	115	5301	1789	216	72	32	437	5.2
09.96	352	137	5077	1986	170	68	38	437	5.3
10.96	371	127	5237	1818	198	66	27	435	9.5
11.96	398	140	4919	1739	102	37	35	435	5.6
12.96	375	131	4928	1728	107	38	33	435	6.8
MIN	340	115	4717	1445	16	5	20	400	4.8
MAX	523	171	5452	2090	237	94	38	438	12.6
YMV	418	--------	5063	--------	137	--------	32	431	7.8
YE t	--------	1083.2	--------	13372.8	--------	374.9	--------	--------	--------

YMV: YEARMEANVALUE YE: YEAR EMISSION

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Date: 5.03.97

EMISSIONDATA BOILER 5

Y E A R P R O T O C O L for 1996

Month	NO2		SO2		DUST		OIL	TEMP	O2
	mg/Nm3	kg/h	mg/Nm3	kg/h	mg/Nm3	kg/h	m3/h	K	Vol.%
:01.96 :	0	0	0	0	0	0	47	434	20.7 :
:02.96 :	0	0	0	0	0	0	46	433	20.8 :
:03.96 :	533	250	4972	2328	122	57	47	435	6.3 :
:04.96 :	545	258	4902	2295	196	92	47	435	2.5 :
:05.96 :	540	258	4997	2369	211	101	47	434	2.4 :
:06.96 :	530	255	4948	2379	189	91	48	436	2.1 :
:07.96 :	519	244	5471	2551	245	116	47	436	2.8 :
:08.96 :	552	256	5461	2498	234	109	45	435	3.0 :
:09.96 :	589	274	5264	2445	352	165	46	437	3.1 :
:10.96 :	486	180	5270	1944	225	83	35	430	4.6 :
:11.96 :	498	185	5036	1885	228	85	24	397	10.2 :
:12.96 :	540	237	4834	2093	173	75	43	435	4.4 :
: MIN :	0	0	0	0	0	0	24	397	2.1 :
: MAX :	589	274	5471	2551	352	165	48	437	20.8 :
: YMV :	444	---	4263	---	181	---	43	431	6.9 :
:YE t :	---	1618.4	---	15175.2	---	661.6	---	---	--- :

YMV: YEARMEANVALUE YE: YEAR EMISSION

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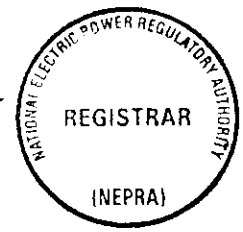
REGISTRAR
(NEPRA)

BIN QASIM POWER STATION

ENVIRONMENT CONTROL



E C O N - Environment Control Measurement-Container

Measurement place: PORT QASIM GATE
Start of measurements: 23.05.1997 at 11:54:30
Parameter file: DEFAULT.PAR

Channel	Date	Time	Mean Value	Unit
Sulphur Dioxide	23.05.1997	12:24:30	0.014	ppm
Nitrogen Monoxide	23.05.1997	12:24:31	0.025	ppm
Nitrogen Dioxide	23.05.1997	12:24:31	0.007	ppm
Total-Nitrogen Oxide	23.05.1997	12:24:31	0.033	ppm
Dust	23.05.1997	12:24:32		µg/m³
Humidity	23.05.1997	12:24:33	54	%
Temperature	23.05.1997	12:24:33	21.0	°C
Wind Speed	23.05.1997	12:24:33	5.9	m/s
Wind Direction	23.05.1997	12:24:34	49	°

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Page - 1 -

E C O N - Environment Control Measurement Container

Measurement place: KESC SUB STN NO.3
Start of measurements: 23.05.1997 at 11:14:45
Parameter file: DEFAULT.PAR

Channel	Date	Time	Mean Value	Unit
Sulphur Dioxide	23.05.1997	11:44:45	0.013	ppm
Nitrogen Monoxide	23.05.1997	11:44:46	0.040	ppm
Nitrogen Dioxide	23.05.1997	11:44:47	0.008	ppm
Total-Nitrogen Oxide	23.05.1997	11:44:47	0.057	ppm
Dust	23.05.1997	11:44:48	1	µg/m³
Humidity	23.05.1997	11:44:48	[illegible]	%
Temperature	23.05.1997	11:44:49	22.2	°C
Wind Speed	23.05.1997	11:44:49	5.3	m/s
Wind Direction	23.05.1997	11:44:49	61	

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

E C O N - Environment Control | Measurement-Container

Measurement place: GULSHAN-E-HADEED.
Start of measurements: 24.05.1997 at 11:23:30
Parameter file: DEFAULT.PAR

Channel	Date	Time	Mean Value	Unit
Sulphur Dioxide	24.05.1997	11:53:30	0.005	ppm
Nitrogen Monoxide	24.05.1997	11:53:31	0.011	ppm
Nitrogen Dioxide	24.05.1997	11:53:31	0.01[illegible]	ppm
Total-Nitrogen Oxide	24.05.1997	11:53:31	0.030	ppm
Dust	24.05.1997	11:53:32	1	µg/m3
Humidity	24.05.1997	11:53:33	65	%
Temperature	24.05.1997	11:53:33	30.2	°C
Wind Speed	24.05.1997	11:53:33	8.8	m/s
Wind Direction	24.05.1997	11:53:34	248	°

REGISTRAR (NEPRA)

E C O N - Environment Control Measurement-Container

Measurement place: PSO TERMINAL NH WAY
Start of measurements: 24.05.1997 at 10:38:16
Parameter file: DEFAULT.PAR

Channel	Date	Time	Mean Value	Unit
Sulphur Dioxide	24.05.1997	11:08:16	0.018	ppm
Nitrogen Monoxide	24.05.1997	11:08:17	0.010	ppm
Nitrogen Dioxide	24.05.1997	11:08:17	0.02	ppm
Total-Nitrogen Oxide	24.05.1997	11:08:18	0.05	ppm
Dust	24.05.1997	11:08:19		µg/m
Humidity	24.05.1997	11:08:19		%
Temperature	24.05.1997	11:08:20		°C
Wind Speed	24.05.1997	11:08:20	10.0	m/s
Wind Direction	24.05.1997	11:08:20		°

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

E C O N - Environment Control | Measurement-Container

Measurement place: GAGHAR RLY CROSSING
Start of measurements: 24.05.1997 at 12:28:03
Parameter file: DEFAULT.PAR

Channel	Date	Time	Mean Value	Unit
Sulphur Dioxide	24.05.1997	12:58:03	0.007	ppm
Nitrogen Monoxide	24.05.1997	12:58:04	0.012	ppm
Nitrogen Dioxide	24.05.1997	12:58:04	0.014	ppm
Total-Nitrogen Oxide	24.05.1997	12:58:04	0.027	ppm
Dust	24.05.1997	12:58:05	1	µg/m³
Humidity	24.05.1997	12:58:06	64	%
Temperature	24.05.1997	12:58:06	29.7	°C
Wind Speed	24.05.1997	12:58:06	10.2	m/s
Wind Direction	24.05.1997	12:58:07	193	°

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Page - 1

E C O N - Environment Control Measurement-Container

Measurement place: FJFC PLANT
Start of measurements: 24.05.1997 at 13:16:36
Parameter file: DEFAULT.PAR

Channel	Date	Time	Mean Value	Unit
Sulphur Dioxide	24.05.1997	13:46:36	0.005	ppm
Nitrogen Monoxide	24.05.1997	13:46:37	0.001	ppm
Nitrogen Dioxide	24.05.1997	13:46:37	0.016	ppm
Total-Nitrogen Oxide	24.05.1997	13:46:37	0.017	ppm
Dust	24.05.1997	13:46:38	1	µg/m
Humidity	24.05.1997	13:46:39	67	%
Temperature	24.05.1997	13:46:39	29.6	°C
Wind Speed	24.05.1997	13:46:39	10.8	m/s
Wind Direction	24.05.1997	13:46:40	208	°

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

E C O N - Environment Control — Measurement Container

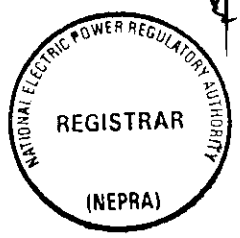
Measurement place: PTA PLANT BIN QASIM
Start of measurements: 24.05.1997 at 14:03:55
Parameter file: DEFAULT.PAR

Channel	Date	Time	Mean Value	Unit
Sulphur Dioxide	24.05.1997	14:33:55	0.018	ppm
Nitrogen Monoxide	24.05.1997	14:33:56	0.027	ppm
Nitrogen Dioxide	24.05.1997	14:33:56	0.010	ppm
Total-Nitrogen Oxide	24.05.1997	14:33:57	0.047	ppm
Dust	24.05.1997	14:33:58	1	µg/m3
Humidity	24.05.1997	14:33:58	70	%
Temperature	24.05.1997	14:33:59	29.5	°C
Wind Speed	24.05.1997	14:33:59	11.9	m/s
Wind Direction	24.05.1997	14:33:59	227	°

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

BIN QASIM POWER STATION

DUE-DILIGENCE REPROT



A.3 BIN QASIM THERMAL POWER STATION

A.3.1 SUMMARY

Bin Qasim Thermal Power Station is KESC's most significant generation asset with 1260 MW installed capacity. The station is located on the eastern outskirts of Karachi, south of the national highway to Hyderabad. The site is adjacent to Pipri Creek and within sight of the Pakistan Steel Mill and Port Qasim, as shown on Figure A.1 (*to follow in draft report*). Seawater extracted via screened intakes supplies the stations cooling water system. This report is prepared on the basis of information provided by KESC and that acquired during a visit to the station, meetings with senior station staff in June 1998 and analysis of the data.

The station has six oil fired units, each of 210 MW capacity, giving a total station installed capacity of 1260 MW and was commissioned on a unit by unit basis between 1983 and 1998. The station operates primarily as a baseload station. Station staff stated that the equipment was technically capable of operating on a two-shift basis, although there is no experience of such operation to date. Plans to convert the station to dual oil/gas firing are currently being implemented.

Units 1, 2, 5 and 6 have Hitachi turbines and boilers with Units 3 and 4 supplied by Ansaldo with Deutsche Babcock boilers. In general, the performance and reliability of the Hitachi units has been considerably better than that of the Ansaldo units.

The station is managed and operated by KESC full time staff, with the exception of contract workers employed when necessary for specialist tasks such as welding and occasionally general labour for site cleaning. About half the staff employed is engaged in operational activities, with the remainder in maintenance. A representative from the relevant manufacturer is normally employed to supervise major plant outages.

Effective station management is constrained by a lack of authority to procure the necessary spares and consumables, and owing to short term generation needs planned outages are frequently cancelled, which, if implemented, would assist in maintaining unit capabilities above the level currently being achieved.

All units, except for Unit 6, which was recently commissioned, are considerably downrated from their installed capacity and operating at reduced efficiency. Provided that detailed inspections do not reveal any currently undetected problems, it should be possible to recover performance to within 3 to 5 per cent of acceptance tests results. In order to achieve this, with the exception of Unit 6, a detailed inspection followed by a major maintenance outage is required on each unit.

A.3.2 OUTLINE PLANT DESCRIPTION

1) STEAM TURBINES

The steam turbines are supplied by Hitachi and Ansaldo as indicated in Table A3.1. There is no record of any unusual defects on the turbines, the station's various problems with performance are attributed by staff to other elements, particularly problems with the boilers and condensers. There have, however, recently been outages on Units 3 and 4 associated with setting the overspeed governors.

TABLE A3.1 BIN QASIM BASIC PLANT DATA

Unit Nr	Year Commissioned	Gross Capacity (MW)		Manufacturer (Boiler/ Turbine)
		Installed	June 1998	
1	1983	210	120	Babcock Hitachi/Hitachi
2	1984	210	180	Babcock Hitachi/Hitachi
3	1989	210	180	Deutsche Babcock/Ansaldo
4	1990	210	180	Deutsche Babcock/Ansaldo
5	1991	210	185	Babcock Hitachi/Hitachi
6	1997	210	210	Babcock Hitachi/Hitachi
Total		1280	1075	

Data: Generation and Co-ordination Department June 1998

TABLE A3.2 BIN QASIM TURBINE DESIGN DATA

Unit	Model/Type	Stages HP+IP+LP	Steam Condition		Exhaust Pressure (bar(a))
			Pressure (bar)	Temp (C)	
1	TCDF	8+6+2x5	140	525	0.07
2	TCDF	8+6+2x5	140	525	0.07
3	TCDF	9+7+2x6	140	525	0.07
4	TCDF	9+7+2x6	140	525	0.07
5	TCDF	8+6+2x5	140	525	0.07
6	TCDF	8+6+2x5	140	525	0.07

Data: Generation and Co-ordination Department June 1998.
Note: TCDF Tandem Compound, Double Flow, Reheat Condensing Steam Turbine Generators

II) BOILERS

Hitachi Babcock boilers are installed for Units 1, 2, 5, and 6 and Deutsche Babcock boilers for Units 3 and 4. All are based on an oil fired, single drum, natural circulation design. To achieve the design steam conditions at the turbine stop and intercept valves, superheat and reheat steam circuits are provided.

On all boilers, combustion takes place in a pressurised furnace, supported by two regenerative rotary air heaters, two forced draught fans and two exhaust gas recirculation fans which are primarily used for reheat steam temperature control purposes. Any two of three 60 per cent duty pumps supplies boiler feed water requirements for full load conditions. Output from these pumps, when in service, is regulated by variable fluid couplings fitted between the pump and the motor, from a combination of drum level and demand signals.

Plant design operating conditions are summarised in Table A3.3.

TABLE A3.3 BIN QASIM BOILER DESIGN DATA

Unit	Capacity (tons/hr)	Steam Conditions				Soot Blowers (No)	Type
		Main		Reheat			
		Pressure (bar)	Temp (C)	Pressure (bar)	Temp (C)		
1	680	145	530	34.6	530	16	Single Drum
2	680	145	530	34.6	530	16	Natural
3	680	145	530	34.2	530	12	Circulation
4	680	145	530	34.2	530	12	System
5	680	145	530	35.1	530	16	
6	680	145	530	35.1	530	16	

Data: Generation and Co-ordination Department June 1998

Problems associated with the boilers are the most likely sources of unit degradation and loss of efficiency. However, with suitable investment, it should be possible to restore output to within 2 to 3 per cent of capability in terms of steam quantity and quality achieved at commissioning. Principal problems are associated with the air heaters and the reheater coils.

From the information provided on unit outages it would seem that air heater seals need to be replaced and the heat transfer "baskets" require refurbishment.

Defective reheater elements will also need to be replaced. Elsewhere in the world it would be unusual to replace reheaters within the first 25 years of service of an oil-fired boiler. Staff stated the reheater problems were caused by fireside corrosion, which could be associated with the relatively high sulphur fuel (specification 3.5 per cent). Options to mitigate this problem include the use of fuel additives to neutralise corrosive elements in the fuel or the replacement of the reheater tubes with higher quality materials.

Operating records suggest that the burner management and tip maintenance/quality control regime needs to be improved. Use of defective / worn burner tips is likely to be a significant source of poor combustion and hence fouling of the boiler gas passes and air heaters. Such an improvement could reduce the need for sootblowing and increase the steam raising capacity, thus restoring the unit output nearer to design rating.

It was stated that Pakistan government inspectors carry out statutory boiler inspections. However the maintenance records provided for 1995 to 1998 do not show outages for statutory inspections on any of the units. No certificates of inspection were seen.

III) ELECTRICAL SYSTEMS

The station does not have 'black start' capability, but does have a 1.7 MW diesel generator unit for emergency use.

Metering equipment to measure units generated and auxiliary power consumption are installed. There has been no recalibration of any station meters since commissioning and there are no check meters. Two way meters are installed on the outgoing feeders.

Staff stated that the station could run in either frequency control, or in load control mode. The plant can be either manually or automatically synchronised.

IV) GENERATORS AND GENERATOR TRANSFORMER

No unusual problems with the generators and generator transformers were reported. Annual tests of generator zone protection are carried out.

TABLE A.3.4 GENERATOR AND GENERATOR TRANSFORMER DESIGN DATA

Unit	Generator Transformer				Generator			
	Manufacturer	Type	Rating		Manufacturer	Capacity (MVA)	Terminal Voltage	Cooling Media
			MVA	kV				
1	Hitachi	(ONAF/	247	21/220	Hitachi	248.3	21	(Water&
2	Hitachi	OFAN	247	21/220	Hitachi	248.3	21	hydrogen)
3	Ansaldo	(1)	250	18/220	Brecolle Marrelli	247.06	18	Hydrogen
4	Ansaldo		250	18/220	Brecolle Marrelli	247.06	18	Hydrogen
5	Fuji Electric		250	18/220	Hitachi	248.3	18	Hydrogen
6	Fuji Electric		250	18/220	Hitachi	248.3	18	Hydrogen

Data: Generation and Co-ordination Department June 1998
(1) ONAF/OFAN: Oil Natural Air Forced/Oil Forced Air Natural

V) CONDENSERS

The condensers are of the under-slung type. Unit 5 was fitted with debris filters and on-load cleaning facilities ("Taprogge"). However the equipment is not used regularly because the cleaning balls are often lost and replacements are not procured. Condenser fouling is a significant constraint on station performance. This problem is exacerbated by the fact that the chlorine plant has been out of service for an extended period, leading to marine growths in the cooling water system.

Chlorinating has not been carried out for a considerable period and the plant non availability is a major cause of condenser fouling, arising from uninhibited marine growth. This is a particular problem during the summer months when outages to clean the condensers are required up to twice per week on each unit. These outages are generally of 12 hours' duration. Condenser fouling is stated by staff to be one of the primary causes of loss of unit output.

Condensate polishing facilities are not provided. Staff stated that the water is of an adequate quality and condenser tube leaks (salt water into condensate) are not common. The response to tube leaks is generally to isolate rather than repair tubes. A chemist on site takes samples of condensate every 2 hours. Continuous monitoring is said to be available but staff stated that it is unreliable. Details of the present condition of the condensers ie. the number of tubes plugged, is not known.

VI) COOLING WATER SYSTEM

Cooling water requirements of the units are supplied from a pump-house having one pump per unit and one spare; all feeding a common unit supply manifold. Coarse screens are provided at the inlet to the cooling water pump house fore-bay chamber and the water intakes for each pump have band screens to prevent ingress of debris into the system.

Maintenance/overhaul requirements for the cooling water system associated with the Ansaldo units (3 to 4 in the period 1997-8) was greater than the Hitachi units (1,2 and 5 in the last10 years). Unreliability of Units 3 and 4 cooling water pump variable pitch impellers, has caused operational problems.

VII) BALANCE OF PLANT AND SUPPORT FACILITIES

Water and Effluent Treatment Facilities

Town's water supply to Bin Qasim is delivered via Pakistan Steel Mills, using a system, which was commissioned in 1996. The quality of the water received is usually reasonable and the supply has been secure. However, because of fears of future shortages, their are plans to commission a desalination plant

at the power station site.

The plant has a water demineralisation plant for the production of treated water for boiler fill and make-up requirements.

There are two oil / water separators in the fuel oil tank area for the collection of oil spillages, however contaminants in all other areas of the station are not intercepted before discharge.

Emission Monitoring

Chimney emission monitoring equipment was installed on Units 1 to 5 in 1992 but is currently not in service because of computer breakdowns. Stack heights are 80m for Units 1 and 2 and 100m for Units 3 to 6.

Fire Protection

Rehabilitation of the site fire water system was virtually complete at the time of Mott MacDonald's visit. The pipework was in place but fire hoses and fire reels had yet to be replaced. The station calls on Port Qasim fire service in the event of any incidents.

Stores

Part of each construction contract includes supply of spares for five years anticipated requirements.

Stores and plant spares management systems are manual and the efficiency of the stores is limited by the availability of parts the purchasing systems. Procurement of any item of value in excess of Rs 2,000 must be referred to the Finance and Purchasing Departments. Shortage of consumable stores and plant spares is a problem because of the protracted procurement process and KESC's poor financial position.

Workshop

The workshop on site is well equipped and the facilities provided are suitable for the majority of maintenance requirements.

Residential Colony

A housing colony for Bin Qasim personnel, comprising of approximately 270 houses is located about 8 km from the site. A brief visit to the colony showed it to be reasonably well kept. The area incorporates a mosque, health centre and recreational area. The colony is popular with staff who relocate from other parts of Sindh, but not with local staff. All the houses are allocated to KESC staff but many do not work at Bin Qasim and a sizeable number of the residents sub-let the accommodation to non-employees. All residents have free water and electricity.

A.3.3 PLANT PERFORMANCE

There are no plant availability, efficiency or cost targets for operational performance of the station to be compared against – the sole objective is to maximise the plants generated output with minimum plant maintenance outages and costs. It would be expected for oil fired plant of this type and age elsewhere in the world to achieve availability levels of at least 88 per cent annually based on installed capacity. It would also be expected that the units would not suffer permanent derating from its installed capacity. Some transient downratings may occur, however, these would normally be cured during planned outages.

In the case of Bin Qasim, the station is often required to cancel planned outages and financial constraints restrict required plant maintenance, the consequences of these decisions is reflected in the achieved performance.

Table A3.5 Bin Qasim operating statistics for the period 1994 to 1998, shows the significant degradation of the units since entering commercial service. Dispatch is generally for all available hours and to the maximum capacity offered. Thus the statistics which show the average loads as significantly lower than the stated maximum loads indicate that there are a high number of transient plant deratings during any operating year. Availability levels are poor compared to what would usually be expected from similar units of this type installed elsewhere.

It should be noted that the units are currently operated without the feed heaters in service, a practice which boosts unit output at reduced operating efficiency.

Auxiliary power consumption is slightly higher than would normally be expected for an oil-fired station of this nature, which is primarily caused by plant output restrictions.

TABLE A3.5 BIN QASIM UNIT OPERATION 1994 TO 1998

Unit No	Installed Capacity (MW)	Period	Maximum Load (MW)	Operating Hours	Total Units Generated (MWh)	Auxiliary Consumption (%)	Power Factor
1	210	1994-95	180	7,909	1,137,055	7.44	0.95
		1995-96	170	8,706	1,297,595	7.19	0.93
		1996-97	175	5,779	750,905	8.43	0.91
		May-98	120	728	73,630	10.17	0.88
2	210	1994-95	205	8,153	1,231,160	7.02	0.92
		1995-96	195	8,167	1,278,820	6.81	0.94
		1996-97	195	8,455	1,281,300	7.05	0.92
		May-98	180	722	100,510	7.70	0.91
3	210	1994-95	190	6,383	856,234	7.41	0.91
		1995-96	140	7,497	879,781	7.50	0.89
		1996-97	160	7,743	990,491	7.17	0.89
		May-98	170	729	105,150	6.71	0.91
4	210	1994-95	200	6,700	910,610	7.36	0.89
		1995-96	175	7,777	1,058,072	7.14	0.92
		1996-97	165	8,067	1,107,077	6.97	0.91
		May-98	0	0	0	-	-
5	210	1994-95	195	7,580	1,166,030	6.03	0.92
		1995-96	200	7,984	1,436,030	5.48	0.94
		1996-97	200	8,387	1,458,870	5.22	0.94
		May-98	180	714	121,050	5.58	0.91
6	210	May-98	210	665	124,391	6.07	0.91

Data: Generation and Co-ordination Department June 1998

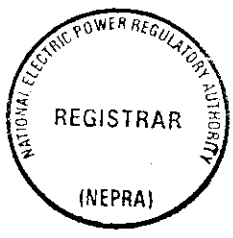


TABLE A3.6 BIN QASIM UNIT PERFORMANCE 1994 TO 1998

Unit No	Installed Capacity (MW)	Period	Maximum Load (MW)	Average Load (MW)	Load Factor	Capacity Factor	Availability Factor
1	210	1994-95	180	144	0.68	0.62	0.90
		1995-96	170	149	0.71	0.71	0.99
		1996-97	175	130	0.62	0.41	0.66
		May-98	120	101	0.48	0.47	N/A
2	210	1994-95	205	151	0.72	0.67	0.93
		1995-96	195	157	0.75	0.70	0.93
		1996-97	195	152	0.72	0.70	0.97
		May-98	180	139	0.66	0.64	N/A
3	210	1994-95	190	134	0.64	0.47	0.73
		1995-96	140	117	0.56	0.48	0.86
		1996-97	160	128	0.61	0.54	0.88
		May-98	170	144	0.69	0.67	N/A
4	210	1994-95	200	136	0.65	0.50	0.76
		1995-96	175	136	0.65	0.58	0.89
		1996-97	165	137	0.65	0.60	0.92
		May-98	0	0	-	-	N/A
5	210	1994-95	195	154	0.73	0.63	0.85
		1995-96	200	180	0.86	0.78	0.91
		1996-97	200	174	0.83	0.79	0.96
		May-98	180	170	0.81	0.77	N/A
6	210	May-98	210	187	0.89	0.80	N/A

Data: Generation and Co-ordination Department June 1998

Since the number of operating hours is equal to the number of hours available, an availability factor including correction for capacity downrating would be close to the capacity factor value. The value would only deviate to reflect starts and stops. This shows that true availability of these units is far from normal standards achieved elsewhere.

Plant efficiency degradation (i.e. increases in heat rate) is far higher than would normally be expected for units of this type and age. Table A3.7 shows that the performance of the units has deteriorated steadily from acceptance performance test levels and that the Ansaldo units have an inferior efficiency to the Hitachi units.

Staff attributed the poor heat rates to fouling in the condensers and choking of tube plates. Marine growth is a problem particularly during the summer season. This problem is exacerbated by the fact that the station cooling water chlorination plant has been out of service for a considerable period.

Without having detailed information on the operating conditions, possible contributions to the loss in efficiency can be estimated as:

- Operation at part load (1 to 3 per cent)
- Wear and tear to steam turbines (typically 1 per cent but in extreme case up to 3 per cent)
- Operation without feed heaters (up to 3 per cent)
- Loss in condenser vacuum (approximately 2 per cent)
- Large number of starts (1 to 5 per cent)
- Degradation of boiler efficiency due to poor combustion control (in the order of 5 per cent)

It can be seen that these sources cannot account for the entire degradation, even if they all occur

simultaneously to the maximum extent. Other sources of "losses" therefore need to be identified. These could include fuel metering accuracy or "leakages" in the process of delivering fuel to the units. However it is still difficult to adequately explain the performance level achieved by the Ansaldo units.

Problems with boiler air heaters have caused significant derating on all units, except Unit 6. Manufacturers recommend boiler cleaning every 10 months, but the period at Bin Qasim is more - typically 2 years. On oil fired boilers elsewhere this interval would not normally be a problem; however it is likely that boiler problems are exacerbated by poor combustion management and the quality of the residue fuel burnt. This results in serious fouling from deposits in the boiler gas passes and, in particular, in the air heater heat exchanger baskets. The resolution of the combustion problems will require the implementation of strict quality control procedures in the checking of burner tips and the funds available to replace tips as soon as they no longer meet the acceptance criteria. Staff stated that weekly checks of the burner tips are carried out but replacement burner tips often not available.

TABLE A3.7 BIN QASIM UNIT EFFICIENCY

Unit No	Commissioning Year	Installed Capacity (MW)	Heat Rate (HHV)		Period	Period Average Heat Rate		
			Design	Commissioning		Gross	Net	Degradation since commissioning %
1	1983	210	8627	8570	1994-95	10,034	10,841	27
					1995-96	9,943	10,713	16
					1996-97	9,919	10,832	16
					May-98	10,854	12,093	27
2	1984	210	8627	8531	1994-95	9,797	10,537	15
					1995-96	9,564	10,359	12
					1996-97	9,748	10,488	14
					May-98	10,395	11,262	22
3	1989	210	8609	8577	1994-95	10,467	11,305	22
					1995-96	11,270	12,184	31
					1996-97	11,439	12,321	33
					May-98	11,028	11,815	29
4	1990	210	8609	8547	1994-95	10,358	11,178	21
					1995-96	10,754	11,580	26
					1996-97	11,115	11,984	36
					May-98	Outage	Outage	N/A
5	1991	210	8442	8352	1994-95	9,363	9,964	12
					1995-96	9,063	9,588	7
					1996-97	9,115	9,617	9
					May-98	9,312	9,862	11
6	1997	210	8442	8400	May-98	8831	9367	5

Data: Generation and Co-ordination Department June 1998

Table A3.8 summarises the operational limits of the units, as currently operated.

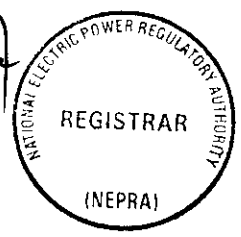


TABLE A3.8 BIN QASIM PLANT OPERATIONAL LIMITS

Unit	Warm Start (hrs)	Cold Start (hrs)	Ramp Rate (°a)/ Min		
			Cold	Warm	Hot
1	2 to 2.5	20	1	3	5
2	2 to 2.5	20	1	3	5
3	2 to 2.5	9	1	3	5
4	2 to 2.5	9	1	3	5
5	2 to 2.5	17	1	3	5
6	2 to 2.5	N/A	1	3	5

Data: Generation and Co-ordination Department June 1998

Table A3.9 shows outage statistics for the units. The station also provided records of outages from 1995 to 1998. In general, insufficient planned outages are carried out because of political pressure to keep the units running as much as possible. This results in sustained deratings which become progressively more difficult to recover. Units 3 and 4 have been less reliable in terms of the number of forced outages. However, although the units are technically similar, the problems have not been common.

TABLE A3.9 BIN QASIM OUTAGE RECORDS

Unit No	Installed Capacity (MW)	Period	Maximum Load (MW)	Availability Factor	Forced Outage Factor	Total Outages	Forced Outages	Planned Outage (Hrs)	Forced Outages (Hrs)
1	210	1994-95	180	0.90	0.03	18	17	N/A	223
		1995-96	170	0.99	0.00	16	14	N/A	24
		1996-97	175	0.66	0.18	15	10	1,599	1,591
		May-98	120	N/A	0.02	2	2	N/A	16
2	210	1994-95	205	0.93	0.06	18	15	N/A	556
		1995-96	195	0.93	0.00	6	4	603	6
		1996-97	195	0.97	0.03	27	27	0	305
		May-98	180	N/A	0.01	4	3	N/A	9
3	210	1994-95	190	0.73	0.18	36	29	N/A	1,544
		1995-96	140	0.86	0.04	44	28	483	316
		1996-97	160	0.88	0.10	80	71	81	908
		May-98	170	N/A	0.03	6	5	N/A	25
4	210	1994-95	200	0.76	0.09	59	47	N/A	789
		1995-96	175	0.89	0.05	61	34	410	432
		1996-97	165	0.92	0.02	38	28		142
		May-98	0	N/A	-	1	0	N/A	0
5	210	1994-95	195	0.87	0.05	17	13	0	412
		1995-96	200	0.91	0.00	14	-	699	12
		1996-97	200	0.96	0.01	21	13	312	20
		May-98	180	N/A	0.01	3	2	N/A	2
6	210	May-98	210	N/A	N/A	N/A	N/A	N/A	N/A

Data: Generation and Co-ordination Department June 1998

A.3.4 ANALYSIS OF UNIT PERFORMANCE

1) UNIT 1

Unit 1 has an installed capacity of 210 MW, was supplied and erected by Hitachi of Japan and commissioned in 1983. At the time of Mott MacDonald's visit the unit output was restricted to 120 MW

less than 60% of its rated capacity. The primary causes of this down-rating are problems with rotary air heaters, reheater tube failure and sootblowers.

The rotary air heater axial, circumferential and radial seals are all badly worn, thus allowing air normally destined for combustion to bypass the boiler and pass directly to the chimney with the boiler exhaust gases, thus limiting the boiler output. The air heater 'basket' heat exchanger elements are also fouled (choked), restricting the flow of air and exhaust gases, also limiting the boiler output. Orders have been placed with the original equipment manufacture for the required replacement parts.

The reheater comprises 65 rows of heat exchanger coils, the first loop of each coil having five tubes. These tube banks have been subject to many failures and are to be replaced. Requisitions for the necessary materials to carry out for this work have been submitted for approval. Staff stated that the failures were caused by high temperature fireside corrosion.

Rack operated long lance sootblowers, necessary for clearing gas pass fouling in the superheater and reheater zones of the boiler, require overhaul. Failure of these units is attributed to use during low load operation, ie when there is insufficient steam available to adequately cool the lance when it is in use causing the lance to overheat and bend whilst in service.

The frequent use of sootblowers on large oil fired boilers is unusual, normally only required in the superheater / reheater enclosure, economiser and air heater zones of the boiler. Greater attention to oil burner cleaning procedures and burner tip accept / rejection criterion would probably result in improved combustion and a reduction in sootblowing requirements. Procurement of better quality fuel oil would probably significantly improve performance and plant overall availability.

There has been a gradual decline in unit output and efficiency, and the maintenance records provided for 1995 to 1998 show that the current problems with reheaters and air heaters have persisted in spite of maintenance carried out. Records show the following maintenance history:

1995-6	Minimal maintenance
1996-7	Repair and overhaul of air heater (1,500 hours)
	Reheater repair (625 hours)
	Cleaning air heaters, adjusting seals and replacing elements (720 hours)
	Repair of reheater tube leaks (260 hours)
1997-98	Air heater inspection and maintenance (250 hours)
	Repair to drum level transmitter (460 hours)

The gradual decline in capability of the unit can partly be explained by inadequate and infrequent maintenance. Further information on outages would be required in order to determine reasons for output not being recovered after outages. However, it is likely that a major overhaul including attention to air heaters and reheaters, combined with improved combustion management will lead to significant output recovery.

A four week outage was planned for Unit 1, commencing 1 June 1998, which includes plans to install debris filters. As far as we know the rebuilding of the air heaters is not included in the programme therefore it is unlikely that the generating capacity of the unit will be significantly improved when the unit returned to service. In fact, an outage on Unit 4 had extended beyond its planned date and there was apparently no work in progress on Unit 1 at the time of Mott MacDonald's visit.

The KESC Revenue Budget for 1998-99 indicates a unit output of 160 MW when the unit is returned to service, giving a forecast average availability for 1998-99 of 133.3MW, an improvement when compared with current achievement, although still significantly below the unit's installed capacity.

II) UNIT 2

Unit 2 is similar to Unit 1, also supplied by Hitachi and was commissioned in 1984. This 210 MW unit is currently capable of generating about 180 MW. Unit availability and output is affected by reheater tube failures resulting from high temperature fireside corrosion. It is planned to retube the affected reheater sections during the next planned unit outage.

In addition to the replacement of defective reheater tubes mentioned above, it is also planned to refurbish the steam air heater drains pump. The steam heated air heater unit is primarily used during unit start up and has little impact on the unit's generating capability when in service, provided that the main air heater is in a satisfactory condition.

During the period from 1 September 1995 to 27 January 1998 the unit had forty outages, none caused by boiler tube failures. A summary of the reasons given for a sample of the outages is given in Table A3.9 Unlike the other units, annual boiler inspections are recorded for Unit 2.

TABLE A3.9 BIN QASIM UNIT 2 - OUTAGE SUMMARY

No. of Outages	Cause
4	Normal shut downs (planned)
7	External transmission system surges
5	Boiler drum water level problems (3 low, 2 high water level)
8	Main steam temperature low
1	Main steam temperature high
2	Boiler feed pump trips
2	High water level in feed heaters
2	Boiler trips
2	LP turbine bypass mistakenly opened
9	Due to miscellaneous other causes

Data: Generation and Co-ordination Department June 1998

This list demonstrates the significance of problems in the supply and control of boiler feedwater. The number of unit outages from miscellaneous causes is also unusually high. Of the total downtime during the period 84% of the time was spent on planned work and 16% on forced outages. The average duration of forced outages was approximately 8 hours.

In 1994 there was a control cable fire, during the time taken to repair the damaged cables an extended major overhaul on Unit 2 was carried out.

Plant availability for Unit 2, relative to the other units at Bin Qasim, has been good (see Table A3.7) although it should be noted that these figures are based on hours only, and not weighted according to capacity available.

Planned refurbishment work on this unit is to include the following major items

- Replacement of the first loop of the steam heated air preheater coils
- Replacement of the steam coil air preheater drains pump

KESC has plans to rehabilitate or refurbish the reheater, and to install debris filters in the cooling water system on this unit.

III) UNIT 3

Similar to Units 1 and 2, Unit 3 has an installed generating capacity of 210 MW. This unit was supplied and erected by Ansaldo, who manufactured the steam turbine generator together with a boiler supplied by Deutsche Babcock. This unit was commissioned in 1989 and has had a poor availability record since that time. From June 1995 to November 1997 (less than two and half years) this unit had 121 outages - 27 planned and 94 forced. By any standards this is an exceptionally poor record. A summary of the primary causes of these outages is given in Table A3.10.

TABLE A3.10 BIN QASIM UNIT 3 OUTAGE SUMMARY

Nr of Outages	Cause
26	Problems on the Electro Hydraulic Control (EHC) system
29	Cooling water system defects and condenser fouling, tube leaks, condenser cleaning condenser vacuum loss Cooling water pump trips due to pump failures.
Misc	Various boiler defects, including drum level control problems, boiler trips from undefined causes combustion control problems causing air heater fouling.
Misc	Control valve defects

Data: Generation and Co-ordination Department June 1998

Operating staff at the station stated that the reliability of this unit has not been as good as the Hitachi units. Two faults common to the Ansaldo units have been the necessity to reset the turbine overspeed governor and to clean fouled condenser tubes. In addition, many outages have occurred due to problems with electro-hydraulic controls, and although persistent, these are unique to Unit 3. Solution of this problem would require significant investment.

IV) UNIT 4

Unit 4 is identical to Unit 3 and was also supplied and erected by the Ansaldo/Deutsche Babcock Consortium. This unit entered commercial service in 1995. Maintenance records suggest that Unit 4 has been more reliable than Unit 3. The most common recurring problems are water side fouling of the condenser. Other events causing forced outages include boiler trips and resetting of the turbine overspeed governor.

At the time of Mott MacDonald's visit this unit was not available due to a planned outage, which was planned for 3 months duration, but had already lasted 4 months. The overrun was stated to be caused by the time taken to order and acquire replacement parts and consumable spares. Prior to the outage the generated output of this unit was limited to 150 MW. The primary cause of this derating was stated to be air heater gas pass blockages and defective air heater seals. In addition, output is further reduced due to defective sootblowers and the impaired effect of part load operation on sootblower effectiveness. One possible means of overcoming the sootblowing steam supply pressure problem whilst the unit is derated or dispatched at part load, would be to introduce an alternative sootblower steam supply from a main steam source through a pressure reducing control station.

Boiler gas passes are badly fouled and in places are partially blocked, a further reason for the loss of unit output. Several superheater and reheater tube failures were reported, however the reasons for and the mode of these failures were not identified.

Boiler flue gas recycling fans are used as an aid to superheat and reheat steam temperature control. However, the fan on Unit 4 is presently not serviceable. Fan failure was induced by operating the fan whilst the gas passes of the reheater section of the boiler were blocked, causing an unacceptable back pressure, hence overloading the fan.

V) UNIT 5

Unit 5 was supplied by Hitachi/Hitachi Babcock of Japan and is similar to Units 1 and 2. This unit was commissioned in 1991 and is currently capable of sustaining an output of 185 MW, 88% of the unit's rated capacity.

A major overhaul of this unit is planned for the latter half of 1998 probably extending into 1999. This will be the first major planned outage since the unit was commissioned.

Debris filters including a Taprogge on load condenser tube cleaning system were installed on this unit's cooling water system in 1995.

Station staff advised that Unit 5 has given satisfactory service since it was commissioned. It was also reported that steam air heater drain pump is the only plant item requiring replacement.

VI) UNIT 6

Unit 6 was also supplied by the Hitachi/Hitachi Babcock group and is similar to Unit 5. This unit was recently commissioned (in 1998) and was in service, generating at full load at the time of this site visit. All performance tests, apart from hot start trials, had been completed successfully, but the unit has not been formally handed over to KESC.

A.3.5 ELECTRICAL INTERCONNECTION

Power is exported from Bin Qasim via three double circuit 220 kV overhead lines, one of which has been newly installed and was commissioned with Unit 6. This grid substation arrangement provides adequate generation export flexibility and redundancy.

A.3.6 FUEL SUPPLY ARRANGEMENTS

All units at Bin Qasim are currently operating on imported furnace oil, which is supplied directly to the station from seagoing tankers berthed in Pipri Creek. Fuel supply and price are government controlled. There are no formal fuel supply contracts and therefore no liquidated damages for failure to perform. Storage on the site is in four bunded tanks, which have a combined total capacity of approximately 120,000 tons, sufficient for approximately 25 days' plant operation at full load.

An oil pipeline and transfer tank was completed in 1990 and provides the main source of fuel supply. Road tanker delivers alternative fuel and lighting up fuel supplies. Light Diesel oil is currently the lighting up fuel, for which there is capacity for 1000 litres' storage on site. 'C' Class meters have been fitted to the oil lines.

There has never been a complete failure of fuel supply during the operating history of the station. However, at the time of the visit by Mott MacDonald the tanks fuel stocks were running at about one day's supply. Staff stated that this condition had been sustained for a considerable time and was due to KESC's poor payment record (at the time of the visit an estimated Rs 9 billion was owed by KESC to the fuel supplier).

The fuel specification is for fuel with a maximum sulphur content of 3.5 per cent. An independent laboratory in Karachi carries out sample testing. No additives are used to aid combustion or inhibit corrosive chimney emissions.

There are plans to convert the station to dual gas and oil firing. For this purpose, a pipeline and natural gas metering station have been commissioned in 1998. Unit 6 will be the first unit to be converted. At the time of the visit, the conversion was scheduled to commence once Unit 4's outage had been completed Gas meters have been fitted to each unit, with a seventh meter to measure total flow.

The station will continue to rely on oil in winter as the gas allocation is diverted to the north of the country for domestic heating.

A.3.7 MISCELLANEOUS

I) SAFETY

A permit to work control system is in operation at the station. Protective clothing and safety equipment is issued to staff. Observations during the visit suggested that such clothing is worn more by staff at Bin Qasim than at other stations.

The station normally erects its own scaffolding and other work access equipment. There are also motorised elevating platforms to assist with quick access to work areas. In general, the Executive Engineer responsible for of each section checks the suitability of the equipment being used. However if equipment is deemed defective or unsuitable, their power to obtain alternative or replacement plant is limited.

Senior staff was unaware of any particular mandatory safety regulations but stated that accident records were kept and that there had not been any serious accidents.

II) ENVIRONMENT

Mott MacDonald's brief does not include an assessment of environmental issues, however we have noted some potentially significant matters, including the following:

On-line chimney exhaust gas emission monitoring equipment has been installed, but is out of service because of computer failures. Station staff did not know when this plant would be returned to service.

Boiler combustion management and exhaust gas monitoring systems are rudimentary, and were out of service at the time of the site visit, it is therefore not possible to comment on the resulting flue gas emission composition. There was no evidence of the deposition of smut resultant from poor combustion at the site.

The oil storage area has two oil/water separators installed as an aid to containing any oil spillages that may occur. There are no catch pits to intercept debris and contaminants originating in other areas of the site before they drain from the site. Parts of the site are contaminated with oil, particularly in the road tanker loading and unloading area.

There are currently no temperature limits for cooling water effluent discharges.

Siltation of Pipri Creek is an increasing problem. The creek has been dredged three times since the station was commissioned, but it is probable that the frequency will have to increase. Staff reported that a dredger had been included in the contract package for Unit 6, but was cancelled. Dredgers are not readily available in Karachi.

There have been a number of unforced shut downs and trips on all the units, especially on Units 3 and 4. Many of these occurrences can be avoided in future by sound operator training and operation and maintenance practice. However, a number of outages were due to external surges and were therefore beyond the control of the station. Damage to the units is most likely to occur during start up, shutting down and in dealing with emergencies. It would therefore be advisable to rehabilitate the simulator available on site and ensure that all operatives are trained and regularly tested with respect to their ability to manage credible emergencies.

A.3.8 INVESTMENT RECOMMENDATIONS

As discussed above, station performance of Bin Qasim is not impressive, given the age and type of the units. From analysis of records, most of the problems at Bin Qasim are caused to some extent by maintenance being delayed as a result of external pressures to keep units operating and by the cumbersome procedures for purchase of spares and consumables.

Not having made a thorough survey of the current condition of the units, it is not possible to produce an accurate estimate of investment requirements. However, the recommendations that follow have been assembled from information obtained, from our analysis of plant records, from impressions gained from site visits and from our knowledge of how similar plants operate elsewhere. The first step in any investment programme would be to conduct extensive investigations and a programme of non-destructive testing on major plant items and equipment.

Boiler performance appears to be the most significant constraint on station output and efficiency. The key investments required are associated with fuel supply quality, air heaters and soot blowers. These include:

- Replacement of air heater seals;
- Refurbishment of air heater "baskets";
- Replacement of defective air heater elements;
- Replacement of stream scrubbers in the boiler drums (to reduce deposition on turbine blades).
- Rebuilding of sootblowers.

Replacement of air heater elements is unusual in units of this age - elsewhere it would be expected that such items would have a life of about 25 years. Staff stated that the reheater problems were caused to a certain extent by fireside corrosion, which could be caused by the relatively high sulphur furnace oil which is currently the primary fuel. Options to investigate would include fuel treatment to purify it before use, additive injection to neutralise corrosive elements in the fuel, replacement of boiler tubes in the most vulnerable parts of the boiler with more highly corrosion resistant materials.

The turbines will need thorough inspection in order to develop a refurbishment programme. It is unlikely that units of this age will require replacement, however allowance has been made for some significant refurbishment work, given the operating history of Bin Qasim.

A comprehensive overhaul of the condensers will be required, including a checking of all tubes for thinning and leakage. Fouling, resulting from marine growth, and pitting, arising from the ingress of suspended solids, also cause problems. Records for the units at Bin Qasim suggest that marine growth is a more significant problem than pitting.

To resolve the fouling problem the cooling water inlet screens will need to be repaired or replaced

Taprogge systems will need to be installed and operated regularly and the chlorination system to be returned to service. Staff stated that the chlorination facilities had not been in operation since the year the station opened.

On units having condensers with significantly thinned tubes or with tube leakage, which has resulted in the plugging of more than 10 to 15 per cent of the tubes, retubing will be necessary. Inspections should also investigate the extent to which the tubes have been correctly installed and remedy any defects discovered.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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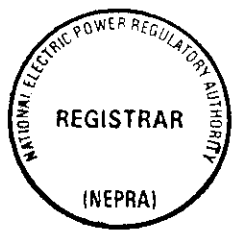
BIN QASIM POWER STATION

ANNUAL GENERATION STATISTICS



THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

BIN QASIM POWER STATION

ANNUAL GENERATION STATISTICS 1994-95

			UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	DEGs	PLANT
1	Installed Capacity	MW	210	210	210	210	210	1.7 x 4	1050
2	Actual Capacity	MW	180	205	190	200	195	1.7 x 4	890
3	Units Generated	KWh							
	I) on H.F.O.		1136882478	1230786540	855877791	910158229	1185140813	0	5298805848
	II) on L.D.O.		192524	393460	358109	451872	889187	27943	2311095
	iii) Total		1137055000	1231180000	856233900	910610100	1186030000	27943	5301116943
4	Auxiliary Consumption	KWh	84564452	86390069	63466558	66981259	70297131	0	371699469
5	Units Sentout	KWh	1052490548	1144789931	792767342	843628841	1095732869	27943	4929417474
6	Reactive Units	KVArh	390828000	536948000	378540400	454752865	484477000	0	2191108800
7	Unit Operating Hour	Hr	7908.88	8153.07	6383.04	6700.17	7579.89		8722.86
8	Forced Outage Hour	Hr	222.96	556.36	1543.52	788.88	412.02		37.14
9	Number of Shutdown	No							
	I) Total		18	18	36	59	17		6
	ii) Forced		17	15	29	47	11		8
10	Maximum Load	MW	180	205	190	200	195		850
11	Minimum Load	MW	20	4	0	0	5		0
12	Load Factor	%	79.87	73.83	70.60	67.95	78.89		71.50
13	Plant Factor	%	61.81	66.93	46.54	49.50	63.38		57.63
14	Availability Factor	%	90.28	93.10	72.87	76.49	86.53		83.85
15	% Aux. Consumed	%	7.44	7.02	7.41	7.36	6.03		7.01
16	Fuel Consumed								
	I) H.F.O.	M.Tonne	282708.38	298834.51	222008.12	233586.24	270355.02	0.00	1307492.27
	ii) L.D.O.	K.Litre	55.00	107.70	105.80	135.73	241.20	9.51	654.94
17	Fuel Consumed / KWh Gen.								
	I) H.F.O.	Kg/KWh	0.2487	0.2428	0.2594	0.2566	0.2320		0.2468
	ii) L.D.O.	Lit/KWh	0.2857	0.2737	0.2971	0.3004	0.2713	0.3403	0.2834
18	Heat Rate	BTU/KWh							
	I) Gross		10034	9797	10467	10356	9363	12162	9957
	II) Net		10841	10537	11305	11178	9964		10708
19	Thermal Efficiency	%	34.00	34.83	32.60	32.95	36.44	28.05	34.27
20	Cost of Fuels	Rupee							
	i) H.F.O.		721963029	764691448	569005273	601074124	894854678	0	3351588552
	ii) L.D.O.		269632	527989	518675	665403	1182478	46622	3210797
	iii) Total		722232661	765219437	569523948	601739527	896037154	46622	3354799349
	Cost of Fuel / KWh Gen.	Paisa							
	i) H.F.O.		63.50	62.13	66.48	66.04	59.64		63.25
	ii) L.D.O.		140.05	134.19	145.65	147.25	132.98	166.85	138.93
	iii) Average		63.52	62.15	66.51	66.08	59.69	166.85	63.28
22	Cost of Fuel / KWh Sentout	Paisa	68.62	66.84	71.84	71.33	63.52	166.85	68.06

Price of H.F.O. = Rs. 2560.69 / M.Tonne — Calorific value of H.F.O. = 18300 BTU/Lb
Price of L.D.O. = Rs. 4802.41 / K.Litre — Calorific value of L.D.O. = 19000 BTU/Lb

REMARKS :

1. Annual Boiler Inspection and Maintenance.
   - Unit 1 in June'95.
   - Unit 3 in June'95.
   - Unit 4 in July'94.
   - Unit 5 in Jan.'95.
2. Units 3,4,5 control cables damaged during rain, July'94.
3. Unit 1 put off in Oct.'94 for RH repair.
4. Unit 2 was put off in Feb.'95/March'95 due to RH leakage/Burner repair.
5. Unit 4, Forced outage in March'95 due to Turbine CV repair.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

BIN QASIM POWER STATION

ANNUAL GENERATION STATISTICS 1995-96

			UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	DEGS	
1	Installed Capacity	MW	210	210	210	210	210		
2	Actual Capacity	MW	170	195	140	175	200		
3	Units Generated	KWh							
	i) on H.F.O.		1297567176	1278702585	877030782	1057411499	1435604836	0	
	ii) on L.D.O.		27824	117415	471618	660001	425170	287	
	iii) Total		1297595000	1278820000	879780600	1058071500	1436030000	287	
4	Auxiliary Consumption	KWh	93356636	87142814	66961386	75517982	70682853	0	
5	Units Sentout	KWh	1204238364	1191677186	812819214	982553518	1365347137	287	
6	Reactive Units	KVArh	499361500	452500000	443221264	459943674	631865000	0	
7	Unit Operating Hour	Hr	8706.42	8166.56	7496.99	7777.47	7901.35		
8	Forced Outage Hour	Hr	23.50	6.17	315.72	432.47	12.43		
9	Number of Shutdown	No							
	i) Total		10	6	44	61	11		
	ii) Forced		14	4	25	34	7		
10	Maximum Load	MW	170	195	140	175	200		
11	Minimum Load	MW	0	8	0	0	0		
12	Load Factor	%	87.67	80.30	83.82	77.14	89.93		
13	Plant Factor	%	70.64	69.33	47.82	57.62	78.06		
14	Availability Factor	%	99.39	92.97	86.59	88.78	91.15		
15	% Aux. Consumed	%	7.19	6.81	7.50	7.14	5.48		
16	Fuel Consumed								
	i) H.F.O.	M.Tonne	319722.40	306911.40	240092.72	281799.66	322440.72	0.00	
	ii) L.D.O.	K Litre	7.70	32.30	148.80	198.78	108.59	12.83	
17	Fuel Consumed / KWh Gen.								
	i) H.F.O	Kg/KWh	0.2464	0.2392	0.2793	0.2665	0.2246		
	ii) L.D.O	Lit/KWh	0.2767	0.2751	0.3154	0.3012	0.2554	0.4194	
18	Heat Rate	BTU/KWh							
	i) Gross		9943	9654	11270	10754	9063	14952	
	ii) Net		10713	10359	12184	11580	9688		
19	Thermal Efficiency	%	34.32	36.34	30.27	31.73	37.65	22.82	
20	Cost of Fuels	Rupee							
	i) H.F.O.		965816919	942306801	754065764	869945509	983819230	0	
	ii) L.D.O.		41195	102645	787748	1030475	564339	69339	
	iii) Total		965857114	942409446	754853512	870975984	984384169	69339	
21	Cost of Fuel / KWh Gen.	Paisa							
	i) H.F.O.		74.43	73.69	85.76	81.33	68.53		
	ii) L.D.O.		148.05	138.52	166.96	197.34	132.87	227.24	
	iii) Average		74.43	73.70	85.80	81.37	68.55	227.24	
22	Cost of Fuel / KWh Sentout	Paisa	80.20	79.09	92.76	87.63	72.52	227.24	

Current Price of H.F.O = Rs. 4339.80 / M.Tonne — Calorific value of H.F.O 18300 BTU/LB

Current Price of L.D.O = Rs. 5431.02 / K.Litre — Calorific value of L.D.O 19000 BTU/LB

REMARKS:

U#2: put off from 010995 to 270995 for Annual Boiler inspection and Maintenance.

U#3: - putoff from 010695 to 210795 for Annual Boiler inspection and Maintenance.
- putoff from 120196 to 210196 for Air Heater Maintenance.
- forced shutdown from 010496 to 100496 for Boiler tube leakage repair.

U#4: - forced shutdown from 090995 to 200995 due to GRP Casing damage.
- putoff from 210296 to 080396 for Annual Boiler inspection and Maintenance.

U#5: putoff from 191195 to 181295 for Annual Boiler inspection and Maintenance.

M/A,E&C,BOPS

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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(NEPRA)

Bin Qasim Thermal Power Station

Combined Generation
Report 1996-97

01.07.96
To
30.06.97

Unit No.	Inst Cap MW	Units Generated on HFO Kwh	Units Generated on LDO Kwh	Total Units Generated Kwh	Auxiliary Consumption Kwh	Total Units Sent Out Kwh	Total Reactive Units Kvar	Max Load MW	Opr Hrs	Outages Details: Total Nos	Forced Nos	Forced Hours	Factors: Output Factor	Cap Factor	Avail Factor	% Aux Consp
1	210	750,491,565	413,435	750,905,000	63,303,616	687,596,384	332,784,000	175	5,779.21	15	10	1,555.40	0.49	0.41	0.66	8.4%
2	210	1,221,010,536	289,464	1,231,300,000	90,355,156	1,190,942,844	533,055,800	195	8,455.30	27	27	305.45	0.75	0.70	0.97	7.1%
3	210	989,595,891	895,509	990,491,400	70,975,314	919,514,086	511,491,750	161	7,743.21	80	71	903.32	0.71	0.54	0.88	7.2%
4	210	1,106,589,663	487,737	1,107,077,400	77,176,031	1,029,901,369	512,857,200	161	2,066.67	35	28	144.50	0.77	0.60	0.92	7.0%
5	210	1,458,457,325	412,675	1,458,870,000	76,192,596	1,382,677,404	527,393,400	200	8,387.02	21	17	48.73	0.83	0.79	0.95	5.2%
6	210	0	0	0	1,789,230	-1,789,230	0	0	0.00				#Error	0.00	0.00	#Error
DEC#1	1.7	0	20,522	20,584	0	20,544	0	0	0.00				#Error	0.00	0.00	0.0%
DEC#2	1.7	0	9,961	9,961	0	9,961	0	0					#Error	0.00		0.0%
DEC#3	1.7	0	60	60	0	60	0	0					#Error	0.00		0.0%
PLANT	1050	5,586,164,980	2,509,429	5,585,674,405	379,797,943	5,202,275,446	2,417,624,550	250	2,745.47		4	14.53	0.75	0.61	0.995	6.30%

Unit No.	Fuel Consumption: HFO MTons	LDO KLs	Fuel Consumption per Kwh: HFO Kg/kwh	LDO L/kwh	Heat Rate: Gross	Net	Fuel Cost: HFO PRs	LDO PRs	Total PRs	Fuel Cost/Kwh: HFO PRs	LDO PRs	Avg PRs	Sent Out PRs	Overall Thermal Eff.
1	184,473.80	97.52	0.2452	0.2015	9,919	10,832	1,130,293,109	771,138	1,131,064,247	1.51	1.87	1.51	1.64	34.40%
2	309,477.35	62.76	0.2416	0.1935	9,748	10,483	1,896,204,861	493,976	1,896,698,826	1.48	1.83	1.44	1.59	35.00%
3	280,523.65	244.50	0.2835	0.2329	11,439	12,321	1,718,802,066	1,926,269	1,720,728,335	1.74	2.15	1.74	1.87	29.83%
4	304,815.93	129.40	0.2755	0.2263	11,115	11,948	1,867,643,781	1,019,465	1,868,663,246	1.69	2.09	1.69	1.81	30.70%
5	325,432.17	89.78	0.2259	0.1856	9,115	9,617	2,018,476,565	707,322	2,019,183,887	1.38	1.71	1.38	1.46	37.43%
6	0.00	1,104.26	#Error	#Error	#Error	-25,856	0	8,699,802	8,699,802	#Error	#Error/Div/0!		-4.84	#Error
DEC#1	0.00	8.59	#Error	0.3559	17,480	17,480	0	67,675	67,675	#Error	3.29	3.29	3.29	19.52%
DEC#2	0.00	4.60	#Error	0.2939	19,347	19,347	0	36,241	36,241	#Error	3.64	3.64	3.64	17.64%
DEC#3	0.00	0.03	#Error	0.4265	20,948	20,948	0	236	236	#Error	3.94	3.94	3.94	16.29%
PLANT	1,402,723.96	1,741.74	0.2522	0.6941	10,182	10,925	8,631,420,382	13,722,124	8,645,142,507	1.55	5.47	1.55	1.64	32.51%

5 August 1997 14:16:43

REGISTRAR
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
(NEPRA)

Bin Qasim Thermal Power Station

Combined Generation Report

From: 01/07/97

To: 30/06/98

Unit No.	Inst Cap MW	Units Generated onHFO: Kwh	Units Generated onLDO: Kwh	Total Units Generated Kwh	Auxiliary Consption Kwh	Total Units SentOut Kwh	Total Reactive Units Kvar	Max Load MW	Opr Hrs	Outages Details: Total Nos	Forced Nos	Forced Hours	Output Factor	Factory: Cap Factor	Avail Factor	%Auxi Consp	Fuel Consumption: HFO MTons	LDO KLs	Fuel Consumption per: HFO Kg/kwh	Kwh LDO L/kwh	Heat Rate: Gross	Net	HFO PRs	Fuel Cost: LDO PRs	Total PRs	Fuel Cost/Kwh: HFO PRs	LDO PRs	Avg PRs	Sent Out	Overall Thermal Eff
1	210	885,178,991	191,009	885,370,000	75,056,992	810,313,008	417,037,000	160	7,243.57	7	6	1,113.87	0.63	0.48	0.83	8.5%	221,809.65	46.10	0.2506	0.2059	10,111	11,048	1,359,054,343	363,194	1,359,417,537	1.54	1.90	1.54	1.68	33.74%
2	210	1,170,830,878	159,122	1,170,990,000	83,162,708	1,087,827,292	472,175,200	180	7,901.47	23	19	37.67	0.74	0.64	0.90	7.1%	288,773.26	37.80	0.466	0.2026	9,952	10,713	1,769,348,417	257,804	1,769,646,220	1.51	1.87	1.51	1.63	34.28%
3	210	779,652,788	494,712	780,147,500	57,765,727	722,381,773	453,655,960	190	6,148.14	53	45	2,765.63	0.47	0.42	0.70	7.4%	220,731.08	134.90	0.2831	0.2326	11,424	12,338	1,352,445,815	1,062,796	1,353,508,611	1.73	2.15	1.73	1.87	29.87%
5	210	632,346,419	132,631	632,479,050	46,953,265	585,525,785	289,809,850	155	5,096.53	14	12	450.25	0.47	0.34	0.58	7.4%	175,232.64	35.40	0.2771	0.2277	11,182	12,079	1,073,671,413	278,895	1,073,950,309	1.70	2.10	1.70	1.83	30.51%
6	210	927,221,861	3,933,139	931,155,000	59,880,105	871,274,895	390,212,800	219	5,380.45	67	48	1,225.90	0.54	0.56	0.68	6.4%	205,662.62	840.25	0.2218	0.1822	8,950	9,565	1,260,118,552	6,619,826	1,266,739,378	1.36	1.68	1.36	1.45	38.12%
DEG#1	1.7	0	7,570	7,570	0	7,570	0	0	0.00				#Error	0.00	0.00	0.0%	0.00	7.18	#Error	0.8091	39,737	39,737	0	56,567	56,567	#Error	7.47	7.47	7.47	8.59%
DEG#2	1.7	0	4,950	4,950	0	4,950	0	0					#Error	0.00		0.0%	0.00	4.96	#Error	0.8547	41,980	41,980	0	39,077	39,077	#Error	7.89	7.89	7.89	8.13%
DEG#3	1.7	0	1,092	1,092	0	1,092	0	0					#Error	0.00		0.0%	0.00	0.58	#Error	0.4531	22,252	22,252	0	4,569	4,569	#Error	4.18	4.18	4.18	15.33%
DEG#4	1.7	0	5,175	5,175	0	5,175	0	0					#Error	0.00		0.0%	0.00	2.73	#Error	0.4500	22,101	22,101	0	21,508	21,508	#Error	4.16	4.16	4.16	15.44%
PLANT	1260	5,733,254,868	5,225,469	5,738,480,337	398,350,242	5,340,130,095	2,685,166,910	85	8,754.42	1	5.58		0.77	0.62	0.999	6.94%	1,420,063.69	1,175.51	0.2477	0.2250	9,993	10,738	8,700,900,636	9,261,138	8,710,161,774	1.52	1.77	1.52	1.63	34.14%

02 January 1999 14:01:23

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY REGISTRAR (NEPRA)

Bin Qasim Thermal Power Station

Combined Generation Report

01 July 1998 To 30 June 1999

Unit No.	Inst. Cap MW	Gen on HFO / LDO	Gen on Gas	Total Generation	Aux Consp.	Total Sent Out	Total Reactive	% Aux Cons	Load Max	Opr Hrs	Outages Total Nos.	Forced Nos.	Forced Hrs	Factors O put / FOF	Capacity F / Avail. F	EFOR
1	210	442,416,377 / 654,231	59,172	443,169,800	45,043,058	398,126,742	233,359,100	10.2%	120	5,970.41	24	15	[illegible]	0.42 / 0.29	0.24 / 68.15%	1.73
2	210	840,883,243 / 602,031	64,726	841,610,000	65,082,340	776,527,660	338,856,000	7.7%	130	7,304.50	21	15	[illegible]	0.44 / 0.17	0.46 / 83.38%	0.57
3	210	512,325,703 / 774,297	0	513,100,000	42,498,920	470,601,080	236,125,701	8.3%	155	4,815.65	45	41	3,260	0.69 / 0.42	0.29 / 54.97%	1.01
4	210	670,627,423 / 2,128,297	0	672,755,720	53,596,720	619,159,000	272,144,300	8.0%	130	6,157.35	62	56	1,050	0.57 / 0.12	0.37 / 70.31%	0.52
5	210	971,251,093 / 224,541	34,367	971,510,000	63,759,901	907,750,099	400,535,000	6.6%	135	7,756.33	14	11	49.5	0.68 / 0.005	0.53 / 99.94%	0.48
6	210	1,425,997,671 / 798,545	16,229,784	1,443,015,000	88,474,799	[illegible]540,201	528,109,000	6.1%	213	8,100.94	40	33	178	0.84 / 0.62	0.79 / 92.82%	-0.06
DEG 1	1.7	0 / 8,940	0	8,940	0	8,940		0.0%							0.00	
DEG 2	1.7	0 / 3,058	0	3,058	0	3,058		0.0%							0.00	
DEG 3	1.7	0 / 585	0	585	0	585		0.0%							0.00	
DEG 4	1.7	0 / 9,656	0	9,656	0	9,656		0.0%							0.00	
DEG 5	1.7	0 / 1,200	0	1,200	0	1,200		0.0%							0.00	
PLANT	1260	4,863,491,530 / 5,305,301	16,387,[illegible]	4,[illegible]	358,455,718	4,526,728,121	[illegible]	7.5%	925.55	6,414	2	176		1.61	0.44	1.08

Unit No.	Fuel Consumption HFO MTon	LDO KLit	Gas mmcf	Fuel/Kwh HFO Kg	LDO Lit	Gas CF	Heat Rate (Btu/Kwh) Gross	Net	Fuel Cost PRs. HFO / LDO PRs	Gas PRs	Total (PRs)	Fuel Cost/Kwh PRs. HFO	LDO	Gas	Avg	Fuel Oil	Overall Thermal Efficiency
1	124,374.41	187.90	0.71	0.26	0.23	11.94	11,339	12,622	730,[illegible]364 / 1,460,3[illegible]	[illegible]	731,840,587	1.55	2.13	1.33	1.45	1.54	34.09%
2	201,717.41	156.00	0.67	0.24	0.20	10.39	9,372	10,090	1,208,3[illegible]4,066 / 1,229,030	[illegible]476	1,209,657,973	1.44	1.86	1.16	1.44	1.56	34.56%
3	146,257.04	217.90	0.00	0.29	0.23	#Error	11,519	12,550	559,114,953 / 1,577,311	0	560,791,164	1.59	2.17	#Error	1.66	1.[illegible]	29.62%
4	179,936.31	549.70	0.00	0.27	0.22	#Error	10,621	11,727	1,056,358,465 / 4,330,756	0	1,063,609,241	1.54	2.03	#Error	1.58	1.71	31.52%
5	234,946.74	52.32	0.33	0.24	0.20	10.28	9,762	10,448	1,290,154,748 / 412,196	39,326	1,350,546,272	1.47	1.64	1.14	1.42	1.52	34.95%
6	328,075.0[illegible]	171.56	153.76	0.22	0.18	9.47	9,001	9,589	1,868,396,722 / 1,351,618	[illegible]22,533	1,885,870,473	1.31	1.69	1.06	1.31	1.37	37.91%
DEG 1	0.00	4.57	0.00	#Error	0.44	#Error	21,582	21,582	0 / 36,044	[illegible]	36,044	#Error	4.08	#Error	4.08	4.08	15.74%
DEG 2	0.00	1.50	0.00	#Error	0.53	#Error	26,552	26,552	0 / 15,442	[illegible]	15,442	#Error	5.05	#Error	5.05	5.05	12.71%
DEG 3	0.00	0.43	0.00	#Error	0.63	#Error	30,795	30,795	0 / 3,388	0	3,388	#Error	5.79	#Error	5.79	5.79	11.05%
DEG 4	0.00	4.50	0.00	#Error	0.44	#Error	21,650	21,650	0 / 39,313	0	39,313	#Error	4.07	#Error	4.07	4.07	15.76%
DEG 5	0.00	0.57	0.00	#Error	0.41	#Error	[illegible]	[illegible]	0 / 4,491	0	4,491	#Error	3.74	#Error	3.74	3.74	17.15%
PLANT	1,209,130.[illegible]	1,36[illegible]	153[illegible]	0.25	0.23	9.49	9,[illegible]	10,[illegible]67	7,102,728,359 / 10,579,340	[illegible]315,446	7,130,624,339	1.45	1.59	1.05	[illegible]	[illegible]	34.13%

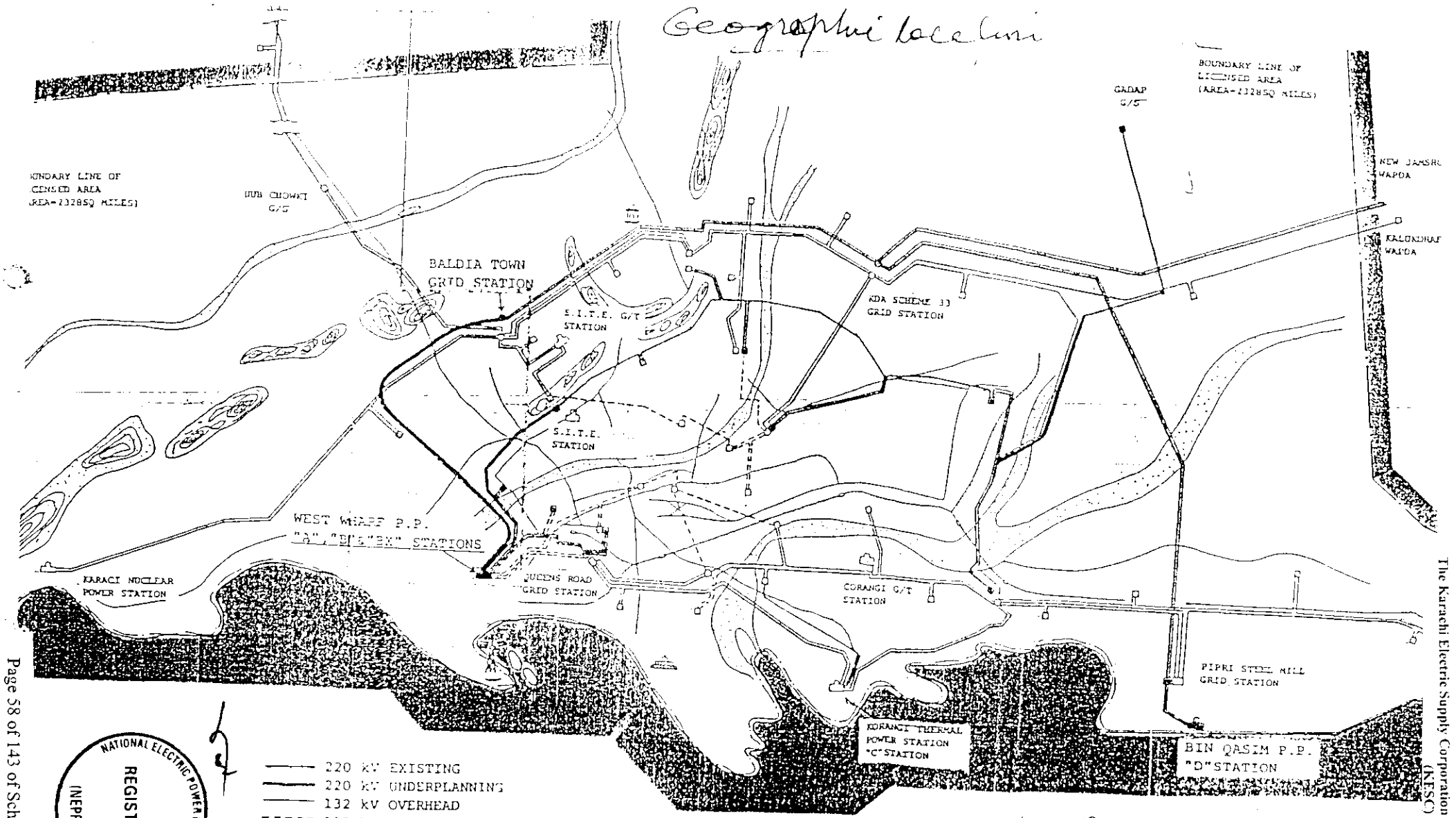
14 July 1999 11:06:15

Details of Outages are attached as "General Shut downs Report"
EFOH is taken at 4 hours evening peak hours
[illegible] shown against DEGs is used by plant auxiliaries through Aux Bus with a corresponding [illegible] in LDO.
FOF: Forced Outage Factor

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

KORANGI THERMAL POWER STATION

LOCATION
&
SITE PLAN



NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

KORANGI THERMAL POWER STATION

EXISTING GENERATION FACILTIES

KORANGI THERMAL POWER STATION

'EXISTING GENERATION FACILITIES
(AS REQUIRED BY NEPRA)

Schedule III

1 Location maps.site map (ENCLOSED)

2 i. 2x125MW HITACHI UNITS
ii. 1x66 MW General Electric

3 Furnace oil and Natural gas/ P.S.O and S.S.G.C(respectively).

4 Not available

5 Sea water

6 Connected to system through five 132 KV feeders
Queen's Road 1&2. Landhi 1&2 and Korangi West.
Line Diagram Attached.Further details to be provided
by GSM Department.

7 382 MW /210MW

Expected remaining life.

unit	no of years.
unit #1 (66M-W)	2
unit #3 (125MW)	3
Unit #4 (125MW)	7

8 Not applicable

9 Unit#1
Restored to operation on22/8/99
U#3
Combustion control System Upgraded
Burners changed with modified one.
Economizer replaced with bare type for 100% sustained
oil firing.
Soot blowers added
Fuel oil system upgraded with new oil skid and oil
additive injection system.
Air pre-heaters elements replaced with modified one.
H.P & L.P heaters replaced.
Flash tank system incorporated.
BFP's discharge V/V motorized
U#4
Air pre-heaters elements replaced with modified one.

10 Operational data sheet attached/Environmental data not available
Constraints in depatching(to be provided LDC)

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

11 Information regarding project (to be provided by Project department)

12 Generation Voltage

U#1	13.8 KV
U#3	13.3 KV
U#4	13.3 KV

Frequency	50 Hz
Power factor	0.85
Ramping rate	0.63MW/min
Alternative fuel	Furnace oil/Natural gas.
Auxilliry consumption	7.50%

Time required to synchronized to grid.

i) Cold start 10 Hrs apx
ii) Hot start (depending on Turbin metal Temperatue)

Sheets regarding Plnt characteristics and other relvent data is attached.

13) Training and development

Most of the Senior engineers at power plant have been trained in Japan, Germany and Italy etc. Some of the officers have also been trained in local institutions such as NIPA, NILAT and wapda academy.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR

KTPS

GENERATOR DATA :-

Description	Unit	Gen. #1	Gen. #3	Gen. #4
Manufacturer		G.E. USA	HITACHI JAPAN	HITACHI JAPAN
Type / Form		ATB	TFLH/K	TFLH/K
Capacity / Rating	MVA	88 MVA at 30 psi	160 MVA at 30 psi	160 MVA at 30 psi
-	MW	66	125	125
Terminal Voltage	KV	13.8	18	18
No. of phases		3	3	3
Connection Method		Grounded Star	Grounded Star	Grounded Star
Current	A	3691	5132	5132
Frequency	Hz	50	50	50
No. of Poles	NO.	2	2	2
Power Factor		0.85	0.85	0.85
Speed	rpm	3000	3000	3000
Neutral Point		Grounding Transf.	Grounding Transf.	Grounding Transf.
Excitation Method		DC Generator	AC Generator	AC Generator
Excitation Voltage	V	250	375	375
Excitation Current	A	806	949	949
Stator Cooling		H2 Cooled	H2 Cooled	H2 Cooled
Rotor Cooling		H2 Cooled	H2 Cooled	H2 Cooled
Driving Method		66 MW steam Turb.	125 MW steam Turb	125 MW steam Turb
Rotational Direction		Clockwise, Tb. end	Clockwise, Tb. end	Clockwise, Tb. end
Short ckt. ratio				
Synchronus reactance	%			
Subtransient reactance	%			
Transient reactance	%			

TRANSFORMER DATA :-

Power Transformer

Description		UNIT NO. 1	UNIT NO 3	UNIT NO 4
MVA rating	MVA	85 MVA	172 MVA	160 MVA
% Imp.volt	%	11.27 %	10.30 %	10.3/10.4 %
Tap steps	NO.	3	3	3
No. of taps	NO.	5	5	5
Max/Min Tap Voltage	KV	138.6-125.4	138.6-125.4	138.6-125.4
Auxillary Transformer				
MVA rating	MVA	7.5 MVA	8.4 MVA	9.375 MVA
% Imp.volt	%	5.59 %	8.3/10.4 %	7.1/8.9 %
Tap steps	NO.	3	3	3
No. of taps	NO.	5	5	5
Max/Min Tap Voltage	KV	14.4-13.2	18.9-17.1	18.9-17.1

Plant Transformer

MVA rating	MVA	7.5
% Imp.volt	%	8.59%
Tap steps	NO.	3
No. of taps	NO.	3
Max/Min Tap Voltage	KV	138.6-125.4

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

KTPS

STEAM TURBINE

Description	Unit	Unit #1	Unit #3	Unit #4
Type		TCDF Condensing	TCDF Reheat Condensing	TCDF Reheat Condensing
Rating	MW	66 MW	125 MW	125 MW
Speed	rpm	3000	3000	3000
Stages		23	27	27
Main Steam Pressure	psig	1250	1800	1800
Main Steam Temp.	Deg.F	950	1000	1000
Reheat Steam Temp.	Deg.F	-	1000	1000
Exhaust Pressure		2.5 inch Hg	3.5 inch. Hg	3.5 inch. Hg

CONDENSER

Cooling Surface	Sq. ft.	58,000	80500	82450
Condenser Pressure		2.5 inch Hg	2.5 inch Hg	2.5 inch Hg
Qty. of cooling water	GPM	54000	81900	79200
Cooling water inlet temp	Deg.F	89	89	89
Condensate Temp.	Deg.F	108.7	100	100

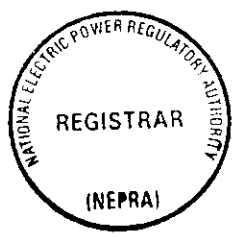
BOILER

Type		B & W two drum Radiant Boiler	B & W Single drum Radiant Boiler	B & W Single drum Radiant Boiler
Fuel		Natural Gas and Heavy Furnace Oil	Natural Gas and Heavy Furnace Oil	Natural Gas and Heavy Furnace Oil
Design Pressure	psig	1500	Water wall, Super Heater & Economizer	Water wall, Super Heater & Economizer
			2120	2120
Max. Continous rating	lb/hr.	590,000	900,000	900,000
Super Heater out let Pr.	psig	1300	1880	1880
temp.	Deg.F	960	1005	1005
Reheater out let Press.	psig	-	471	471
temp.	Deg.F	-	1005	1005

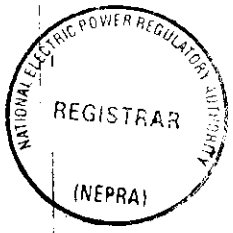
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

KORANGI THERMAL POWER STATION

EMISSION VALUES

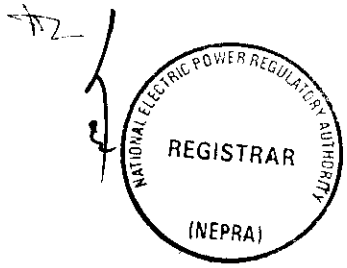


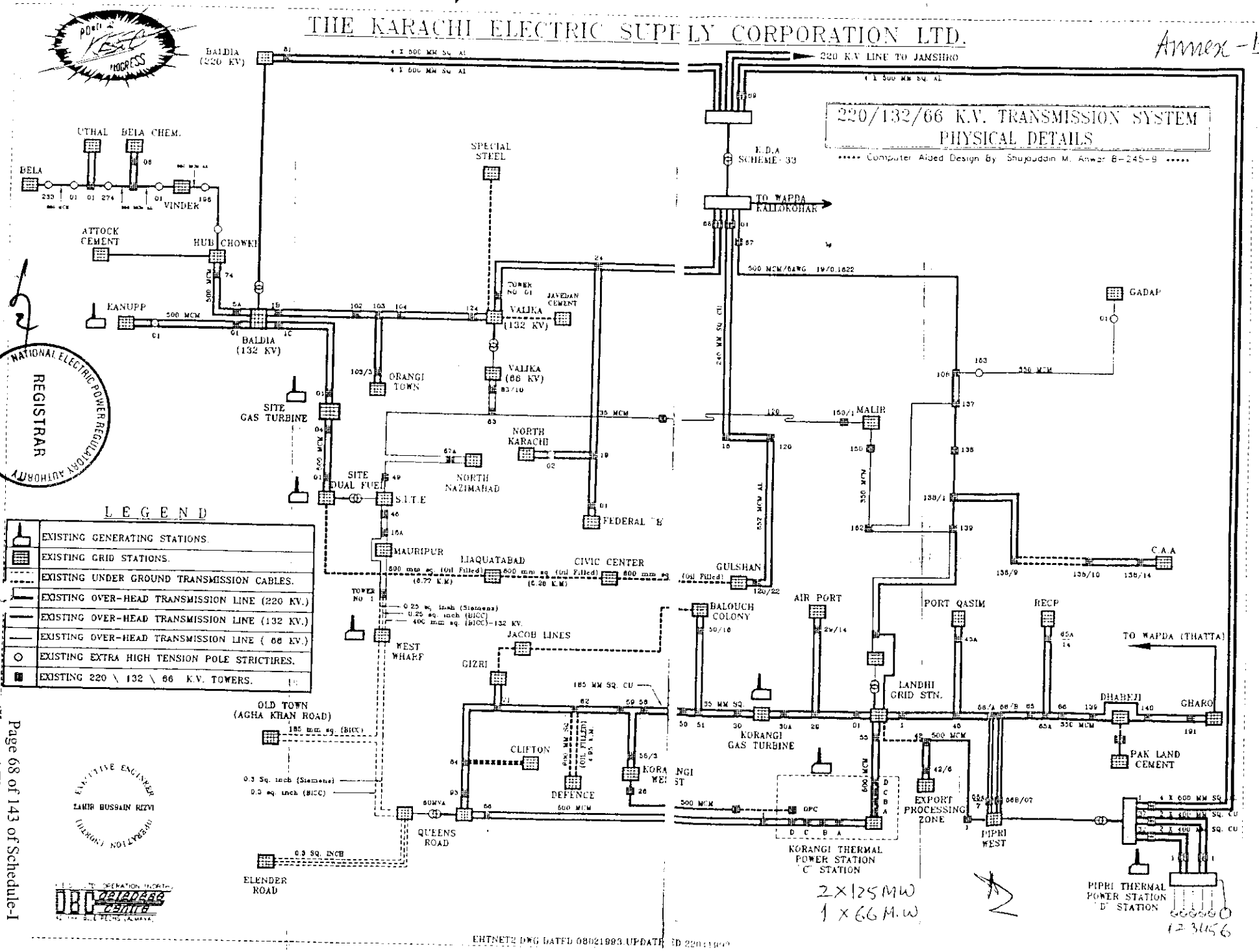
THE PLANT IS OLD
EMISSION & IMMISSION EQUIPMENT
NOT INSTALLED.



KORANGI THERMAL POWER STATION

KESC TRANSMISSION SYSTEM




THE KARACHI ELECTRIC SUPPLY CORPORATION LTD.
Annex-B
220/132/66 K.V. TRANSMISSION SYSTEM
PHYSICAL DETAILS
***** Computer Aided Design By Shujauddin M. Anwar 8-245-9 *****
BALDIA (220 KV)
220 K.V LINE TO JAMSHRO
K.D.A SCHEME-33
TO WAPDA KALLOKOHAK
UTHAL
BELA CHEM.
BELA
VINDER
ATTOCK CEMENT
HUB CHOWKI
SPECIAL STEEL
JAVEDAN CEMENT
EANUPP
VALIKA (132 KV)
BALDIA (132 KV)
ORANGI TOWN
VALIKA (66 KV)
SITE GAS TURBINE
SITE DUAL FUEL
S.I.T.E
NORTH KARACHI
NORTH NAZIMABAD
FEDERAL 'B'
MAURIPUR
LIAQUATABAD
CIVIC CENTER
GULSHAN
MALIR
GADAP
C.A.A
AIR PORT
BALOUCH COLONY
PORT QASIM
RECP
TO WAPDA (THATTA)
JACOB LINES
WEST WHARF
GIZRI
LANDHI GRID STN.
DHABEJI
GHARO
KORANGI GAS TURBINE
PAK LAND CEMENT
OLD TOWN (AGHA KHAN ROAD)
CLIFTON
DEFENCE
QUEENS ROAD
ELENDER ROAD
EXPORT PROCESSING ZONE
KORANGI THERMAL POWER STATION 'C' STATION
2X125MW
1X66M.W
PIPRI WEST
PIPRI THERMAL POWER STATION 'D' STATION
LEGEND
EXISTING GENERATING STATIONS.
EXISTING GRID STATIONS.
EXISTING UNDER GROUND TRANSMISSION CABLES.
EXISTING OVER-HEAD TRANSMISSION LINE (220 KV.)
EXISTING OVER-HEAD TRANSMISSION LINE (132 KV.)
EXISTING OVER-HEAD TRANSMISSION LINE (66 KV.)
EXISTING EXTRA HIGH TENSION POLE STRICTIRES.
EXISTING 220 \ 132 \ 66 K.V. TOWERS.
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)
EHTNET2.DWG DATED 08021993.UPDATED 22011993

KORANGI THERMAL POWER STATION

ANNUAL GENERATION STATISTICS

KTPS

ELECTRICAL OUT PUT (Mwh)

UNIT	1995-96	1996-97	1997-98	1998-99	Jul-Dec.99
1	248590	64460	-	-	110250
2	304020	55450	-	-	-
3	467460	520530	480980	567960	356690
4	533030	599160	631610	599160	98670

FUEL CONSUMPTION, GAS (MCF)

UNIT	1995-96	1996-97	1997-98	1998-99	Jul-Dec.99
1	3791850	921196.8	0	0	1720960
2	4656387	859151	0	0	0
3	4871432	5027072.34	5574870	6463839.96	2736794
4	5251702	5794695.82	5866613	6852548.35	1121129

FUEL CONSUMPTION, HFO (M.TON)

UNIT	1995-96	1996-97	1997-98	1998-99	Jul-Dec.99
1	0	0	0	0	0
2	0	0	0	0	0
3	33721.39	3133.39	9587.37	43112.82	37637.11
4	39917.28	35038.73	28222.85	16249.15	353.57

GROSS HEAT RATE (BTU/KWH)

UNIT	1995-96	1996-97	1997-98	1998-99	Jul-Dec.99
1	14491	13577	-	-	14209
2	15181	14719	-	-	-
3	12403	12155	10756	11557	11550
4	12261	11546	12875	11909	12214

OVER ALL THERMAL EFFICIENCY (%)

UNIT	1995-96	1996-97	1997-98	1998-99	Jul-Dec.99
1	23.55	25.13	-	-	23.01
2	22.47	23.16	-	-	-
3	27.51	28.07	28.87	29.52	29.54
4	27.83	29.55	28.87	28.53	27.94

OPERATING COST (Ps./Kwh)

YEAR	1995-96	1996-97	1997-98	1998-99	Jul-Dec.99
	112.81	124.16	134.43	139.03	174.50

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

REF.NO.:KTPS/P-10/95
DATED : JULY - 15, 1995

THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED
GENERATION STATISTICS OF KORANGI THERMAL POWER STATION FOR THE YEAR 1994-95

ITEM	UNITS	UNIT#1	UNIT#2	UNIT#3	UNIT#4	E.GEN	COMBINED
INST.CAPACITY	M.W.	66	66	125	125	0	382
ACT. CAPACITY	M.W.	55	45	105	110	0	315
U.G.GAS	KWH	88,100,000	294,870,000	205,152,000	382,916,000	0	971,038,000
U.G. F.OIL.	KWH	0	0	209,908,000	189,074,000	0	398,982,000
U.G. HSDO	KWH	0	0	0	0	0	0
U.G. LDO	KWH	0	0	0	0	60,010	60,010
U.G. TOTAL	KWH	88,100,000	294,870,000	415,060,000	571,990,000	60,010	1,370,080,010
AUX.CONS.	KWH	5,985,000	19,983,000	32,560,000	44,214,000	0	102,742,000
N.G.C.	KWH	82,115,000	275,887,000	382,500,000	527,776,000	60,010	1,268,338,010
RSE. UNITS	KVARH	33,350,000	235,250,000	300,650,000	420,030,000	0	989,280,000
OPR. HRS.	HRS	1,599.95	7,899.54	5,608.03	8,292.38	30.42	23,430.32
FSD. HRS.	HRS	1,088.05	561.46	257.82	467.62	0.00	2,374.95
FED. HRS.	HRS	5,832.00	0.00	2,894.15	0.00	0.00	8,726.15
S.D. HRS	HRS	0.00	(0.00)	0.00	0.00	7,241.58	7,241.58
TOTAL HRS	HRS	8,760.00	8,760.00	8,760.00	8,760.00	7,272.00	39,312.00
SHUT : TOTAL	NO.	8	21	8	21	7	65
DOWN : FORCED	NO.	8	21	8	21	0	58
MAX.DEMAND	M.W.	55	45	105	110	0	315
MIN.DEMAND	M.W.	0	0	0	0	0	0
LOAD FACTOR	%	84.31	82.96	70.49	62.71	ERR	54.18
PLANT FACTOR	%	13.24	51.00	37.91	52.24	ERR	40.34
AVAIL.FACTOR	%	31.69	90.17	64.02	94.66	100.00	99.85
AUX.CONS.FACT	%	6.79	6.44	7.84	7.73	0.00	7.48
POWER FACTOR	%	0.94	0.78	0.81	0.81	1.00	0.81
FUEL GAS	MCF	1,443,607	4,894,480	2,569,511	4,798,863	0	13,706,461
FUEL F.OIL	M.TON	0.00	0.00	62,048.29	55,341.17	0.00	117,389.46
FUEL HSDO	LITRE	0	0	0	0	0	0
FUEL LDO	LITRE	0	0	0	0	26,682	26,682
FUEL ADD.	LITRE	0	0	2,038	0	0	2,038
CONS. : GAS	CFT/KWH	16.39	16.60	12.52	12.53	ERR	14.12
CONS. : F.OIL	KG/KWH	ERR	ERR	0.30	0.29	ERR	0.29
PER : HSDO	LIT/KWH	ERR	ERR	ERR	ERR	ERR	ERR
UG GA : LDO	LIT/KWH	ERR	ERR	0.00	0.00	0.44	0.44
GR. HEAT RATE	BTU/KWH	15,567	15,769	11,913	11,874	15,117	12,963
NET HEAT RATE	BTU/KWH	15,701	16,854	12,928	12,869	15,117	14,005
KVA HEAT RATE	BTU/KVAH	14,559	12,306	9,648	9,571	15,117	10,503
THERMAL EFF.	%	21.92	21.64	28.65	28.74	22.58	25.33
COST OF GAS	Rs.	97,841,057.13	333,105,872.29	175,998,332.81	385,404,222.11	0.00	992,349,484.34
COST OF F.O.	Rs.	0.00	0.00	155,120,104.52	139,352,371.59	0.00	294,472,476.11
COST OF HSDO	Rs.	0.00	0.00	0.00	0.00	0.00	0.00
COST OF LDO	Rs.	0.00	0.00	0.00	0.00	117,667.83	117,667.83
COST OF ADD	Rs.	0.00	0.00	648,084.00	0.00	0.00	648,084.00
COST OF TOTAL	Rs.	97,841,057.13	333,105,872.29	331,766,521.32	486,756,593.70	117,667.83	1,231,587,712.27
COST /UG GAS	Ps.	111.06	113.65	85.79	85.76	ERR	95.93
COST /UG F.O.	Ps.	ERR	ERR	73.90	73.17	ERR	73.86
COST /UG HSDO	Ps.	ERR	ERR	ERR	ERR	ERR	ERR
COST /UG LDO	Ps.	ERR	ERR	0.00	0.00	196.08	196.08
COST /UG AVG.	Ps.	111.06	113.65	79.93	81.60	196.08	89.89
COST /UEG	Ps.	119.15	121.46	86.74	88.44	196.08	97.19

ITEMIC...(Rs/u)	AVERAGE	COST
GAS : 950/CFT	68.39	Rs./MCF
F.O.(18300/lb	2,499.99	Rs./MTON
HSDO(34400/Lit	ERR	Rs./Lit
LDO (34000/Lit	4.41	Rs./Lit
ADD.	318.00	Rs./Lit

DEPUTY CHIEF ENGINEER

SUPERINTENDING ENGINEER (EFF. & COORD)

EFFICIENCY ENGINEER

TO: CHIEF ENGINEER (GENERATION)
CC:GENERAL MANAGER (G.C).... WITH COMPLIMENTS
CC:SEEC/SED/EE/DEGEN/P-10/MF/DCEK/DCE(COORD)/CA/CCOF/CMS/SE(PLR)

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

GENERATION STATISTICS OF KORANGI THERMAL POWER STATION FOR FINANCIAL YEAR 1995-96

ITEM	UNITS	UNIT NO.1	UNIT NO.2	UNIT NO.3	UNIT NO.4	E.GEN	COMBINED
INST.CAP.	MW	66	66	125	125	0	382
ACT.CAP	MW	55	45	85	105	0	260
U.G. GAS	KWH	248,590,000	304,020,000	381147802	409424686	0	1323182688
U.G.F.OIL	KWH	-	0	106312198	128805114	0	235117312
U.G. HSDO	KWH	0	0	0	0	0	0
U.G. LDO	KWH	0	0	0	0	6800	6800
U.G.TOTAL	KWH	248,590,000	304020000	487460000	538230000	6800	1558306800
AUX. CON.	KWH	14237000	19188000	44350000	45316000	0	123091000
U.S.O	KWH	234353000	284832000	423110000	492914000	6800	1435215800
RE. UNITS	KVARH	152430000	234550000	382370000	332220000	0	1101570000
OPR. HRS.	HRS	5751.95	8052.13	8080.8	81[illegible]	88	8771.8
FSD. HRS	HRS	824.05	731.87	703.2	59[illegible]	-	1[illegible]
PSD.HRS	HRS	2208	0	0	0	0	0
S.B. HRS	HRS	0	0	0	0	0	0
TOTAL HRS	HRS	8784	8784	8784	8784	8784	8784
SHUT/TOTAL	NO	11	12	8	13	0	4
DOWN/FORCED	NO	11	12	8	13	0	4
MAX. DEMAND	MW	55	45	85	105	0	260
MIN. DEMAND	MW	10	10	15	10	0	20
LOAD FACTOR	%	78.579	83.903	68.057	62.598	0	58.327
PLANT FACTOR	%	42.879	52.440	42.574	49.019	0	46.441
AVAIL. FACTOR	%	65.482	91.668	91.995	93.224	0.031	99.861
AUX. CON. FACTOR	%	6.727	6.311	9.487	8.419	0.000	7.899
POWER FACTOR		0.85	0.79	0.77	0.85	0	0.81
FUEL GAS	MCF	3791850	4858387	4671432	5261702	0	18573371
FUEL F. OIL	M.TON	0	0	33721.39	39917.28	0	73638.67
FUEL HSDO	LITRE	0	0	0	0	0	0
FUEL LDO	LITRE	0	0	0	0	2333	2333
FUEL ADD	LITRE	0	0	9295	0	0	9295
FUEL/GAS	C. FT/KWH	15.25	15.98	12.93	12.83	0	14.04
CONS./F.OIL	KG./KWH	0	0	0.3	0.3	0	0.3
PER/HSDO	LIT/KWH	0	0	0	0	0	0
U.G. ON/LDO	LIT/KWH	0	0	0	1	0.343	0.3
G. HEAT RATE	BTU/KWH	14491	15181	12403	[illegible]	-	13229
N.HEAT RATE	BTU/KWH	16371	16204	13703	[illegible]	[illegible]	[illegible]
KVA HEAT RATE	BTU/KVAH	12317	11993	9550	[illegible]	[illegible]	[illegible]
THERMAL EFF.	%	23.55	22.47	27.51	27.6[illegible]	[illegible]	25.79
COST OF GAS	RS	322110818.3	411164218.8	394917992.4	445076103.9	0	1573269133.30
COST OF F. OIL	RS	0	0	84303475	99793200	0	184096675
COST OF HSDO	RS	0	0	0	0	0	0
COST OF LDO	RS	0	0	0	0	10288.5	10288.5
COST OF ADD.	RS	0	0	2082080	0	0	2082080
COST OF TOTAL	RS	322110818.3	411164218.8	481303547.4	544869303.9	10288.5	1759458178.80
COST/UG GAS	PAISAS	129.58	135.24	109.35	108.71	0	118.90
COST/UG F.O	PAISAS	-	0	79.30	77.48	0	78.30
COST/UG HSDO	PAISAS	0	0	0.00	0	0	0
COST/UG LDO	PAISAS	0	0	0	0	151.3	151.3
COST/UG AVG.	PAISAS	129.58	135.24	102.96	101.23	151.30	112.91
COST/USO	PAISAS	137.45	144.35	113.75	110.64	151.30	122.69

ITEM/C.V. (BTU) AVG. COST
GAS/950/CFT 84.70 RS/MCF
F.O./18300/LB 2600 RS/MTON
HSDO/34400/LIT RS/LIT
LDO/34000/LIT 4.41 RS/LIT
ADD 224 RS/LIT

CHIEF ENGR.

S.E (E&C)

EFF. ENGR.

→ TO:GENERAL MANAGER (GEN)
CC:GENERAL MANAGER(G.& C.)
CC:SEEC/SEO/EE/CEGEN/P10/MF/CEK/CE (G&C)/CA/CCOF/CMS/SE(P&[illegible]

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY REGISTRAR (NEPRA)

dt. 13-8-97

KORANGI THERMAL POWER STATION FOR FINANCIAL YEAR 1996-97

INST.CAP.	MW						
CT.CAP	%						85
G.E.C.	KWH	64460000	55450000	509956900	480266931	0	1110133831
U.G.F.OIL	KWH	0	0	10573100	118893069	0	129466169
U.G. HSDO	KWH	0	0	0	0	0	0
U.G. LDO	KWH	0	0	0	0	0	0
U.G.TOTAL	KWH	64460000	55450000	520530000	599160000	0	1239600000
AUX. CON	KWH	3852000	3490000	36893000	44708000	0	88943000
U.S.O	KWH	60608000	51960000	483637000	554452000	0	1150657000
RE. UNITS	KVARH	7710000	11290000	293609000	266374000	0	578983000
OPR. HRS.	HRS	1547.58	1534.03	7429.27	7499.06	0	8726.16
FSD. HRS	HRS	6468.42	6481.97	1330.73	1260.94	0	33.84
PSD. HRS	HRS	0	0	0	0	0	0.00
S.B. HRS	HRS	0	0	0	0	0	0.00
TOTAL HRS	HRS	8760	8760	8760	8760	8760	8760.00
SHUT/TOTAL	NO	9	7	12	32	0	12
DOWN/FORCED	NO	9	7	12	32	0	12
MAX. DEMAND	MW	45	40	95	125	0	270
MIN. DEMAND	MW	5	10	25	5	0	15
LOAD FACTOR	%	92.560	90.367	73.8	63.9	0	52.6
PLANT FACTOR	%	11.149	9.591	47.5	54.7	0	37.0
AVAIL. FACTOR	%	17.666	17.512	84.8	85.606	0	99.6
AUX. CON. FACTOR	%	5.976	6.294	7.1	7.5	0	7.2
POWER FACTOR		0	0	0.84	0.9	0	0.87
FUEL GAS	MCF	921196.8	859151	6527072.34	5794695.82	0	14102116
FUEL F.OIL	M.TON	0	0	3133.39	35038.73	0	38172.12
FUEL HSDO	LITRE	0	0	0	0	0	0
FUEL LDO	LITRE	0	0	0	0	0	0
FUEL ADO	LITRE	0	0	453	0	0	453
FUEL/GAS	C. FT/KWH	14.29	15.49	12.80	12.07	0	12.703
CONS./F.OIL	KG./KWH	0	0	0.296	0.295	0	0.295
PER/HSDO	LIT/KWH	0	0	0	0	0	0
U.G. ON LDO	LIT/KWH	0	0	0	0	0	0
G. HEAT RATE	BTU/KWH	13576	14719	12155	11546	0	12050
N.HEAT RATE	BTU/KWH	14439	15708	13082	12478	0	12981
KVA HEAT RATE	BTU/KVAH	0	0	10210	10392	0	10483
THERMAL EFF.	%	25.13	23.18	28.07	29.55	0	28.32
COST OF GAS	RS	8209684	7546706.2	636077021.3	551056072.2	0	1345776642
COST OF F. OIL	RS	0	0	12527418.38	180739748.5	0	193267167
COST OF HSDO	RS	0	0	0	0	0	0
COST OF LDO	RS	0	0	0	0	0	0
COST OF ADO	RS	0	0	101472	0	0	101472
COST OF TOTAL	RS	82096843	76546706.2	648705911.7	731795820.7	0	1539145281.4
COST/UG GAS	PAISAS	127.36	138.05	124.73	114.74		121.23
COST/UG F.O	PAISAS	0	0	118.48	152.02	0	149.28
COST/UG HSDO	PAISAS	0	0	0	0	0	0
COST/UG LDO	PAISAS	0	0	0	0	0	0
COST/UG AVG.	PAISAS	127.36	138.05	124.62	122.14	0	124.16
COST/USO	PAISAS	139.46	147.32	134.13	131.99	0	133.76

H.V.(BTU) AVG. COST
GAS/ CFT 95.43RS/MCF
F.O/ /LB 5063.43 RS/MTON
HSDO/3400/LIT RS/LIT
/3400/LIT RS/LIT
224 RS/L

TO GENERAL MANAGER (G&C)
E(G)/C.E.(BQPS)/CCE(K)/CE/(CC)(P)

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

DY CHIEF ENGR.
S.E (E&C)
EFF. ENGR

Chief Engineer

THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

REF. NO. KTPS/P10/98/ 3740
DATED:17-10 1998.

GENERATION STATISTICS FOR KORANGI THERMAL POWER STATION

FINANCIAL YEAR 1997-1998.

ITEM	UNITS	UNIT #1	UNIT #3	UNIT--#4	COMBINED
INST.CAP	MW	56	125	12	31
ACT CAP	MW	0.00	118	10	22
U.G. GAS	KWH	0.00	448,609,311.00	472,935,435.00	921,544,746.00
U.G.F.OIL	KWH	0.00	32,280,689.00	95,024,565.00	127,305,254.00
U.G. HSDO	KWH	0.00	0.00	0.00	0.00
U.G. LDO	KWH	0.00	0.00	0.00	0.00
U.G.TOTAL	KWH	0.00	480,890,000.00	567,960,000.00	1,048,850,000.00
AUX. CON	KWH	54000.00	33,775,000.00	43,430,000.00	77,259,000.00
U.S.O.	KWH	0.00	447,115,000.00	524,530,000.00	971,591,000.00
RF. UNITS	KVARH	0.00	281,430,000.00	313,900,000.00	595,330,000.00
OPR. HRS	HRS	0.00	6,120.71	7,177.92	13,631.21
FSD. HRS	HRS	0.00	576.71	1,582.08	129.39
PSD HRS	HRS	0.00	2,062.58	0.00	0.00
S.B. HRS	HRS	0.00	0.00	0.00	0.00
TOTAL HRS	HRS	0.00	8,760.00	8,760.00	17,760.00
SHUT/TOTAL	NO	0.00	17	19	5
DOWN/FORCED	NO	0.00	5	4	5
MAX. DEMAND	MW	0.00	118	105	215
MIN. DEMAND	MW	0.00	5	10	15
LOAD FACTOR	%	0.00	86.58	75.35	86.3
PLANT FACTOR	%	0.00	62.85	51.87	37.9
AVAIL. FACTOR	%	0.00	63.87	81.94	98.5
AUX. C. FACTOR	%	0.00	7.02	7.65	7.4
POWER F.C.		0.00	0.87	0.89	0.87
FUEL GAS	MCF	0.00	5,574,870.00	5,866,613.00	11,441,483.00
FUEL F.OIL	M.TON	0.00	9,567.37	28,222.85	37,810.22
FUEL HSDO	LITRE	0.00	0.00	0.00	0.00
FUEL LDO	LITRE	0.00	0.00	0.00	0.00
FUEL ADD	LITRE	0.00	553.00	0.00	553.00
FUEL/GAS	C.FT/KWH	0.00	13.43	13	12.42
CONS.F.OIL	KG./KWH	0.00	0.297	0.297	0.297
PER/HSDO	LIT/KWH	0.00	0.00	0.00	0.00
U.S. ON/LDO	LIT/KWH	0.00	0.00	0.00	0.00
G. HEAT RATE	BTU/KWH	0.00	11,817.29	11,817.05	11,817.15
N.HEAT RATE	BTU/KWH	0.00	12,709.96	12,795.40	12,756.82
KVA H.RATE	BTU/KVAH	0.00	10,281.04	10,398.99	10,280.92
THERMAL EFF.	%	0.00	28.87	28.87	28.87
COST OF GAS	RS	0.00	575,450,780.21	603,280,197.30	1,178,730,977.51
COST OF F.OIL	RS	0.00	58,742,966.44	172,924,788.94	231,667,755.38
COST OF HSDO	RS	0.00	0.00	0.00	0.00
COST OF LDO	RS	0.00	0.00	0.00	0.00
COST OF ADD	RS	0.00	146,272.00	0.00	146,272.00
COST OF FUEL	RS	0.00	634,340,018.65	776,204,986.24	1,410,545,004.89
COST/UG (GAS)	PAISAS	0.00	128.27	128	27.91
COST/UG F.O.	PAISAS	0.00	181.98	182	181.98
COST/UG (HSDO)	PAISAS	0.00	0.00	0.00	0.00
COST/UG LDO	PAISAS	0.00	0.00	0.00	0.00
COST/UG AVG	PAISAS	0.00	131.91	136.67	134.48
COST/USO	PAISAS	0.00	141.87	147.98	140.18

ITEM/C.V. (BTU)	AVG. COST
GAS/950/CFT	111.38 RS/MCF
F.O./18300/LB	8127.12 RS/MTON
HSDO/34400/LIT	RS/LIT
LDO/34000/LIT	RS/LIT
ADD	224 RS/LIT

TO GENERAL MANAGER (G&C)

CC: [illegible]

S.E.

Office of Deputy Chief Engineer (Generation) No. 284 Dated 17/10/98 Sent To.....

DY.CHIEF ENGR. (E&C)

17/X

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY REGISTRAR (NEPRA)

THE KARACHI SUPPLY CORPORATION LIMITED.

RE: NO. KTPS/P10/99/4820
DATED: 09-07-1999

GENERATION STATISTICS FOR KORANGI THERMAL POWER STATION FROM JUL-98 TO JUN-99.

ITEM	UNITS	UNIT NO.3	UNIT NO.4	STATION
INS.CAP	MW	125	125	250
ACT CAP	MW	105	85	190
U G GAS	KWH	533,290,173	545378335	1,078,666,508
U G F OIL	KWH	148,519,827	53783666	202,303,492
U G HSDO	KWH	0	0	0
U G LDO	KWH	0	0	0
U G TOTAL	KWH	681,810,000	589,160,000	1,260,970,000
AUX. CON	KWH	48,836,000	48506000	93,342,000
U.S.O	KWH	634,974,000	552,654,000	1,187,628,000
RE. UNITS	KVARH	392,810,000	339782000	732,592,000
OPR. HRS	HRS	7,796.23	7,819.82	8,722.70
FSD. HRS	HRS	963.77	940.36	37.30
PSD.HRS	HRS	0.00	0.00	0.00
S.B. HRS	HRS	0.00	0.00	0.00
TOTAL HRS	HRS	8,760.00	8,760.00	8,760.00
SHUT DOWNS TOTAL	NO	11	13	3
SHUT DOWNS FORCED	NO	11	13	3
MAX. DEMAND	MW	105	95	190
MIN. DEMAND	MW	10	5	20
LOAD FACTOR	%	83.29	80.66	77.29
PLANT FACTOR	%	62.27	54.72	58.49
AVAIL. FACTOR	%	89.00	89.27	99.57
AUX. CON. FACTOR	%	8.87	7.76	7.29
POWER FACTOR		0.87	0.87	0.87
FUEL GAS	MCF	8483639.96	8652548.35	13,316,388.31
FUEL F. OIL	M.TON	43,112.82	16249.15	59,361.97
FUEL HSDO	LITRE	0.00	0.00	0.00
FUEL LDO	LITRE	0.00	0.00	0.00
FUEL ADD	LITRE	0.00	0.00	0.00
FUEL/GAS	C. FT/KWH	12.12	12.58	12.35
CONS./F.OIL	KG./KWH	0.290	0.302	0.293
PER/HSDO	LIT/KWH	0.00	0.00	0.00
U.G. ON/LDO	LIT/KWH	0.00	0.00	0.00
G. HEAT RATE	BTU/KWH	11,557	11,959	11,745
N.HEAT RATE	BTU/KWH	12,409	12,965	12,668
KVA. HEAT RATE	BTU/KVAH	10,054	10,404	10,218
THERMAL EFF.	%	29.52	28.53	29.05
COST OF GAS	RS	692,141,824.46	763,147,360.02	1,455,289,184.48
COST OF F. OIL	RS	239,002,446.81	86,604,338.64	325,606,785.45
COST OF HSDO	RS	0.00	0.00	0.00
COST OF LDO	RS	0.00	0.00	0.00
COST OF ADD	RS	0.00	0.00	0.00
COST OF TOTAL	RS	931,144,271.27	849,751,698.66	1,780,895,969.93
COST/UG GAS	PAISAS	129.79	139.93	134.92
COST/UG F.O	PAISAS	160.92	161.02	160.95
COST/UG HSDO	PAISAS	0.00	0.00	0.00
COST/UG LDO	PAISAS	0.00	0.00	0.00
COST/UG AVG.	PAISAS	136.57	141.82	139.03
COST/USO	PAISAS	146.84	153.76	149.95

Note.: Figs.Projected,as Recorded at KTPS.

ITEM/C.V. (BTU)	AVG. COST
GAS/950/CFT	111.367 RS/MCF
F.O./18300/LB	5485.11 RS/M.T
HSDO/34400/LIT	N/R
LDO/34000/LIT	N/R
ADD	Z24 RS/LIT

C.E (G) / GENERAL MANAGER (G&C)

EFF. ENGR.

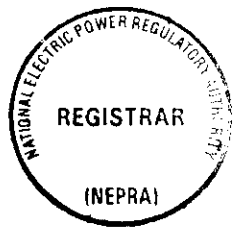
S.E. (E&C)

DY.CHIEF ENGR.
K.T.P.S

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

KORANGI THERMAL POWER STATION

DUE-DILIGENCE REPORT



A.4 KORANGI THERMAL POWER STATION

A.4.1 SUMMARY

Korangi Thermal Power Station (KTPS) is located in south-east Karachi on a site adjacent to Korangi Creek. The installed plant was constructed in two phases. Units 1 and 2, each of 66 MW installed capacity, were commissioned in 1965 and 1966 respectively. Unit 3, rated at 125 MW, was commissioned in 1970, followed by a similar unit as Unit 4 in 1977.

The plant runs as a baseload station, firing predominantly on oil during the winter and a combination of oil and gas during the summer months. Units 3 and 4 are capable of 100 per cent sustained firing on either oil or gas. There are both oil and gas pipelines to the station, with tankered oil acting as a backup. The furnace oil is piped directly from the oil refinery. Because of high system power demand, maintenance outages are usually limited to breakdowns only.

Units 1 and 2 were supplied and constructed by General Electric of USA. Unit 1 is still potentially available for commercial service, however, it has not generated since 1996 because of generator exciter failure. Unit 2 suffered an explosion in 1996 as a result of mechanical governor failure and has since been out of service. Units 3 and 4 steam turbine generators were supplied by Hitachi and were in service at the time of the site visit.

TABLE A4.1 KORANGI THERMAL POWER PLANT - BASIC EQUIPMENT DATA

Unit No	Year Commissioned	Gross Capacity (MW)		Manufacturer (Boiler/ Turbine)
		Installed	June 1998	
1	1965	66	40*	Babcock and Wilcox (USA)/GE (USA)
2	1966	66	0	Babcock and Wilcox (USA)/GE (USA)
3	1970	125	95	Babcock Hitachi (Japan)/Hitachi (Japan)
4	1977	125	70	Babcock Hitachi (Japan)/Hitachi (Japan)
Total		382	205	

Data: Generation and Co-ordination Department June 1998
* Unit 1 has not generated since 1996

The degradation in unit efficiencies has been large, even considering their age. This is because maximising output is given priority over efficiency, planned maintenance is often delayed as a result of political pressure to keep units running and operating practices do not optimise performance. Plant availabilities could be improved by more intensive programming of activities during outage periods and by giving station managers more authority and accountability in procurement, budgeting and plant performance.

Korangi Thermal Power Station has a sanctioned staffing entitlement of 507, of which 270 posts are presently filled (approx. 90 operations, 120 maintenance, plus administration and stores etc).

Although the Load Dispatch Centre (LDC) controls the dispatch of KESC generation and imports from IPPs, KANUPP, PASMIC and WAPDA, KTPS has a co-ordinating role amongst the KESC generation stations. Communication is by direct telephone to the other stations and the LDC.

The extensive use of asbestos for insulation remains an environmental liability and staff. There are currently no regulations or procedures for working with the substance. The low stack heights, cooling

water temperatures and effluent quality are also potential liabilities.

A.4.2 OUTLINE PLANT DESCRIPTION

I) TURBINES

TABLE A4.2 KORANGI THERMAL POWER PLANT - TURBINE DESIGN DATA

Unit	Model/Type	Stages HP+IP+LP	Steam Condition		Exhaust Pressure (inches Hg abs)
			Pressure (psig)	Temp (F)	
1	TCDF, condensing	18+0+2x5	1250	950	2.5
2	TCDF, condensing	18+0+2x5	1250	950	2.5
3	TCDF, condensing	10+12+2x5	1800	1000	3.5
4	TCDF, condensing	10+12+2x5	1800	1000	3.5

Data: Generation and Co-ordination Department June 1998
Note: TCDF: Tandem Compound Double Flow

Both Units 1 and 2 steam turbines are two cylinder machines having a single flow HP cylinder and a double flow LP cylinder. Following the serious incident on Unit 2 in 1996, this turbine is no longer serviceable.

II) BOILERS

Plant design operating conditions are summarised in Table A4.3.

TABLE A4.3 KORANGI THERMAL POWER PLANT - BOILER DESIGN DATA

Unit	Model/Type	Capacity (tons/hr)	Steam Conditions			
			Main		Reheat	
			Pressure (psig)	Temp (F)	Pressure (psig)	Temp (F)
1	Stirling Radiant type, two drum, natural circulation	295	1300	960	none	none
2	Stirling Radiant type, two drum, natural circulation	295	1300	960	none	none
3	B&W Water tube radiant type, single drum, natural circulation (Elpaso type)	495	1800	1005	471	1005
4	B&W Water tube radiant type, single drum, natural circulation (Elpaso type)	495	1880	1005	428	1005

Data: Generation and Co-ordination Department June 1998

Unit 2 boiler is in a state of dry preservation following the incident in 1996.

Statutory inspections are carried out by government boiler inspectors who issue an annual certificate. However staff stated that there is no creep life monitoring on the plant so effects of operation at excessively high temperatures would be difficult to detect.

III) ELECTRICAL SYSTEMS

Unit transformers step up generated output to 132 kV for outgoing transmission to five feeders, one each to: Queens Road 1 and 2, Landhi 1 and 2 and Korangi West.

The station does not have black start capability. However there are two 3.6 MVA diesel generators for emergency use and a 132 to 3.3kV (7.5 to 9.375 MVA) plant auxiliary transformer for general off-load and start up requirements.

Generator output and auxiliary consumption are metered for each of the units. There are no check meters and the existing meters have never been check calibrated. Meter reading is done manually by station staff each shift.

Staff stated that the station operates in either frequency or load control modes, as required. There is no experience of two-shift working.

IV) GENERATORS AND GENERATOR TRANSFORMERS

TABLE A4.4 GENERATOR AND GENERATOR TRANSFORMER DESIGN DATA

Unit	Generator Transformer			Generator			
	Manufacturer (Type)	Rating		Manufacturer (Type)	Capacity (MVA)	Terminal Voltage	Cooling Media
		MVA	kV				
1	GE (GRY)	85	13.8/132	GE (ATB2)	88.235	13.8	Hydrogen
2	GE (GRY)	85	13.8/132	GE (ATB2)	88.235	13.8	Hydrogen
3	BBC (TPOA)	172	18/132	Hitachi (TFLF)	164.8	18	Hydrogen
4	BBC (TPOA)	172	18/132	Hitachi (TFLF)	165.8	18	Hydrogen

Data: Generation and Coordination Department June 1998

The alternators are hydrogen cooled with hydrogen being supplied from an on-site production plant. The carbon dioxide necessary for purging the alternators for maintenance work is externally sourced.

V) CONDENSERS

All four turbo alternators at Korangi have direct water cooled underslung condensers. Cooling water is abstracted from the sea.

VI) COOLING WATER SYSTEM

Each unit condenser is supplied with cooling water by one of two 100 per cent duty circulating water pumps, water requirements being abstracted from the sea.

VII) BALANCE OF PLANT AND SUPPORT FACILITIES

Water and Effluent Treatment Facilities

There are proposals to install a desalination plant to supplement the existing water supply, from the town's main connection to the site. Staff stated that supplies to date have been reasonably reliable both in terms of quality and quantity, but that the desalination plant had been planned in because of the increasing demand for water in the city.

Emission Monitoring

There is no emissions-monitoring carried out at the station. Given the low stack heights and the types of fuel burned, it is likely that computer modelling would reveal air quality problems.

Stores

A general range of consumable stores and plant spares are kept on site. During the visit a random stores contents check was carried out and all items chosen at random from the inventory were found in the location specified on the register. However, station management stated that operations were constrained

by the lengthy procurement procedures. The lead time on most spares is approximately two years so once a major maintenance has been completed, the process of ordering the recommended parts for the next overhaul is initiated.

Although the station approves the specifications and suppliers for spare parts and consumables, all procurement for orders exceeding about Rs 20,000 is referred to the purchasing department

Workshop

The station workshops at Korangi are fitted out with tools, machinery and equipment as would be expected of a power station of this vintage. Generally the facilities were in reasonable order given the age of the station

Residential Colony

Korangi Thermal has a small residential colony close to the station which consists of small blocks of flats and some small houses. The size and standard of accommodation is inferior to that at the Bin Qasim colony.

A.4.3 PLANT PERFORMANCE

Table A4.5 summarises recent unit performance. Auxiliary consumption in the order of 6 to 7 per cent would be expected for units of this type. Slightly higher values might occur when the units are running at below their installed capacity, however some values recorded at KTPS are outside this range. It is likely that this difference could be recovered following a major maintenance overhaul provided that good operations practices are followed.

TABLE A4.5 KORANGI THERMAL POWER PLANT - UNIT OPERATION 1994 TO 1998

Unit No	Installed Capacity (MW)	Period	Maximum Load (MW)	Operating Hours	Total Units Generated (MWh)	Auxiliary Consumption (%)	Power Factor
1	66	1993-4	55	2,880	129,700	6.33	0.80
		1994-5	55	1,900	88,100	6.75	0.94
		1995-6	55	5,751	248,590	5.72	0.85
		1996-7	45	1,548	64,460	5.98	0.99
		May-98	0	0	0	-	-
2	66	1993-4	50	7,591	318,900	6.71	0.84
		1994-5	45	7,899	294,870	6.44	0.78
		1995-6	45	8,052	304,020	6.31	0.79
		1996-7	40	1,534	55,450	6.29	0.98
		May-98	0	0	0	-	-
3	125	1993-4	110	7,422	497,210	9.34	0.82
		1994-5	105	5,608	415,060	7.84	0.81
		1995-6	85	8,081	467,460	9.49	0.77
		1996-7	95	7,429	520,530	7.09	0.87
		May-98	110	694	58,570	6.71	0.85
4	125	1993-4	118	7,799	675,940	7.12	0.85
		1994-5	110	8,293	571,990	7.73	0.81
		1995-6	105	8,189	538,230	8.42	0.85
		1996-7	125	7,499	599,160	7.46	0.91
		May-98	90	516	34,510	8.69	0.91

Data Generation and Co-ordination Department June 1998

Availability figures for units of the type and age installed at KTPS should be at least 80 per cent, including any derating. Although the KESC availability statistics are not adjusted to include derating, Units 3 and 4 can be seen to have reasonable availability. Unit 1's poor availability is largely a result of maintenance following the explosion in Unit 2 and the current excitation problems.

TABLE A4.6 KORANGI THERMAL POWER PLANT - UNIT PERFORMANCE 1994 TO 1998

Unit No	Installed Capacity (MW)	Period	Maximum Load (MW)	Average Load (MW)	Load Factor	Capacity Factor	Availability Factor
1	66	1993-4	55	45	0.68	0.22	33
		1994-5	55	46	0.70	0.15	22
		1995-6	55	43	0.65	0.43	65
		1996-7	45	42	0.63	0.11	18
		May-98	0	0	-	-	-
2	66	1993-4	50	42	0.64	0.55	87
		1994-5	45	37	0.57	0.51	90
		1995-6	45	38	0.57	0.52	92
		1996-7	40	36	0.55	0.10	18
		May-98	0	40	-	-	-
3	125	1993-4	110	67	0.54	0.45	85
		1994-5	105	74	0.59	0.38	64
		1995-6	85	58	0.46	0.43	92
		1996-7	95	70	0.56	0.48	85
		May-98	110	84	0.68	0.63	93
4	125	1993-4	118	87	0.69	0.62	89
		1994-5	110	69	0.55	0.52	95
		1995-6	105	66	0.53	0.49	93
		1996-7	125	80	0.64	0.55	86
		May-98	90	60	0.54	0.37	69

Data: Generation and Co-ordination Department June 1998

TABLE A4.7 KORANGI THERMAL POWER PLANT - UNIT EFFICIENCIES

Unit No	Commiss-ioning Date	Installed Capacity (MW)	Heat Rate (HHV)		Period	Heat Rate		
			Design	Commissioning		Gross	Net	Degradation since commissioning (%)
1	1965	66	10581	10570	1993-4	15,451	16,495	46
					1994-5	15,567	16,701	47
					1995-6	14,491	15,371	37
					1996-7	13,578	14,439	28
					May-98			
2	1966	66	N/A	N/A	1993-4	15,694	16,821	N/A
					1994-5	15,769	16,882	N/A
					1995-6	15,181	16,204	N/A
					1996-7	14,719	15,708	N/A
					May-98			
3	1970	125	9241	9115	1993-4	12,627	13,927	37
					1994-5	11,913	12,928	33
					1995-6	12,403	13,703	36
					1996-7	12,185	13,082	33
					May-98	11,502	12,329	26
4	1977	125	8831	8751	1993-4	11,845	12,941	32
					1994-5	11,874	12,869	36
					1995-6	12,261	13,388	40
					1996-7	11,546	12,478	32
					May-98	12,589	13,787	44

Data: Generation and Co-ordination Department June 1998

Unit efficiencies are poor when compared with commissioning tests. The differences can partly be accounted for by:

- the age of the units
- the lack of efficiency targets
- operation without feed heaters
- feed pump limitations
- operation at less than installed capacity for sustained periods
- large numbers of trips and starts
- insufficient frequency of planned outages
- significant change in fuel type
- air heater damage and poor combustion control
- condenser fouling

However, the maximum degradation expected from the total of these sources would not normally exceed about 20 per cent.

TABLE A4.8 KORANGI THERMAL POWER PLANT - OUTAGE RECORDS

Unit No.	Installed Capacity (MW)	Period	Maximum Load (MW)	Availability Factor	Forced Outage Factor	Total Outages (Nr)	Forced Outages (Nr)	Planned Outage (Hrs)	Forced Outages (Hrs)
1	66	1993-4	55	32.88	0.50	14	13	1,464	4,418
		1994-5	55	21.65	0.12	8	8	5,832	1,028
		1995-6	55	65.48	0.09	11	11	2,208	824
		1996-7	45	17.67	0.74	9	9	0	6,468
		May-98	0	-	-	1	0	744	0
2	66	1993-4	50	87	0.13	15	14	3	1,166
		1994-5	45	90	0.10	21	21	0	861
		1995-6	45	92	0.08	12	12	0	732
		1996-7	40	18	0.74	7	7	0	6,481
		May-98	0	-	-	1	0	744	0
3	125	1993-4	110	84.73	0.15	13	13	0	1,338
		1994-5	105	64.02	0.03	8	6	2,894	288
		1995-6	85	92.00	0.08	8	8	0	703
		1996-7	95	84.80	0.15	12	12	0	1,331
		May-98	110	93.30	0.07	3	3	0	80
4	125	1993-4	118	89.03	0.11	11	11	0	961
		1994-5	110	94.66	0.05	21	21	0	468
		1995-6	105	93.22	0.07	13	13	0	595
		1996-7	125	85.61	0.14	32	32	0	1,261
		May-98	90	69.30	0.31	3	3	0	228

Data: Generation and Co-ordination Department June 1998

Forced outage rates on the units are relatively high. The high figures for Units 1 and 2 in 1996-7 were caused by the exciter failure on Unit 1 and the explosion on Unit 2, which caused severe damage to the neighboring unit.

Activity schedules are compiled prior to planned outages. However, there is scope for reducing total outage time and improving performance by increasing the frequency of planned outages, increasing the activity level during outage periods and reducing the lead time for procurement.

Cold starts take about 9 to 10 hours to synchronisation with ramp rates of about 25 MW per hour for the first two hours. Hot starts are 90 minutes to synchronisation.

A.4.4 ANALYSIS OF UNIT PERFORMANCE

1) UNIT 1

At the time of the site visit this Unit was out of service for planned overhaul which is scheduled to last until December 1998. The principal problem is a defective generator exciter, replacement parts for which are currently on order.

The performance statistics show that the unit's availability and output has been below what might be expected for one of this age and type. Lack of planned maintenance was the reason given by staff for this.

Past maintenance has included upgrading of the turbine supervisory instrument system in 1983 and modification of the turbine thrust bearings in 1995 to incorporate additional performance monitoring equipment.

The boiler underwent an extensive overhaul in 1983, which included the following work:

- Installation of a computer based combustion control system
- Installation of additional sootblowers
- Modifications to the furnace oil handling system, by adding a new fuel oil skid
- Replacement of steam coil air pre-heaters with a modified design.

II) UNIT 2

Unit 2 was involved in a serious operational incident in 1996, during which the turbine overspeed protection failed to operate, causing an explosion in the hydrogen cooled alternator and rendering the unit unserviceable. Remnant parts of this turbo-generator have been used as a source of spares to keep Unit 1 serviceable. A thorough survey of Unit 2 would be necessary to determine the replacement parts required, before any rehabilitation of this unit is considered. Staff stated that such a survey had been carried out by GE to identify the replacement parts necessary to bring the unit back into commercial service, however this report was not available to Mott MacDonald during the visit.

Unit 2 boiler has been kept in a preserved state since the incident, but its precise condition is not known. Since it is in a state of dry preservation but staff stated that there were no moisture absorbing agents being used to maintain the condition, the extent of deterioration cannot be confirmed.

III) UNIT 3

Unit 3, rated at 125 MW and supplied by Hitachi/Hitachi Babcock, was commissioned in 1970. The only serious operational incidents that have occurred on this unit since commissioning are a boiler explosion in 1972 and a number of air heater fires. Subsequent to the 1972 incident, the unit was out of service until the boiler was rebuilt in 1985. Originally the unit was oil fired however, since its re-commissioning in 1982 gas has been the normal fuel.

The air heaters installed are of the Lungstrom type. Since the occurrence of the fires, the air heaters have now fitted with permanently installed fire protection facilities.

Maintenance has included upgrade of the turbine supervisory instrumentation system in 1983.

Maintenance to the boiler in 1985 included upgrading the combustion control system and changing the burners for a modified design. The economiser was replaced with a "bare tube" type suitable for sustained 100 per cent oil firing. During this outage soot blowers were added and the furnace oil handling system was modernised by the addition of a new fuel oil skid and fuel oil additive injection system. Modified air heater elements were also fitted.

In the operating year 1997-8, both the high and low pressure feed water heaters were replaced, a flash tank system was also incorporated into the units drains system. The boiler feed pumps discharge valves were motorised.

IV) UNIT 4

Unit 4, a unit similar to Unit 3, entered service in 1977. This Unit also has dual firing capability and is normally gas fired. No major operating incidences on this unit were reported. The statistics show that the unit performs relatively well, when compared with the other units at the site, and aside from efficiency the performance approaches international norms.

The air pre-heater elements were replaced with a modified design in 1995 and there are plans to test

42

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condenser tubes during an outage in 1998.

A.4.5 ELECTRICAL INTERCONNECTION

The power output of Korangi Thermal Power Plant is generated at 13.8kV on Units 1 and 2 and 18kV on Units 3 and 4. Site outgoing feeders are connected to Queens Road Substation via two 136kV 50 MVA circuits, Landhi also by two 50MVA circuits and Korangi West by a single circuit having a capacity of 50 MVA.

A.4.6 FUEL SUPPLY ARRANGEMENTS

Transportation of oil and gas is via pipelines, with oil tankers providing a back-up. Fuel analysis is carried out by an independent laboratory.

All fuel oil supplies to Korangi are provided from the nearby refinery at prices fixed by the Government of Pakistan. There is a facility to store sufficient fuel oil for ten days' operation at full load approximately 18,000 tonnes.

Gas is the preferred fuel for Units 3 and 4. However, gas supplies are generally diverted to the north of the country during the winter to meet domestic heating demands so oil firing is more common during the winter. Gas consumption is metered by Sui-Southern and they will only accept payment based on their meter readings.

A.4.7 MISCELLANEOUS

I) SAFETY

Staff stated that there was no official "Permit to Work" system in operation, however some hazardous activities, such as work on busbars, were restricted to designated individuals and that such work areas were roped off. The plant managers commented however that given the hot working conditions, staff are often reluctant to wear protective equipment provided. Mott MacDonald did not see any staff wearing ear defenders or hard hats, for example.

A significant percentage of the insulation material used at Korangi is asbestos. Staff stated that the locations where asbestos is used as insulation are known, however there are no regulations nor any formal procedures for working in these areas.

II) ENVIRONMENT

Mott MacDonald's brief has not included assessment of environmental liabilities, however we have noted some potentially significant issues:

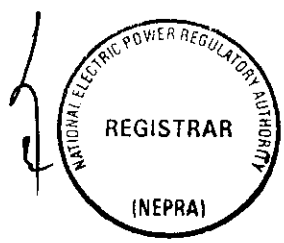
- The stack heights, particularly Units 1 and 2 (34 m), are not great considering the location of the plant. Units 3 and 4 have stacks of 47 metres' height.
- There is no emissions-monitoring equipment installed, nor is there any monitoring of effluent. All effluent is discharged directly to the sea and there are currently no limits on temperature for cooling water effluent.
- Transformers are not bunded so there is no means of containing leaks.

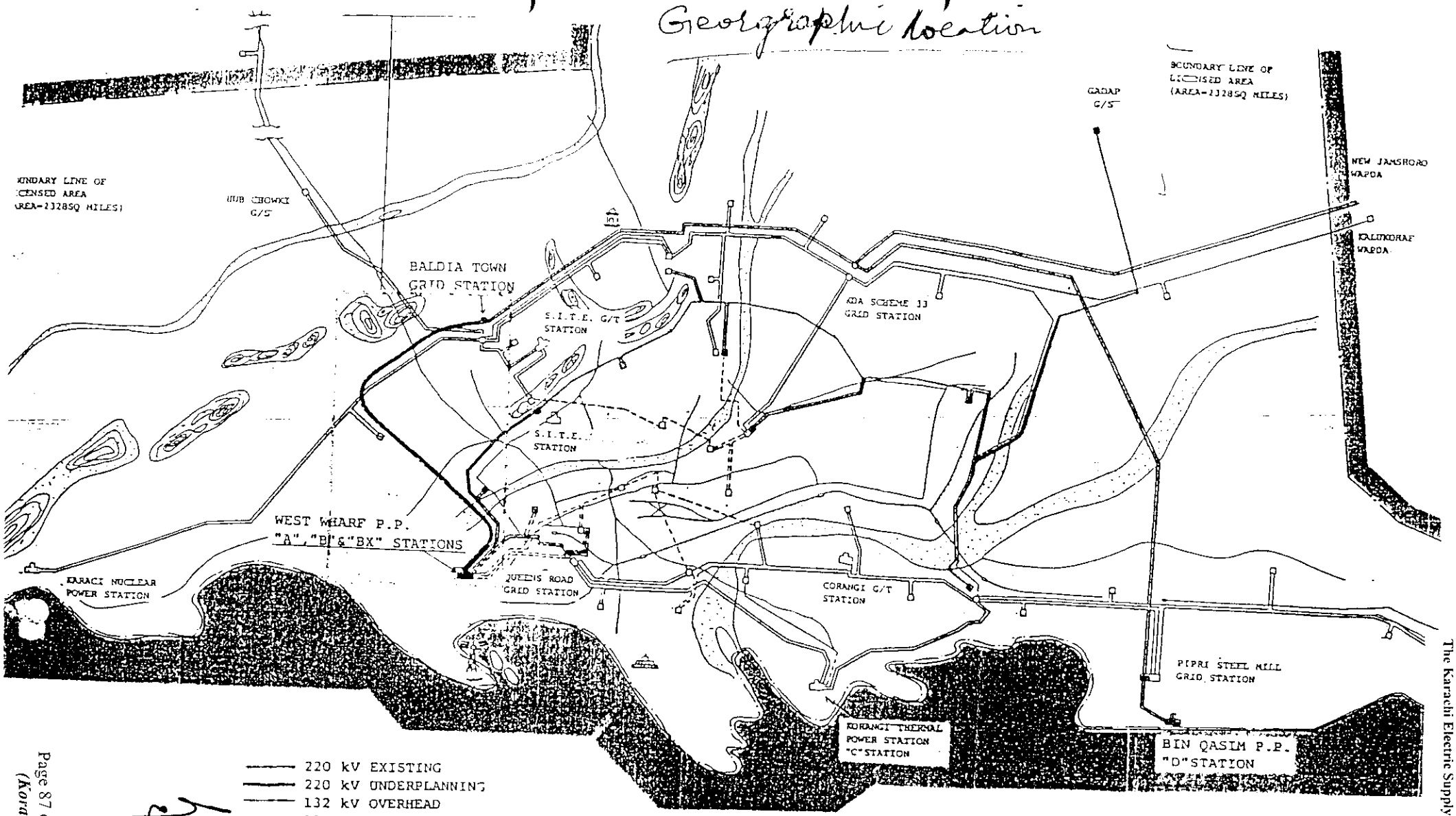
III) INSURANCE

Staff was not aware of any insurance requirements such as statutory inspections of pressure part However, the government boiler inspectors issue annual certificates to allow boiler operation

KORANGI TOWN GAS TURBINE POWER STATION

LOCATION
&
SITE PLAN





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KORANGI TOWN GAS TURBINE POWER STATION

EXISTING GENERAION FACILITY

EXISTING GENERATION FACILITIES

01. Location map of the KTGTPS is attached herewith.

02. Model No. PG-5341, MS5001P, GE-Hitachi. Four identical units of the above model are installed.

03. FUEL: i) Natural gas, supplied by Sui Southern Gas Co. through Pipe Lines.

ii) High Speed Diesel Oil as a backup fuel supplied by various Oil Companies.

04. Emission Values are not available.

05. Raw Water is being used for cooling purpose supplied through main Water Line by Karachi Water and Sewerage Board and also sometimes through Water tankers.

06. The nearest Grid is Korangi Town Grid situated within our boundary wall, 11.5 KV generated voltage is stepped up to 132 KV fed to Grid System, line diagrame is attached herewith. (Annex D)

07. Installed capacity on ISO condition is 100/80 MW. Average derated capacity is 72 MW, varied from 68 MW to 76 MW. Expected remaining life is about eight (08) years.

08. Due diligence report is attached herewith prepared by a Swiss Bank.

09. After operation of about Twenty Five thousand (25,000) hours, every unit is overhauled under the supervision of Foreign Experts. Damaged/Old parts are replaced with new ones.

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10. Operational record of last five years is attached herewith.

11. The total project cost at the time of installation was Rs. 43,18,27,817.83. Fixed cost as on 30.06.1999 was Rs. 557,039,295.80. The depreciation value is Rs. 447,411,850.00. Written down value is Rs. 109,627,445.80. Foreign Exchange component was financed by Asian Development Bank(ADB-230 PAK) amounting $ 22 million US Dollars. The balance local component was incurred by KESC.

12. PLANT CHARACTERISTICS:

Generating voltage	-	11.5 KV
Frequency	-	50 Hertz.
Power factor	-	0.8
Automatic control voltage	-	Local
Ramping rate	-	3 MW / Minute
Alternative fuel	-	High Speed Diesel Oil
Auxiliary consumption	-	3.17 to 4.38 %

Time required to synchronized to grid is about six minutes from startup.

13. Training and development.

Most of the engineers at power plant been trained in japan.

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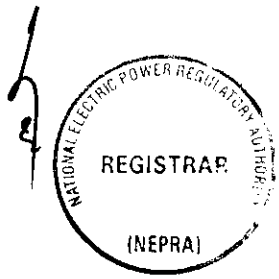
KORANGI TOWN GAS TURBINE POWER STATION

PLANT DETAILS

-42-



1.0 Generation Assets :

1.1 Contacts

a Korangi Town Gas Turbine Power Station

b Deputy Chief Engineer
Korangi Gas Turbine Power Station
KESC Ltd.
Address :
Plot 1/19, Sector 10, Korangi Industrial Area, Karachi
Telephone # 5067497-8

1.2 Technical Details

a **Total Installed Capacity.**

4 x 25 / 20 MW = 100 / 80 MW

b **Gas Turbine**

GE Frame Size 5 PG5341, Heavy Duty Gas Turbine
Hitachi Ltd.
Japan

Generator

27 MVA
Model EFBZ-LA-K
Hitachi Ltd.
Japan.

Transformer

30 MVA
Hitachi Ltd.
Japan.

c **Black Start**

Unit 1 and 2
2 x 25/20 = 50 / 40 MW

d **History**

Generator Top Turn Modification of Unit # 1,2,3 & 4

e **Technical Details Of HV Installation.**

As per drawing.

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f **Generation / Transmission Voltage**

11.5 / 132 KV

g **Planned Upgradation / Rehabilitation.**

Generator Top Turn Modification of all the four units completed as per plan.

h **Environmental Requirements**

Clean / dust free air

i **Stacks**

Stacks = 4 Nos
Height = 10.8 M

1.3 PERFORMANCE

a. Availability

Unit	1998-99	1997-98	1996-97	1995-96	1994-95
1	86.65	97.61	97.68	99.84	95.77
2	96.10	99.93	99.22	99.88	99.90
3	88.90	99.96	99.60	99.86	99.63
4	99.43	99.88	99.74	99.94	98.03

b. Electrical Out Put :

Unit	1998-99		1997-98		1996-97	
	Gross	Net	Gross	Net	Gross	Net
1	52593700	50331640	72989300	70205680	96139600	92770510
2	52197200	49903190	65243000	62754800	71945300	69418950
3	57601200	55100310	72680500	69908660	85532800	82519650
4	75160400	71807900	72967500	70184710	93650100	90349270

Unit	1995-96		1994-95	
	Gross	Net	Gross	Net
1	99179900	95834350	59886500	57986470
2	87921200	84955440	74044500	71695270
3	54877000	53025880	66415300	64308150
4	47491100	45889120	68853300	66668790

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(NEPRA)

c. **No. Of Operation Hours (as on 31. 03. 2000)**

Unit	Hours
1	79290
2	70710
3	68532
4	71603

1.4 OPEREATION

a. Routine Spares

Planning for procurement of spares for 2 years.

b. Source of Spares

Average I year

c. Operation Cost.

YEAR	Ps / KWH
July 98 – June 99	214.57
July 97 - June 98	220.22
July 96 - June 97	194.21
July 95 – June 96	161.63
July 94 – June 95	132.28

Fuel & Lube Oil

Fuel

Gas
High Speed Diesel Oil

Lube Oil

T – 32 (Turbine Oil)

Contractor

Hire for Units Overhaul (Due to shortage of staff)

d. Heat Rate

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(NEPRA)

	GAS	HSDO
Designed	12400 Btu/kwh	12540 Btu/kwh
Commn.	12900 Btu/kwh	13230 Btu/kwh

	COMBINED
July 1998 – June 1999	17091 Btu/kwh

e. Capacity of the Station

Current Net	/ Gross (MW)
68	100

f. Capacity Of Units (MW)

Unit	Design	Comm.	Current
1	25	20.0	16.0
2	25	19.6	16.0
3	25	20.8	19.0
4	25	20.0	17.0

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1.5 MAINTENANCE

a. Details of Cost

Major maintenance work done during last five years

1. Major overhauling of Unit # 3
2. Major overhauling of Unit # 4
3. Painting of HSDO Tanks
4. Major overhauling of Unit # 1 & 2 in progress.

b. Details of Maintenance Programs

1. Combustion Inspection 2 days
2. HGP Inspection 20 days
3. Major Overhauling 30 days
4. Gas Compressor Overhauling 20 days

1.6 FUEL

a. Main & Backup Fuel

i. Natural Gas
From Sui Southern Gas Company by pipe line.

ii. Diesel
From PSO, Caltax, Shell by truck lorry.

b. Fuel Handling facility

i. **Natural Gas**

Supplied by SSGC through 12" pipeline
Direct feeding to machine by compressor

ii. **Diesel**

Facilitate with 2 set of unloading pumps skid 2 day tank of 7000 BBL capacity each & one small tank of 100 KL.

c. **Fuel Cost**

Natural Gas Rs. 138.01 / mcf
Diesel Rs. 12.78 / Liter

d. **Alternate Fuel**

HSDO

e. **Fuel Consumption at each Source**

Unit	1998-99		1997-98		1996-97	
	Gas (MCF)	HSDO (L)	Gas (MCF)	HSDO (L)	Gas (MCF)	HSDO (L)
1	923874	608164	1253943	1099325	1551218	3387084
2	917618	659501	1106330	1260515	1137190	3292662
3	1004859	707545	1043301	5733322	1424649	1720227
4	1355937	-	1292290	-	1637980	-

Unit	1995-96		1994-95	
	Gas (MCF)	HSDO (L)	Gas (MCF)	HSDO (L)
1	1756315	1116276	1012916	1595867
2	1557777	824783	1315994	261268
3	986309	-	1193604	73713
4	854064	-	1199325	922242

1.7 SITE & INTERCONNECTION

a. **Site Plans** As per drawing

b. **Planned Upgrade** Nil

b. **Single Line Diagram** Drawing Attached

c. **Source & Availability of Water** From 3" line of KWSB & also from Tankers

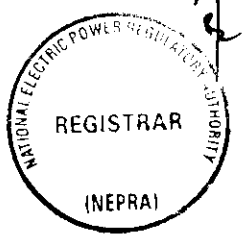
d. **Water Quality** City Water

e. **Water Treatment at Site** Nil

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

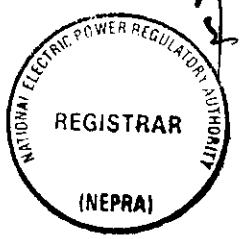
KORANGI TOWN GAS TURBINE POWER STATION

EMISSION VALUES



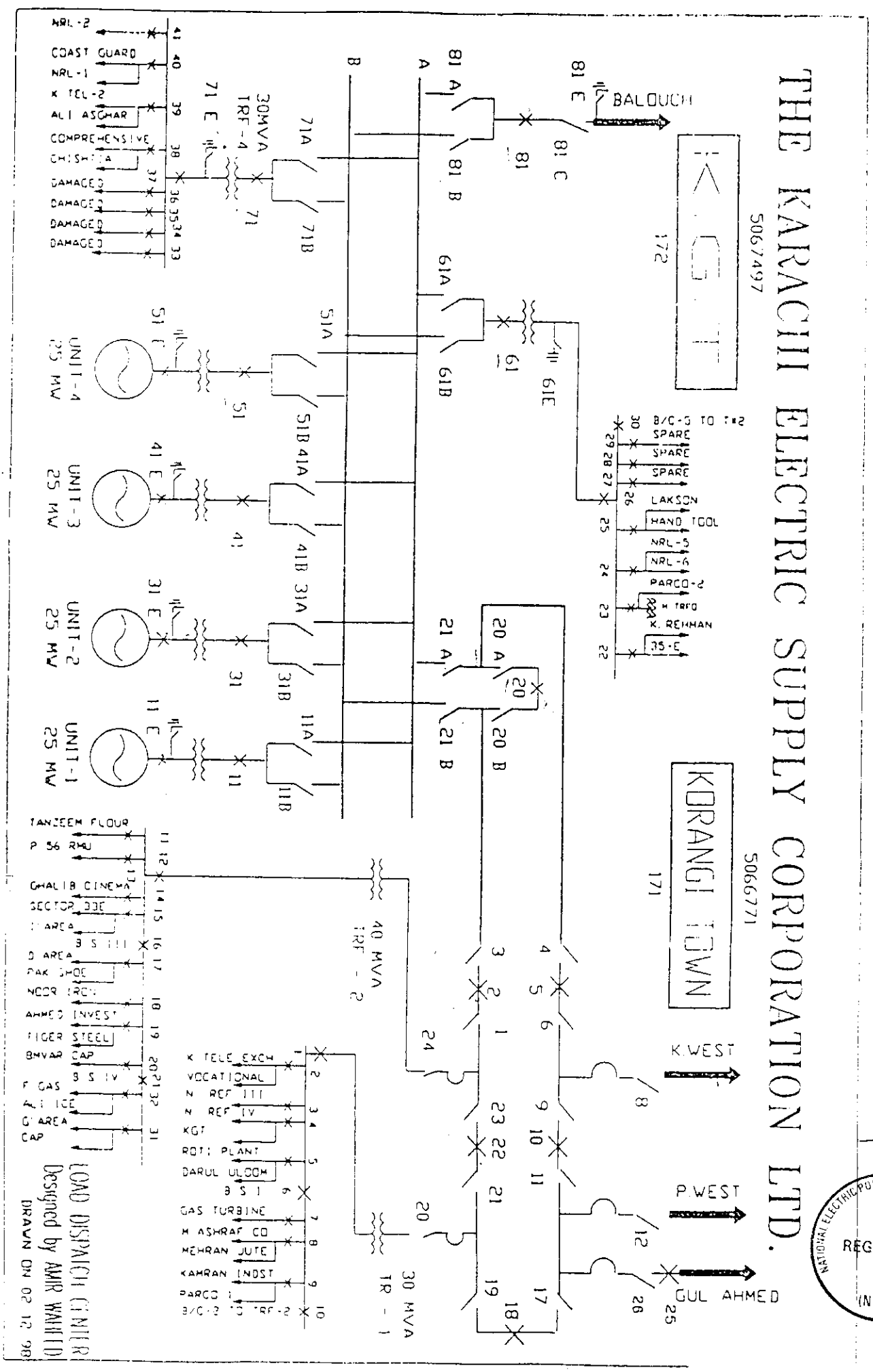
ANNEX.'A'.

THE PLANT IS OLD
EMISSION & IMMISSION EQUIPMENT
NOT INSTALLED.



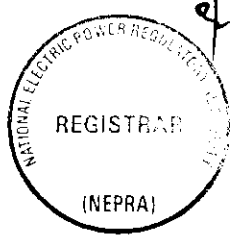
KORANGI TOWN GAS TURBINE POWER STATION

SINGLE LINE ELECTRICAL DIAGRAM



KORANGI TOWN GAS TURBINE POWER STATION

DUE-DILIGENCE REPORT



KORANGI GAS TURBINE POWER STATION

SUMMARY

Korangi Gas turbine Power Station is located in Karachi town adjacent to the Gul Ahmed independent power project. The station was built and commissioned in 1978 to meet the power demands of the Korangi industrial area development. The four open cycle gas turbine units installed are of the GE Frame 5 type and were all operating at base load at the time of the site visit. These units have given extended reliable service since their installation. Below table summarises the turbines installed at the site.

KORANGI GAS TURBINE POWER PLANT BASIC EQUIPMENT DATA

Unit Nr	Year Commissioned	Gross capacity (MW)			Operating Hours (to June 1998)	Manufacturer
		ISO	Commissioned	June 1998		
1.	1978	25/20	20.0	16	67,865	Hitachi, Japan
2.	1978	25/20	19.6	17	60,151	Hitachi, Japan
3.	1978	25/20	20.8	19	57,312	Hitachi, Japan
4.	1978	25/20	20.0	18	60,383	Hitachi, Japan
Total		100/80	80.4	70		

Data: Generation and Co-ordination Department June 1998

All gas turbine units at the station are fitted with dual firing capability, i.e. either natural gas or high speed diesel, the former being the station, with staff divided into the following functions:

- Electrical maintenance
- Mechanical maintenance
- Instrument and control maintenance
- Efficiency
- Operations

The plant was intended to be operated as peaking plant, and this is usually the case during the winter season. However, as a result of the derating of plant at the Bin Qasim and Korangi Thermal Plants, the Korangi Gas Turbines are run as baseload for much of the summer season. Thus, although the total capacity of the station is far smaller that these two thermal stations, it currently plays as important part in the KESC generation portfolio on account of its reliability

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There is no emissions monitoring and effluent is discharged directly to drains which run besides the site boundary. The stack heights are 10.8 metres.

PLANT DESCRIPTION

I) TURBINES

The gas turbines are all of the GE Frame 5 PG 5341 type, with technical details as outlines in below table Natural gas is the primary fuel, with high speed diesel as backup

KORANGI GAS TURBINES POWER PLANT-TURBINES DESIGN DATA

Category	Technical Details
Turbines stages (nr)	2
Compressor stages (nr)	17
Speed (rpm)	5100
Inlet pressure (kg/sq cm abs)	1.033
Inlet temperature (deg C)	40
Base load (MW)	19.5
Peak load (MW)	21.18

Data Generation and Co-ordination Department June 1998

II) ELECTRICAL SYSTEMS AND INTERCONNECTION

Generation is at 11 5 kv transformation to 132 kv for transmission Generation can either be in frequency control mode, or load control mode and automatic voltage regulation is available for the control of reactive power.

Output is metered as gross generation and auxiliary consumption to derive net output However, there are no check meters, nor has there been any calibration of the meters

Black start is available on Units 1 and 2

III) GENERATORS AND GENERATOR TRANSFORMERS

GENERATOR AND GENERATOR TRANSFORMER DESIGN DATA

Unit	Generator Transformer			Generator			
	Manufacturer Type	Rating		Manufacturer (Type)	Capacity (MVA)	Terminal Voltage	Cooling Media
		MVA	KV				
1.	Hitachi, Japan	30	11 5/132	Hitachi, Japan EFBZ-LA-K	27	N/A	N/A
2	Hitachi, Japan	30	11 5/132	Hitachi, Japan EFBZ-LA-K	27	N/A	N/A
3	Hitachi, Japan	30	11 5/132	Hitachi, Japan EFBZ-LA-K	27	N/A	N/A
4.	Hitachi, Japan	30	11 5/132	Hitachi, Japan EFBZ-LA-K	27	N/A	N/A

DATA Generation and Co-ordination Department June 1998

Modifications to the generators have been carried out.

REGISTRAR (NEPRA)

PLANT PERFORMANCE

The gas turbines continue to give reliable service .Although they are robust technology and can be expected to continue to operate well in the short to medium term, twenty years operation is considered a typical life for gas turbines. Therefore, life extension programmes or other substantial investment are unlikely be worthwhile.

KORANGI GAS TURBINE POWER PLANT-UNIT OPERATION 1994 TO 1998

Unit No.	Installed Period	Period	Maximum Load (MW)	Operating Hours	Total Units Generated (M Wh)	Auxiliary Consumption (%)	Power Factor
1.	25	1994-95	N/A	N/A	59,887	3 17	N/A
		1995-96	N/A	N/A	99,180	3 37	N/A
		1996-97	20	5,603	96,140	3 50	0 92
		May-98	18	594	8,734	3 86	0 92
2.	25	1994-95	N/A	N/A	74,045	3 17	N/A
		1995-96	N/A	N/A	87,921	3 37	N/A
		1996-97	19	4,644	71,945	3 51	0 92
		May-98	17	677	9,933	3 86	0 92
3.	25	1994-95	N/A	N/A	66,415	3.17	N/A
		1995-96	N/A	N/A	54,877	3 37	N/A
		1996-97	22	4,721	85,533	3.51	0.92
		May-98	20	591	10,507	3.86	0.92
4.	25	1994-95	N/A	N/A	68,853	3.17	N/A
		1995-96	N/A	N/A	47,491	3 37	N/A
		1996-97	19	5,801	93,650	3.51	0 92
		May-98	19	659	11,218	3 86	0 92

Data: Generation and Co-ordination Department June 1998
N/A Data not available

KORANGI GAS TURBINES POWER PLANT-UNIT PERFORMANCE 1994 TO 1998

Unit No.	Installed Capacity (MW)	Period	Maximum load (MW)	Average load (MW)	Load Factor	Capacity Factor	Availability Factor
1.	25	1994-95	N/A	N/A	N/A	N/A	95 77
		1995-96	N/A	N/A	N/A	N/A	99 84
		1996-97	20	17	0.69	0 44	97 68
		May-98	18	15	0.59	0.47	90 96
2.	25	1994-95	N/A	N/A	N/A	N/A	00 0
		1995-96	N/A	N/A	N/A	N/A	99 88
		1996-97	19	15	0 62	0 33	00 22
		May-98	17	15	0 59	0 53	99 65
3.	25	1994-95	N/A	N/A	N/A	N/A	00 63
		1995-96	N/A	N/A	N/A	N/A	99 86

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Unit No.	Installed Capacity (MW)	Period	Maximum load (MW)	Average load (MW)	Load Factor	Capacity Factor	Availability Factor
		1996-97	22	18	0.72	0.39	90.60
		May-98	20	18	0.71	0.56	99.64
4.	25	1994-95	N/A	N/A	N/A	N/A	98.03
		1995-96	N/A	N/A	N/A	N/A	99.01
		1996-97	19	16	0.65	0.43	99.74
		May-98	19	17	0.68	0.60	98.61

Data: Generation and Co-ordination Department June 1998
N/A: Data not available

The statistics show that auxiliary consumption is according to what might be expected for such units 2 to 3 per cent is typical for open cycle gas turbines. The operating hours indicate a peaking role during the winter with some base load during the summer months. Availability statistics are based on hours of availability only, rather than being erected for any derating. However they show that outages of the plant due to outages-both planned and forced- are rare.

The units are ramped up at a rate of up to 3 MW per minute.

KORANGI GAS TURBINE POWER PLANT-UNIT EFFICIENCIES

Unit No.	Commissioning Date	Installed Capacity (MW)	Heat Rate (LHV)		Period	Heat Rate (HHV)		
			Design	Commissioning		Gross	Net	Degradation since commissioning (%)
1.	1979	25	12400	12900	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	16,542	17,143	17
					May-98	16,701	N/A	18
2.	1979	25	12400	12900	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	16,593	17,197	18
					May-98	16,662	N/A	18
3.	1979	25	12400	12900	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	16,516	17,120	17
					May-98	16,576	N/A	17
4.	1979	25	12400	12900	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	16,166	17,223	14
					May-98	16,623	N/A	18

Data: Generation and Co-ordination Department June 1998
N/A: Data not available
Note: 11 per cent allowed as an estimate of the difference between LHV and HHV assuming commissioning on gas.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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KORANGI GAS TURBINE POWER-OUTAGE RECORDS

Unit No.	Installed Capacity (MW)	Period	Maximum Load (MW)	Availability Factor	Starts (Nr)	Forced Outage Factor	Forced Outage (Nr)	Forced Outage (Hrs)
1.	25	1994-95	N/A	95.77	N/A	N/A	N/A	N/A
		1995-96	N/A	99.84	N/A	N/A	N/A	N/A
		1996-97	20	97.68	233	0.01	12	130
		May-98	18	90.96	20	0.09	9	67
2.	25	1994-95	N/A	99.9	N/A	N/A	N/A	N/A
		1995-96	N/A	99.88	N/A	N/A	N/A	N/A
		1996-97	19	99.22	288	0.00	11	36
		May-98	17	99.65	10	0.00	2	2
3.	25	1994-95	N/A	99.63	N/A	N/A	N/A	N/A
		1995-96	N/A	99.86	N/A	N/A	N/A	N/A
		1996-97	22	99.60	302	0.00	11	19
		May-98	20	99.64	14	0.00	2	2
4.	25	1994-95	N/A	98.03	N/A	N/A	N/A	N/A
		1995-96	N/A	99.94	N/A	N/A	N/A	N/A
		1996-97	19	99.74	188	0.00	7	15
		May-98	19	98.64	10	0.01	3	10

Data: Generation and Co-ordination Department June 1998, N/A : Data not available

FUEL SUPPLY ARRANGEMENTS

The primary fuel is gas, which is imported via a pipeline, Backup high speed diesel (HSD) is delivered by tanker. Storage facilities on site amount to 2700 kilolitres

GENERATION ON GAS AND HSD IN 1996-97

Unit Nr	Units Generated (MWh)	
	Gas	HSD
1.	88,448	7,692
2.	64,767	7,178
3.	81,458/	4,075
4.	93,650	0

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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KORANGI TOWN GAS TURBINE POWER STATION

GENERATION STATISTICS

KORANGI GAS TURBINE POWER STATION

GENERATION STATISTICS FOR THE MONTH OF JULY 94 – JUNE 95

ITEM	UNITS	UNIT NO. 1	UNIT NO. 2	UNIT NO. 3	UNIT NO. 4	COMBINED
INSTALLED/ DERATED CAPACITY	MW	25-20/20 I.S.O.	25-20/20 I.S.O.	25-20/20 I.S.O.	25-20/20 I.S.O.	100-80/80 I.S.O.
a) GAS	KWH	56194900	73495000	66256100	66756000	262702000
b) OIL	KWH	3691600	549500	159200	2097300	6497600
c) TOTAL	KWH	59886500	74044500	66415300	68853300	269199600
AUX. CONSUMPT.	KWH	1900030	2349230	2107150	2184510	8540920
SENT OUT	KWH	57986470	71695270	64308150	66668790	260658680
REACTIVE UNITS GENERATED	KVARH	25751170	31839110	28558580	29606900	115755760
SCHEDULED/FORCED SHUTDOWN/HRS.	HRS-MIN	3432-36/370-01	4494-30/8-05	3857-0/32-15	4104-0/172-19	6116-25/–
NO. OF STARTS/NO. OF FORCED SHUTDOWN	NOS.	304/12	347/15	358/30	350/15	276/2
MAX. DEMAND	M.W.	20/5	20/5	20/12	21/5	82/05
LOAD/PLANT FACTORS	%	82.23/27.34	82.37/33.81	86.09/30.32	79.89/31.43	53.67/30.73
AVAILABILITY FACTOR	%	95.77	99.90	99.63	98.03	95.12
AUX. CONSUMPTION	%	3.17	3.17	3.17	3.17	3.17
a) GAS	MCF/CM	1012916	1315994	1193604	1199325	4721839
b) F.O.	M.TONS					
c) HSDO	LIT.	1595867	261268	73713	922242	2853090
d) LDO	LIT.					
a) GAS	CFT/KWH / SCF/KWH	18.02	17.90	18.01	17.96	17.97
b) F.O.	Kg/KWH					
c) HSDO	Lit/KWH	0.432	0.475	0.463	0.439	0.439
d) LDO	Lit/KWH					
HEAT RATE/ HEAT RATE	BTU/KJ KWH KWH	16986	17005	[illegible]	17009	17028/17586
THERMAL EFFICIENCY	%	20.09	20.06	19.94	20.06	20.04
a) GAS	Rs.	69875056.27	91230353.07	82961660.43	83274652.16	327341721.93
b) F.O.	Rs.					
c) HSDO	Rs.	9766706.04	1598960.16	451123.56	5644121.04	17460910.80
d) LDO	Rs.					
e) TOTAL	Rs.	79641762.31	92829313.23	83412783.99	88918773.20	344802632.73
a) GAS	Ps.	124.34	124.13	125.21	124.74	124.60
b) F.O.	Ps.					
c) HSDO	Ps.	264.56	290.98	283.36	269.11	265.72
d) LDO	Ps.					
e) AVERAGE	Ps.	132.98	125.36	125.59	129.14	128.09
COST OF FUEL PER KWH SENT OUT	Ps/KWH	137.34	129.47	129.70	133.37	132.28

CALORIFIC VALUES & AVERAGE COSTS
950 BTU/CFT ____ X ____ Rs./MCF
BTU/Lb ____ X ____ Rs./M.T.
34460 BTU/LIT ____ X ____ Rs./Lit.
Rs./Lit.

SUPERINTENDING ENGINEER
KORANGI GAS TURBINE POWER STATION

Forwarded to (M.D.A.) KESC
with compliments.
(CO-ORDINATION)/STAFF OFFICER TO M.D.(A)
CE/S.E.(KGC)KGTPS/GTM
ENGR.(KG)/S.E.K.G./O.E./SE.

REGISTRAR
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
(NEPRA)

THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

GENERATION STATISTICS FOR THE YEAR 1995-96

	ITEM		UNITS	UNIT NO.1	UNIT NO.2	UNIT NO. 3	UNIT NO. 4	
1.	INSTALLED/ ACTUAL CAPACITY		MW	25-20/20 I.S.O.	25-20/20 I.S.O.	25-20/20 I.S.O.	25-20/20 I.S.O.	
2.	UNITS GENERATED	a) GAS	KWH	86615800	86145100	54877000	47491100	285129000
		b) OIL	KWH	2564100	1776100	—	—	4340200
		c) TOTAL	KWH	99179900	87921200	54877000	47491100	289469200
3.	AUX. CONSUMT.		KWH	3345550	2965760	1851120	1601980	9764410
4.	UNIT SENT OUT		KWH	95834350	84955440	53025880	45889120	279704790
5.	REACTIVE UNITS GENERATED		KVARH	42647330	37806100	23597100	19561160	123611690
6.	RUNNING/FORCED SHUTDOWN/HRS.		HRS-MIN	5708-54/13-05	5496-12/9.48	3165-0/12-07	2961-06/4-24	65592.30
7.	NO.OF STARTS/NO.OF FORCED SHUTDOWN		NOS.	231/07	253/06	124/12	213/5	1671/30
8.	MAX/MIN. DEMAND		M.W.	20/05	20/05	21/5	20/10	78/-
9.	LOAD/PLANT FACTORS		%	86.86/45.91	79.98/40.70	82.56/25.90	80.19/21.98	53.84/-
10.	AVAILABILITY FACTOR		%	99.84	99.88	99.86	99.94	99.88
11.	AUX.CONSUMPTION		%	3.37	3.37	3.37	3.37	3.37
12.	FUEL CONSUMPTION	a) GAS	MCF/DM³	1756315	1557777	986309	854064	5154465
		b) F.O.	M.TONS					
		c) HSDO	LIT.	1116276	824783	—	—	1941059
		d) LDO	LIT.					
13.	FUEL CONSUMPTION/KG	a) GAS	CFS/KG KWH/KWH	18.17	18.08	17.97	17.98	18.07
		b) F.O.	KG/KWH					
		c) HSDO	LIT/KWH	0.435	0.464	—	—	0.44
		d) LDO	LIT/KWH					
14.	GROSS HEAT RATE/ NET HEAT RATE		BTU/KJ KWH KWH	17210	17155	17074	17084	17147
15.	THERMAL EFFICIENCY		%	19.82	19.89	19.98	19.97	19.89
16.	FUEL COST	a) GAS	Rs.	14904004692	13216192297	84324330.50	73012430.25	435536957
		b) F.O.	Rs.					
		c) HSDO	Rs.	7723691.06	5840099.90	—	—	13563790
		d) LDO	Rs.					
		e) TOTAL	Rs.	15676373798	13800202290	84324330.50	73012430.25	452102532
17.	FUEL COST PER U. G.	a) GAS	Ps.	154.26	153.41	153.66	153.73	153.80
		b) F.O.	Ps.					
		c) HSDO	Ps.	301.22	328.81	—	—	312.59
		d) LDO	Ps.					
		e) AVERAGE	Ps.	158.05	156.96	153.66	153.73	157.00
	COST OF FUEL PER UNITS SENT OUT		Ps/KWH	163.57	162.44	159.02	159.10	162.00

C/VALUES & AVERAGE COSTS

- GAS 950 BTU/CFT = _____ Rs./MCF
- F.O. _____ BTU/Lb = _____ Rs./M.T.
- HSDO 34460 BTU/LIT = _____ Rs./Lit.
- _____ = _____ Rs./Kat.

SUPERINTENDING ENGINEER
KORANGI GAS TURBINE POWER

C.E.(P.&D.) with compliments,
D.G.E.(CO-ORDINATION)/STAFF OFFICER TO M.D.(A)
A/CCOS/S.E.(ENC)KTPC/DPM
EXTY.ENGR.(KG)/S.E.K.G/S.E./MP.
C.O.*/KTPS*

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED

GENERATION STATISTICS FOR THE YEAR OF 1996~1997 July June

ITEM	UNITS	UNIT NO.1	UNIT NO.2	UNIT NO. 3	UNIT NO. 4	
INSTALLED/ ACTUAL CAPACITY	MW	25-20/20 I.S.O.	25-20/20 I.S.O.	25-20/20 I.S.O.	25-20/20 I.S.O.	[illegible]
2. UNITS GENERATED a) GAS	KWH	88448100	64767400	81457600	93650100	328327200
b) OIL	KWH	7691500	7177900	4075200	—	18944600
c) TOTAL	KWH	96139600	71945300	85532800	93650100	347271800
3. AUX.(CONSUMT.	KWH	3369090	2526350	1301350	3300830	12297420
4. UNIT SENT OUT	KWH	92770510	69418950	82519650	90349270	335058380
5. REACTIVE UNITS GENERATED	KVARH	41340028	30936479	36779104	40269543	149325154
6. RUNNING/FORCED SHUTDOWN/HRS.	HRS-MIN	5603-06/129-56	4644-07/136-17	4721-49/19-05	5801-18/15-20	7110-42/ 8-10
7. NO.OF STARTS/NO.OF FORCED SHUTDOWN	NOS.	233/12	288/11	302/11	188/7	136/4
8. MAX/MIN. DEMAND	M.W.	20/5	19/10	22/10	19/5	80/10
9. LOAD/PLANT FACTORS	%	85.79/43.90	81.54/32.85	78.99/39.06	84.96/42.76	61.05/39.64
10. AVAILABILITY FACTOR	%	97.68	99.22	99.60	99.74	99.89
11. AUX.CONSUMPTION	%	3.50	3.51	3.52	3.52	3.54
12. CONSUMPTION a) GAS	MCF/DM	1551218	1187190	1424649	1637980	5751037
b) F.C.	M.TONS					
c) HSDO	LIT.					
d) LDO	LIT.	3387084	3292662	1720227	—	8399973
13. FUEL CONSUMPTION a) GAS	CFT/M3 KWH/KWH	17.54	17.56	17.49	17.49	17.52
b) F.C.	Kg/KWH					
c) HSDO	Lit/KWH	0.440	0.459	0.422		
d) LDO	Lit/KWH					0.443
14. GROSS HEAT RATE/ NET HEAT RATE	BTU/KJ KWH KWH	16542/17143	16593/17197	16516/17120	16166/17223	16566/17170
15. THERMAL EFFICIENCY	%	20.63	20.57	20.66	21.11	20.61
FUEL COST a) GAS	Rs.	152386988.89	111416641.56	140891293.39	164458790.77	569153714.56
b) F.C.	Rs.					
c) HSDO	Rs.					
d) LDO	Rs.	32883998.47	32055290.77	16630648.16	—	81569937.40
e) TOTAL	Rs.	185270987.31	143471932.33	157521941.55	164458790.77	650723651.96
COST PER U.G. a) GAS	Ps.	172.29	172.03	172.96	175.64	173.23
b) F.C.	Ps.					
c) HSDO	Ps.	427.54	446.58	408.09	—	430.57
d) LDO	Ps.					
e) AVERAGE	Ps.	192.71	199.42	184.17	175.64	187.38
COST OF FUEL PER UNITS SENT OUT	Ps/KWH	199.71	206.68	190.89	182.06	194.21

C/VALUES & AVERAGE COSTS

GAS	950 BTU/CFT	98.97 Rs./MCF	
F.C.	BTU/Lb	Rs.M.T.	
HSDO	34460 BTU/LIT	9.71 Rs./Lit.	
		Rs./Lit.	

SUPERINTENDING ENGINEER
KORANGI GAS TURBINE POWER STATION

M.D.A.(M.D.A.)
C.E.G. with compliments.
C.E.(CO-ORDINATION)/STAFF OFFICER TO M.D.(A)
A/DCOP/S.E.(E&C)KTPS/TPM
EFFY.ENGR.(KG)/S.E.K.G./S.E./MF.
E/KTGTPS

REGISTRAR (NEPRA)

The Karachi Electric Supply Cor.
KORANGI TOWN GAS TURBINE POWER STATION

GENERATION STATISTICS FOR THE MONTH OF JULY-97 ~ JUNE-98

ITEM		UNITS	UNIT NO. 1	UNIT NO. 2	UNIT NO. 3	UNIT NO. 4	UNIT NO.	COMBINED
Installed/ Actual capacity		MW	20/19	20/19	[illegible]	20/20		80/74
Units Generated	a) Gas	KWH	70567100	62560100	[illegible]	72967500		265360600
	b) Oil	KWH	2422200	2682900	[illegible]	—		[illegible]
	c) Total	KWH	72989300	65243000	72680500	72967500		[illegible]
Aux. Consumption		KWH	2783620	2493200	2771840	2782790		[illegible]
Units Sent Out		KWH	70205680	62759800	69908660	70184710		[illegible]
Reactive Units Generated		KVARH	31385390	29054470	31252600	31376000		[illegible]
Running/Forced Outages		HRS MINS	7578-43/205-03	4322-56/5-11	4178-19/2-38	4508-54/10-07		[illegible]
No. of Shutdowns Planned/Forced		Nos.	201/21	270/5	291/2	177/15		[illegible]
Max/Min Demand		MW	19/10	19/10	21/5	20/07		[illegible]
Load Factor		%	[illegible]/42.23	79.43/37.75	82.83/42.06	80.91/42.22		[illegible]
Availability		%	97.61	99.93	99.96	99.88		99.97
Aux. Consumption		%	3.81	3.81	3.81	3.81		3.81
Fuel Consumed	a) Gas	MCF/Dm³	1253943	1106330	1045330	1292290		4695864
	b) F.O.	M. Tons						
	c) HSDO	Ltr.	1099325	1260515	5733322	—		8093162
	d) LDO	Ltr.						
Fuel Consumption	a) Gas	Cft./M³ KWH/KWH	17.76	17.68	17.60	17.61		17.69
	b) F.O.	Kg/KWH						
	c) HSDO	Ltr./KWH	0.452	0.469	0.427	—		[illegible]
	d) LDO	Ltr./KWH						
Heat Rate		BTU/KJ KWH/KWH	16839	16774	16355	16824		[illegible]
Plant Efficiency		%	20.26	20.34	20.86	20.28		[illegible]
Fuel Cost	a) Gas	Rs.	139620998.08	123258870.84	116241901.89	143973947.53		[illegible]
	b) F.O.	Rs.						
	c) HSDO	Rs.	10619479.50	12176574.90	55383890.53	—		[illegible]
	d) LDO	Rs.						
	e) Total	Rs.	150310477.58	135435445.72	171625792.42	143973947.53		601345663.2[illegible]
Fuel Cost per KWH	a) Gas	Ps.	197.95	197.02	196.45	197.31		197.15
	b) F.O.	Ps.						
	c) HSDO	Ps.	438.42	453.85	412.86	—		422.14
	d) LDO	Ps.						
	e) Average	Ps.	205.93	207.58	236.13	197.31		211.23
Cost (fuel) Sent Out		Ps/KWH	214.10	315.81	245.50	205.13		220.[illegible]

C. V. VALUES & AVERAGE COSTS

1	GAS — 920 BTU/Cft	KJ/m3	Rs./MCF
2	F.O. — BTU/Lb	KJ/Kg	Rs./M.T.
3	HSDO — 24410 BTU/Ltr	KJ/Ltr	Rs./Ltr.
4	LDO — BTU/Ltr	KJ/Ltr	Rs./Ltr.

CONVERSION TABLE

1 Kg	= 2.205 Lbs.	1 Lb	=	[illegible]	[illegible]
1 Km³	= 35.31 Cft.	1 Cft	=	[illegible]	[illegible]
1 BTU	= 1.070 KJ	1 KJ	=	[illegible]	[illegible]

To

CHIEF ENGINEER (GENERATION & SERVICES)

CC: (C) [illegible]

DCEK / CONT / CCO

SE (E&C) / SE (O) / Ch. Engr. (SS-WW) (KTPS)

S.E./O.C.D.

POWER STATION SUPERINTENDING ENGINEER
KORANGI TOWN GAS TURBINE POWER STATION, KESC

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

The Karachi Electric Supply Corporation Limited

K.T.C.T. POWER STATION

GENERATION STATISTICS FOR THE MONTH OF JULY-1998 ~ JUNE-1999

S.	ITEM		UNITS	UNIT NO. 1	UNIT NO. 2	UNIT NO. 3	UNIT NO. 4	UNIT NO. COMBINED	COMBINED
1.	Installed/ Actual capacity		MW	20/17	20/18	20/20	20/20	80/75	
2	Units Generated	a) Gas	KWH	51076800	50829100	55857500	75160400	232923800	
		b) Oil	KWH	1516900	1368100	1743700	–	4628700	
		c) Total	KWH	52593700	52197200	57601200	75160400	237552500	
3.	Aux. Consumption		KWH	2262060	2244010	2500			
4.	Units Sent Out		KWH	50331640	49903190	55100			
5.	Reactive Units Generated		KVARH	22615300	22444790	24768520	32318480	102147	
6.	Running/Forced Shutdown HRS		HRS-MINS	3632-48/1169-50	3607-12/341-31	3479-36/	4692-04/49-49	6272-36/18-46	
7.	No. of Shutdowns Total/Forced		Nos.	118/05	226/24	211/10	253/10	177/05	
8.	Max/Min: Demand		MW	17/10	18/05	20/0	20/10	71/05	
	Load/Plant Factors		%	85.16/30.02	80.39/29.79	82.77/32.52	79.77/42.70	5334/33.70	
	Availability Factor		%	86.65	96.10	88.90	99.43	99.79	
9.	Aux. Consumption		%	4.30	4.40	4.34	4.46	4.38	
10.	Fuel consumption.	a) Gas	MCF/Om3	923874	917618	1004859	1355937	4202288	
		b) F.O.	M. Tons						
		c) HSDO	Lit.	608164	659501	707545	–	1975210	
		d) LDO	Lit.						
13.	Fuel consumption U.G.	a) Gas	Cft/MJ KWH/KWH	18.09	18.05	17.99	18.04	18.04	
		b) F.O.	Kg/KWH						
		c) HSDO	Lit/KWH	0.401	0.482	0.406	–	0.421	
		d) LDO	Lit/KWH						
14.	Gross Heat Rate/ NET HEAT RATE		BTU/KJ KWH/KWH	17086/17554	17134/17924	16996/17726	17138/17938	17091/17875	
15.	Plant Efficiency		%	19.97	19.92	20.08	19.91	19.97	
16.	Cost of Fuel	a) Gas	Rs.	102885222	102188786	1.19042	151000917	467979139	
		b) F.O.	Rs.						
		c) HSDO	Rs.	5718841	6556440	6877957	–	19407236	
		d) LDO	Rs.						
		e) Total	Rs.	108604063	108745226	1877677	151000917	487386477	
17.	Cost of Fuel/ U.G	a) Gas	Ps.	201.43	201.04	200.39	200.90	200.91	
		b) F.O.	Ps.						
		c) HSDO	Ps.	349.15	479.24	394.10	–	419.28	
		d) LDO	Ps.						
		e) Average	Ps.	206.49	208.34	206.20	200.90	205.17	
	Cost of fuel/ Unit Sentout		Ps/KWH	216.29	217.91	215.56	210.28	214.57	

C / VALUES & AVERAGE COSTS

1. GAS	BTU/Cft	KJ/m3	Rs /MCF
2. F.O.	BTU/Lb	KJ/Kg	Rs /M.T.
3. HSDO	BTU/Lit	KJ/Lit	Rs./Lit.
4. LDO	BTU/Lit	KJ/Lit	Rs /Lit.

CONVERSION TABLE

1 Kg	= 2.205 Lbs	1 Lb	= 0.4536	Kg.
1 Km³	= 35.31 Cft	1 Cft	= 0.0283	m³
1 BTU	= 1.076 KJ	1 KJ	= 0.948	BTU

To :

CHIEF ENGINEER (GENERATION & SERVICES)

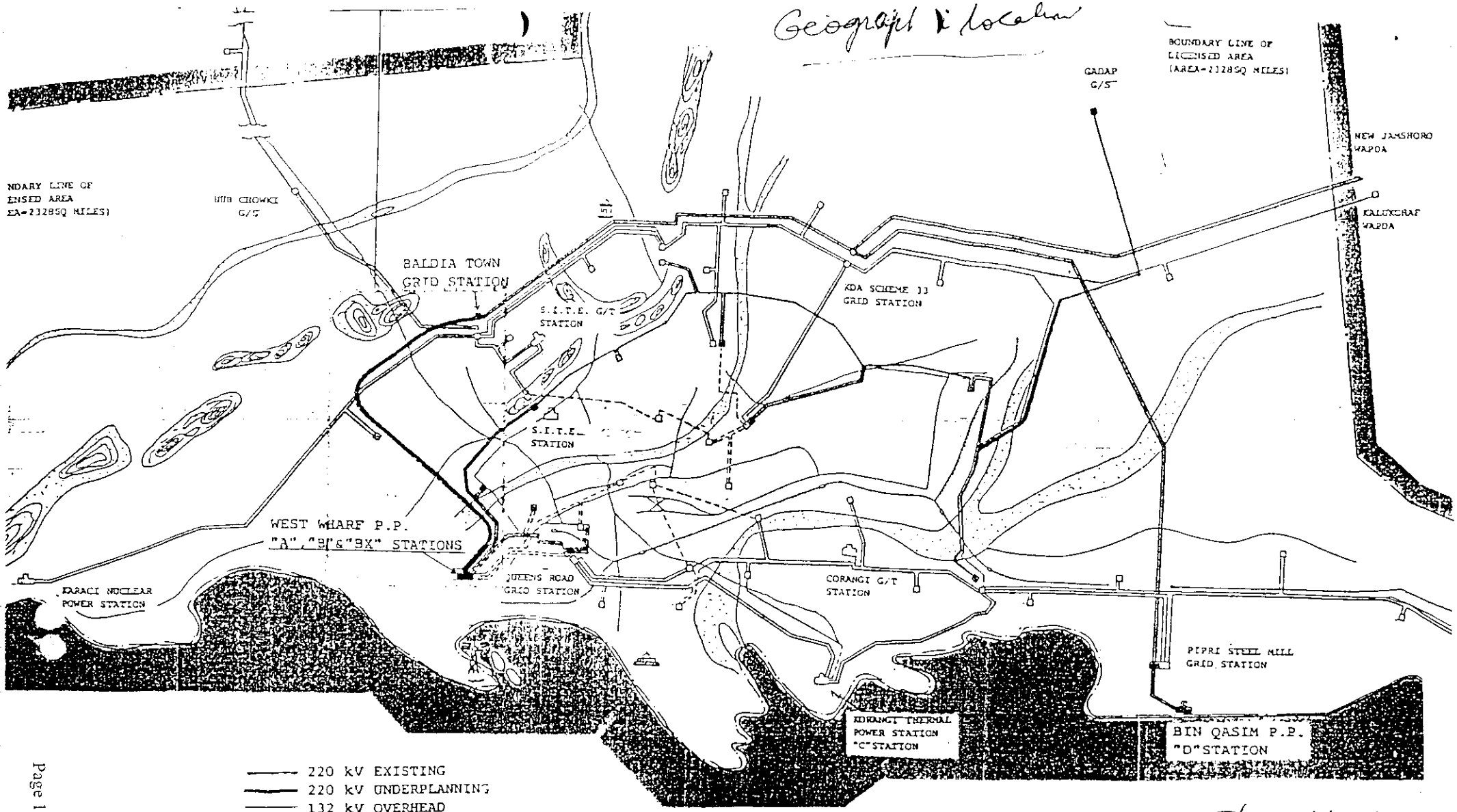
CC:- CCE (CO ORDINATION)
CC DCEK / COM / CCOF
CC:- SE (E&C) / SE (O)/ Elty. Engr (SS-WW) (KTPS)

S.E./O.C.E. POWER STATION

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

S.I.T.E. GAS TURBINE POWER STATION

LOCATION
&
SITE PLAN

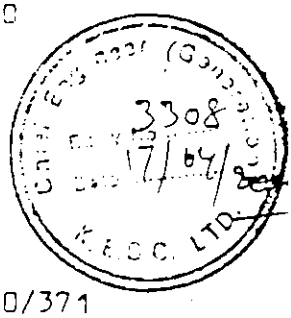


S.I.T.E. GAS TURBINE POWER STATION

PLANT DETAILS

Ref.No: SGTPS/1.03/2000/ 222

Date : 17 - APRIL-2000



CHIEF ENGINEER (GEN):

Subject: Generation Licence

With reference to the NEPRA Letter No. SECK/EL/00/371 dated 06.4.2000. Please find the following information concerned to SGTPS under the heading of Schedule-III.

(b) Existing Generation Facilities (Gas Turbine Thermal):

1. Location maps, site map -

As per drawing enclosed.

2. Technology, number of Units -

Gas Turbine G.E. Frame size 5 PG-5341. Heavy duty Gas Turbines Hitachi Ltd. Japan, 5 Units.

3. Fuel : type, imported/indigenous, suppliers, logistics, pipeline etc.

Natural Gas & High Speed Diesel Oil.

i) Gas from Sui Southern Gas Co. by Pipeline.
ii) HSDO from Caltex, Shell, P.S.O. by tankers.

4. Emission Values -

Not available.

5. Cooling water source, Tube wells, sea/river/canal.

Cooling system is closed system. Condensate cooling water arranged by Truck lorry from K.T.P.S. as & when required.

6. Interconnection with national grid company, distance and name of nearest grid voltage level (single line diagram) -

Drawing enclosed.

7. Install capacity, derated capacity, expected remaining life -

Install capacity at Base Load
5x19.59 MW = 98 MW on Gas at 40°C.

Derated capacity - 87 MW

Expected remaining life - 4 to 5 years.

8. Due diligence report -

Not available.

9. Rehabilitation plans, previous rehabilitation programme. -

No rehabilitation programme, only Top Turn mocification of Generators carried in Units 1, 2, 3 & 5.

10. Operational record including environmental monitoring data for the last five years, constraints in despatching. -

Five years Generation Statistic sheets enclosed.

Environmental monitoring is not available.

11. Project cost, information regarding sources and amounts of equity and debt. -

Total Project Cost = RS. 673863365.31

12. Plant characteristics, generation voltage, frequency, power factor, automatic generation control, ramping rate, alternative fuel, auxiliary consumption time(s) required to synchronize to grid. -

Plant characteristic enclosed.

Generation voltage	:	11.5 KV
Frequency	:	50 Hz.
Power Factor	:	0.8
Automatic generation control	:	N/A
Ramping rate	:	4 MW/min.
Alternative fuel	:	H.S.D.O.
Auxiliary consumption	:	2.6 %

13. Training and development -

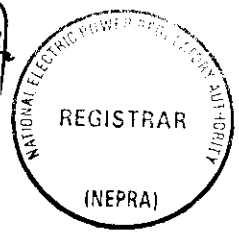
Most of the engineers working at Power plant been trained in Japan.

(MUHAMMAD JAMIL)
DEPUTY CHIEF ENGINEER
S.I.T.E. GAS TURBINE POWER STATION
PHONE-2578978

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

S.I.T.E. GAS TURBINE POWER STATION

PLANT CHARACTERISTICS



1.0 Generation Assets :

1.1 Contacts

a. S.I.T.E. Gas Turbine Power Station

b. Deputy Chief Engineer
S.I.T.E. Gas Turbine Power Station
KESC Ltd.
Address :
F-255 S.I.T.E. , Karachi.
Telephone # 2578978 & 2580323
Fax # 2580323

1.2 Technical Details

a **Total Installed Capacity.**

5 x 25 / 20 MW = 125 / 100 MW

b **Gas Turbine**

GE Frame Size 5 PG5341, Heavy Duty Gas Turbine
Hitachi Ltd.
Japan

Generator

27 MVA
Model EFBZ-LA-K
Hitachi Ltd.
Japan.

Transformer

30 MVA
Hitachi Ltd.
Japan.

c **Black Start**

Unit 1 and 2
2 x 25/20 = 50 / 40 MW

d **History**

Generator Top Turn Modification of Unit # 1,2,3 & 5

e **Technical Details Of HV Installation.**

As per drawing.

f **Generation / Transmission Voltage**

11.5 / 132 KV

g **Planned Upgradation / Rehabilitation.**

Generator Top Turn Modification of Unit # 4

h **Environmental Requirements**

Clean / dust free air

i **Stacks**

Stacks = 5 Nos
Height = 10 8 M

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

1.3 PERFORMANCE

a. Availability

Unit	1998-99	1997-98	1996-97	1995-96	1994-95
1	94.45	95.10	93.10	65.23	83.65
2	86.42	82.10	92.10	95.18	96.30
3	97.92	94.10	91.10	94.21	96.08
4	88.71	91.10	91.10	95.10	96.17
5	-	-	-	-	-

b. Electrical Out Put :

Unit	1998-99		1997-98		1996-97	
	Gross	Net	Gross	Net	Gross	Net
1	66609900	64204900	72079700	69858949	83434900	80994060
2	71550300	68966377	50117500	48573397	68558300	66582100
3	41530600	40030790	61829200	59924263	65825700	63914070
4	29893600	28814041	63089900	61146121	63834100	61968170
5	-	-	-	-	-	-

Unit	1995-96		1994-95	
	Gross	Net	Gross	Net
1	42658200	41238700	25205300	24283450
2	72817760	70394605	89487300	86260124
3	60852700	58827757	69140440	68727228
4	62878000	63685835	73442300	70822798
5	-	-	-	-

c. No. Of Operation Hours (as on 31. 03. 2000)

Unit	Hours
1	61670.8
2	69095.2
3	44752.8
4	57504.6
5	29386.7

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

1.4 OPEREATION

a. Routine Spares

Planning for procurement of spares for 2 years

b. Source of Spares

Average 1 year

c. Operation Cost.

YEAR	Ps / KWH
July 98 – June 99	221.45
July 97 - June 98	244.77
July 96 - June 97	237.60
July 95 – June 96	184.32
July 94 – June 95	129.41

Fuel & Lube Oil

Fuel

Gas
High Speed Diesel Oil

Lube Oil

T – 32 (Turbine Oil)

Contractor

Hire for Units Overhaul (Due to shortage of staff)

d. Heat Rate

	GAS	HSDO
Designed	12245 Btu/kwh	12385Btu/kwh
Commn	12965 Btu/kwh	13110 Btu/kwh

	COMBINED
July 1998 – June 1999	16316 Btu/kwh

e. Capacity of the Station

Current Net / Gross (MW)

88 125

f. Capacity Of Units (MW)

Unit	Design	Comm.	Current
1	25	20.74	18.5
2	25	20.74	20.5
3	25	20.74	18.5
4	25	20.74	17.0
5	25	20.74	19.5

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

1.5 MAINTENANCE

a. Details of Cost

Major maintenance work done during last five years

1. Re-commissioning of Unit # 3
2. Bulk Painting Work
3. Major Overhauling of Unit # 1
4. Major Overhauling & Generator Top Turn Modification of Unit # 5

b. Details of Maintenance Programs

1 Combustion Inspection 2 days

2 HGP Inspection 20 days

3 Major Overhauling 30 days

4 Gas Compressor Overhauling 20 days

5 Generator Overhauling & Top Turn Modification 40 days

1.6 FUEL

a. Main & Backup Fuel

i. Natural Gas
From Sui Southern Gas Company by pipe line.

ii Diesel
From PSO, Caltax, Shell by truck lorry.

b. Fuel Handling facility

i. **Natural Gas**

Supplied by SSGC through 12" pipeline
Direct feeding to machine by compressor

ii. **Diesel**

Facilitate with 2 set of unloading pumps skid 2 day tank of 7000 BBL capacity each.

c. Fuel Cost

Natural Gas	Rs. 138.01 / mcf
Diesel	Rs. 12.78 / Liter

d. Alternate Fuel

HSDO

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

e. **Fuel Consumption at each Source**

Unit	1998-99		1997-98		1996-97	
	Gas (MCF)	HSDO (L)	Gas (MCF)	HSDO (L)	Gas (MCF)	HSDO (L)
1	1080546	1333507	1006511	5204464	1006890	10235868
2	1199517	148128	815201	663249	761897	10423412
3	671893	743820	1028375	594410	872137	6606633
4	499504	259392	820301	6052652	695851	9921102
5	-	-	-	-	-	-

Unit	1995-96		1994-95	
	Gas (MCF)	HSDO (L)	Gas (MCF)	HSDO (L)
1	756840	231253	392526	1801725
2	994313	6884237	1471630	549911
3	915008	3382899	1123138	409310
4	717835	8486940	1076688	3424435
5	-	-	-	-

1.7 SITE & INTERCONNECTION

a. **Site Plans** As per drawing

b. **Planned Upgrade** Nil

b. **Single Line Diagram** Drawing Attached

c. **Source & Availability of Water** S.I.T.E. Association & also from Tankers

d. **Water Quality** Potable Water

e. **Water Treatment at Site** Nil

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

S.I.T.E. GAS TURBINE POWER STATION

EMISSION VALUES

THE PLANT IS OLD
EMISSION & IMMISSION EQUIPMENT
NOT INSTALLED.

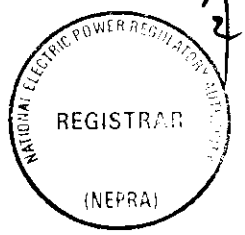
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

S.I.T.E. GAS TURBINE POWER STATION

SINGLE LINE ELECTRICAL DIAGRAM

S.I.T.E. GAS TURBINE POWER STATION

DUE-DILIGENCE REPORT



A.6 SITE GAS TURBINE POWER STATION

A.6.1 SUMMARY

Following the development of the Sindh Industrial Trading Estate (SITE) in the 1960's and the preparation of a power development plan by KESC in 1977, the SITE gas turbine power station was developed in 1978-9. Three units were commissioned in 1979 and two in 1980, with all units entering commercial operations in February 1980. The station still has an installed capacity of 125 MW at ISO conditions (5 GE Frame 5 gas turbine generators), each unit having a design rating at ISO conditions of 25 MW and a site rating of approximately 20MW when new and clean.

The station normally operates as peaking plant, but at the time of the visit, which was in the height of the summer season, that plant was operating at base load to compensate for deratings at the Bin Qasim and Korangi Thermal stations. The installed and current declared unit gross capacities are as listed in Table A6.1. The gross capacity of Unit 5 was 20.5 MW when it was last operated.

TABLE A6.1 SITE GAS TURBINE POWER PLANT -BASIC EQUIPMENT DATA

Unit Nr	Year Commissioned	Gross Capacity (MW)			Operating Hours (to June 1998)	Manufacturer
		ISO	Commissioned	June 1998		
1	1979	25	20.74	18.90	53,712	Hitachi (GE design)
2	1979	25	20.74	20.50	59,881	Hitachi (GE design)
3	1980	25	20.74	18.05	38,816	Hitachi (GE design)
4	1980	25	20.74	17.09	53,235	Hitachi (GE design)
5	1980	25	20.74	-	27,386	Hitachi (GE design)
Total						

Data: Generation and Co-ordination Department June 1998

The units are being refurbished and upgraded by Hitachi, including modifications to the generator rotor At the time of Mott MacDonald's visit, the upgrade on Units 1, 2 and 3 had been completed. Unit 5 has been out of service since November 1989 because of damage to the turbine rotor.

The units are normally run on gas, with high speed diesel (HSD) as backup fuel. There is a pipeline for the gas but the HSD is delivered to site by road tankers. HSD is stored on site in two tanks with a combined capacity of 2500 kilolitres.

The station is managed by a Deputy Chief Engineer, under the authority of the Chief Engineer for SITE. Site staff are divided into three teams plus an efficiency engineer:

- Electrical and instrument maintenance
- Mechanical maintenance
- Operations

There is a sanctioned staff of 117, of which 91 posts are currently filled.

There is no monitoring of emissions, nor any treatment of effluent. Stack heights are 10.8 metres.

A.6.2 PLANT DESCRIPTION

I) TURBINES

The gas turbines are all of the GE Frame 5 PG 5341 type, with technical details as outlined in Tables A6.2 and A6.2. Natural gas is the primary fuel, with high speed diesel as backup.

TABLE A6.2 SITE GAS TURBINE POWER PLANT - TURBINE DESIGN DATA

Category	Technical Details
Turbine stages (nr)	2
Compressor stages (nr)	17
Speed (rpm)	5100
Inlet pressure (kg sq cm abs)	1.033
Inlet temperature (deg C)	40
Base load (MW)	19.5
Peak load (MW)	21.18

Data: Generation and Co-ordination Department June 1998

II) ELECTRICAL SYSTEMS AND INTERCONNECTION

Generation is at 11.5 kV with transformation to 132 kV for transmission. Generation can be in either frequency control mode or load control mode and automatic voltage regulation is available for the control of reactive power.

Output is metered as gross generation and auxiliary consumption to derive net output. However, there are no check meters, nor has there been any calibration of the meters.

Black start is available on Units 1 and 2.

III) GENERATORS AND GENERATOR TRANSFORMERS

TABLE A6.3 GENERATOR AND GENERATOR TRANSFORMER DESIGN DATA

Unit	Generator Transformer			Generator			
	Manufacturer	Rating		Manufacturer (Type)	Capacity (MVA)	Terminal Voltage	Cooling Media
		MVA	kV				
1	Hitachi, Japan	30	11.5/132	Hitachi, Japan (EFBZ I.A K)	27	N.A	N.A
2	Hitachi, Japan	30	11.5/132	Hitachi, Japan (EFBZ I.A K)	27	N.A	N.A
3	Hitachi, Japan	30	11.5/132	Hitachi, Japan (EFBZ I.A K)	27	N.A	N.A
4	Hitachi, Japan	30	11.5/132	Hitachi, Japan (EFBZ I.A K)	27	N.A	N.A
5	Hitachi, Japan	30	11.5/132	Hitachi, Japan (EFBZ I.A K)	27	N.A	N.A

Data: Generation and Co-ordination Department June 1998

A.6.3 PLANT PERFORMANCE

TABLE A6.4 SITE GAS TURBINE POWER PLANT -UNIT OPERATION 1994 TO 1998

Unit No.	Installed Capacity (MW)	Period	Maximum Load (MW)	Operating Hours	Total Units Generated (MWh)	Auxiliary Consumption (%)	Power Factor
1	20.74	1994-95	N/A	N/A	25,205	3.66	N/A
		1995-96	N/A	N/A	42,658	3.33	N/A
		1996-97	21.3	4,330	83,435	2.93	0.88
		May-98	N/A	N/A	N/A	N/A	N/A
2	20.74	1994-95	N/A	N/A	89,487	3.61	N/A
		1995-96	N/A	N/A	72,818	3.33	N/A
		1996-97	21	3,845	68,558	2.88	0.89
		May-98	N/A	N/A	N/A	N/A	N/A
3	20.74	1994-95	N/A	N/A	69,140	0.60	N/A
		1995-96	N/A	N/A	60,854	3.33	N/A
		1996-97	21	3,682	65,826	N/A	0.86
		May-98	N/A	N/A	N/A	N/A	N/A
4	20.74	1994-95	N/A	N/A	73,442	3.57	N/A
		1995-96	N/A	N/A	65,878	3.33	N/A
		1996-97	20	3,620	63,834	2.92	0.85
		May-98	N/A	N/A	N/A	N/A	N/A
5	20.74	1994-95	0	0	0	-	-
		1995-96	0	0	0	-	-
		1996-97	0	0	0	-	-
		May-98	0	0	0	-	-

Data: Generation and Co-ordination Department June 1998, N/A: Data not available

TABLE A6.5 SITE GAS TURBINE POWER PLANT - UNIT PERFORMANCE 1994 TO 1998

Unit No	Installed Capacity (MW)	Period	Maximum Load (MW)	Average Load (MW)	Load Factor	Capacity Factor	Availability Factor
1	20.74	1994-95	N/A	N/A	N/A	N/A	0.84
		1995-96	N/A	N/A	N/A	N/A	0.65
		1996-97	21.3	18	0.89	0.46	0.93
		May-98	N/A	N/A	N/A	N/A	N/A
2	20.74	1994-95	N/A	N/A	N/A	N/A	0.96
		1995-96	N/A	N/A	N/A	N/A	0.95
		1996-97	21	18	0.85	0.35	0.92
		May-98	N/A	N/A	N/A	N/A	N/A
3	20.74	1994-95	N/A	N/A	N/A	N/A	0.96
		1995-96	N/A	N/A	N/A	N/A	0.94
		1996-97	21	18	0.85	0.35	0.91
		May-98	N/A	N/A	N/A	N/A	N/A
4	20.74	1994-95	N/A	N/A	N/A	N/A	0.96
		1995-96	N/A	N/A	N/A	N/A	0.95
		1996-97	20	18	0.85	0.35	0.91
		May-98	N/A	N/A	N/A	N/A	N/A
5	20.74	1994-95	0	0	0	0	-
		1995-96	0	0	0	0	-
		1996-97	0	0	0	0	-
		May-98	0	0	0	0	-

Data: Generation and Co-ordination Department June 1998, N/A: Data not available

52

The units, with the exception of Unit 5, have given reliable service as peaking plants. The modifications to the generator rotors should assist in reliable operation. However, more extensive investigations and replacement of significant parts will be required to extend the life since the units have been in service for almost 20 years.

The statistics show that auxiliary consumption is according to what might be expected for such units - 2 to 3 per cent is typical for open cycle gas turbines. The operating hours indicate a peaking role during the winter with some baseload during the summer months. Availability statistics are based on hours of availability only, rather than being corrected for any derating.

The units are ramped up at a rate of up to 4 MW per minute

TABLE A6.6 SITE GAS TURBINE POWER PLANT - UNIT EFFICIENCIES

Unit No.	Commissioning Date	Installed Capacity (MW)	Heat Rate (LHV)		Period	Heat Rate (HHV)		
			Design	Commissioning		Gross	Net	Degradation since commissioning (%)*
1	1979	20.74	12,245	12,965	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	15,878	16,354	11
					May-98	N/A	N/A	N/A
2	1979	20.74	12,245	12,965	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	15,965	16,444	12
					May-98	N/A	N/A	N/A
3	1979	20.74	12,245	12,965	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	16,251	16,738	14
					May-98	N/A	N/A	N/A
4	1980	20.74	12,245	12,965	1994-95	N/A	N/A	N/A
					1995-96	N/A	N/A	N/A
					1996-97	15,877	16,353	22
					May-98	N/A	N/A	N/A
5	1980	20.74	12,245	12,965	1994-95	-	-	-
					1995-96	-	-	-
					1996-97	-	-	-
					May-98	-	-	-

Data: Generation and Co-ordination Department June 1998
N/A: Data not available
Note: * 11 per cent allowed as an estimate of the difference between LHV and HHV, assuming commissioning on gas

TABLE A6.7 SITE GAS TURBINE POWER PLANT - OUTAGE RECORDS

Unit No.	Installed Capacity (MW)	Period	Maximum Load (MW)	Availability Factor	Starts (Nr)	Forced Outage Factor	Forced Outages (Nr)	Forced Outages (Hrs)
1	20.74	1994-95	N/A	0.84	N/A	N/A	N/A	N/A
		1995-96	N/A	0.65	N/A	N/A	N/A	N/A
		1996-97	21.3	0.93	N/A	N/A	N/A	N/A
		May-98	N/A	N/A	N/A	N/A	N/A	N/A
2	20.74	1994-95	N/A	0.96	N/A	N/A	N/A	N/A
		1995-96	N/A	0.95	N/A	N/A	N/A	N/A
		1996-97	21	0.92	N/A	N/A	N/A	N/A
		May-98	N/A	N/A	N/A	N/A	N/A	N/A
3	20.74	1994-95	N/A	0.96	N/A	N/A	N/A	N/A
		1995-96	N/A	0.94	N/A	N/A	N/A	N/A
		1996-97	21	0.91	N/A	N/A	N/A	N/A
		May-98	N/A	N/A	N/A	N/A	N/A	N/A
4	20.74	1994-95	N/A	0.96	N/A	N/A	N/A	N/A
		1995-96	N/A	0.95	N/A	N/A	N/A	N/A
		1996-97	20	0.91	N/A	N/A	N/A	N/A
		May-98	N/A	N/A	N/A	N/A	N/A	N/A
5	20.74	1994-95	0		N/A	N/A	N/A	N/A
		1995-96	0		N/A	N/A	N/A	N/A
		1996-97	0		N/A	N/A	N/A	N/A
		May-98	0		N/A	N/A	N/A	N/A

Data: Generation and Co-ordination Department June 1998
N/A: Data not available

TABLE A6.8 MAINTENANCE HISTORY

Unit Nr	Combustion Inspection	Hot Gas Pipe Inspection	Major Overhaul	
			Date	Comment
1	Annual	1983 (by GE)	1987 (by Alsthom) 1992 (by GE) 1995 (by Hitachi)	- - New rotor
2	Annual	1983 (by GE) 1989	1986 1990 1998 (by Hitachi)	Generator rotor mods
3	Annual	1985 (by GE) 1989	1993 (by Hitachi)	Generator rotor mods
4	Annual	1983	1990	
5	Annual	1985		

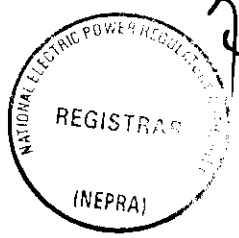
Data: Generation and Co-ordination Department June 1998

Modifications by Hitachi to the generator rotors for Units 4 and 5 are planned.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

S.I.T.E. GAS TURBINE POWER STATION

GENERATION STATISTICS



THE KARACHI ELECTRIC SUPPLY CORPORATION LIMITED
S.I.T.E. GAS TURBINE POWER STATION
(GENERATION STATISTICS)

Ref.No: SGTPS/3.02/95/3[illegible]
Date : 26 AUG. 1995.

PERIOD ...JULY-1994 - JUNE-1995

S.NO.	ITEMS		UNITS	UNIT-1	UNIT-2	UNIT-3	UNIT-4		COMBINED
1.	INSTALLED/ ACTUAL CAPACITY		M W	25-20/20 ISO	25-20/20 ISO	25-20/20 ISO	25-20/20 ISO	-	
2.	UNITS GENERATED.	GAS	K W H	20816850	87118270	68174800	6490780	-	125-100/60 [illegible]
		OIL	K W H	4329450	23C9030[illegible]	1015600	8535220	-	241017000
		TOTAL	K W H	25205300	[illegible]	69190400	73442300	-	16306380
3.	AUX. CONSUMPTION		K W H	521850	3227[illegible]	2463172	2619502	-	257325500
4.	UNITS SENT OUT		K W H	24283450	[illegible]	60727228	70822798	-	9231700
5.	REACTIVE UNITS GENERATED.		KVARH	24291300	[illegible]	39631100	42130900	-	248093600
6.	RUNNING/FORCED SHUT-DOWN/HOURS		HRS-MIN	2151.58	4701.[illegible]	3760.70	3979.38	-	154456800
7.	NO. OF SHUT DOWNS TOTAL / FORCED		NOs.	230	200/[illegible]	308/1	320/2	-	5419.70
8.	MAX/MIN. DEMAND		M W	16.5	21.30	21.60	21.50	-	1146/6
9.	LOAD / PLANT FACTOR		%	70.01	67.66	85.17	85.84	-	79/15
10.	AVAILABILITY FACTOR		%	83.65	96.30	96.08	96.17	-	60.10/21.5[illegible]
11.	AUX. CONSUMPTION		%	3.65	3.60	3.57	3.57	-	405
12.	FUEL CONSUMPTION.	a) GAS	MCF	392526	1471630	1123138	1076688	-	3.59
		b) F.O.	M.TONS	-	-	-	-	-	4063982
		c) HSDO	LITRES	1801725	945511	409310	3424435	-	-
		d) LDO	LITRES	-	-	-	-	-	6565381
13	FUEL CONSUMPTION/ U.G.	a) GAS	CFT/KWH	18.85	16.03	16.47	16.58		
		b) F.O.	KG/KWH	-	-	-	-		16.86
		c) HSDO	LIT/KWH	0.41	0.40	0.40	0.40	-	[illegible]
		d) LDO	LIT/KWH	-	-	-	-	-	0.40
14.	GROSS HEAT RATE		BTU/KWH	17257	15988	15624	15534	-	[illegible]
15.	PLANT EFFICIENCY		%	19.77	21.34	21.83	21.96	-	15824/16475
16.	COST OF FUEL	a) GAS	RS.	26603802.70	101580586.94	77843337.53	74737939.53	-	21.49
		b) F.O.	RS.	-	-	-	-	-	28[illegible]
		c) HSDO	RS.	11026557.00	5613433.32	2504952.72	20957566.65	-	-
		d) LDO	RS.	-	-	-	-	-	[illegible]
		TOTAL	RS.	37630359.70	1075[illegible]2.20	80348290.05	95695506.08	-	-
	COST OF FUEL/ U.G.	a) GAS	Ps.	127.80	116.60	114.18	115.15	-	[illegible]
		b) F.O.	Ps.	-	-	-	-		[illegible]
		c) HSDO	Ps.	251.26	245.39	246.65	245.54	-	-
		d) LDO	Ps.	-	-	-	-	-	[illegible]
		AVERAGE	Ps.	149.29	120.01	116.127	130.30	-	-
	COST OF FUEL / UNITS SENT OUT		Ps./KWH	154.96	124.50	120.41	135.12	-	124.77
									120.41

C/Values & Average Costs

1- Gas ---- BTU/CFT ---- KJ/M^3 ---- Rs./MCF
2- F.O. ------ BTU/LG. ---- KJ/Kg ---- Rs./M.T
3- HSDO ---- BTU/LIT -- KJ/Lit ---- Rs./Lit
4- LDO ------ BTU/LIT - KJ/Lit ------- Rs./Lit

1 Kg = 2.205 Lbs. 1 Lb. = 0.4536 Kg
1 M^3 = 35.31 CFT. 1 CFT = 0.0283 M^3
1 BTU = 1.076 KJ 1 KJ = 0.940 BTU

To: [illegible] - with compliments.
To: C.E.G.S. --do--

cc: [illegible]/E.E/C.E.
[illegible]

NOTE: 1) Unit-5 forced out from 18.5.89.
2) Heat Rate high due to partial load for Unit-1.

DY. CHIEF ENGINEER
SITE G.T.P.S.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Ref.No: SGTPS/3.02/[illegible]
Date : [illegible]

Month... July 1995 - June 1996

ITEMS		UNITS	UNIT # 1	UNIT # 2	UNIT # 3	UNIT # 4	UNIT # 5	COMBINED
INSTALLED/ ACTUAL CAPACITY		M W	25 20/1.5	25-24/125	25 [illegible]	25-24/100	[illegible]	125-100/[illegible]
UNITS GENERATED.	GAS	K W H	42163416	50348624	5265[illegible]276	45601633		[illegible]
	OIL	K W H	554784	16469076	8200[illegible]4	20276367	—	196+C5[illegible]
	TOTAL	K W H	42658200	72817700	608[illegible]00	65878000	—	4550[illegible]
AUX. CONSUMPTION		K W H	1419500	2423092	202[illegible]43	2192165		24326600
UNITS SENT OUT		K W H	41238700	70394608	588[illegible]757	63685835		8059[illegible]
REACTIVE UNITS GENERATED.		KVARH	22936200	40952700	35836100	38941500		2341[illegible]
RUNNING/FORCED SHUT-DOWN/HOURS		HRS-MIN	2325.97	4106.80	3385.05	3754.33		[illegible]
NO. OF SHUT DOWNS TOTAL / FORCED		NOs.	187/1	258	276/1	291		[illegible]
MAX/MIN. DEMAND		M W	20.[illegible]	21	21	20.6		[illegible]
LOAD / PLANT FACTOR		%	59.64	54.43	85.66	85.18		[illegible]
AVAILABILITY FACTOR		%	65.23	95.18	94.21	95.16		[illegible]
AUX. CONSUMPTION		%	3.33	3.33	3.33	3.33		3.33
FUEL CONSUMPTION.	a) GAS	MCF	756840	994313	915[illegible]08	791835		3463[illegible]
	b) F.O.	M.TONS	—			—		
	c) HSDO	LITRES	231253	6884237	338[illegible]899	8486940	—	1873532[illegible]
	d) LDO	LITRES	—	—		—		—
FUEL CONSUM.	a) GAS	CFT/KWH	17.98	17.65	17.38	17.50	—	17.61
	b) F.O.	KG/KWH	—	—		—		
	c) HSDO	LIT/KWH	0.42	0.42	0.41	0.42		0.42
	d) LDO	LIT/KWH	—		—			
GROSS HEAT RATE		[illegible]/KWH	17041	16229	16200	15944		1628[illegible]
PLANT EFFICIENCY		%	20.02	21.02	21.06	21.40		[illegible]
COST OF FUEL	a) GAS	RS.	64748471.33	84032002.56	77704174.68	67429652.09		2937[illegible]
	b) F.O.	RS.	—		—	—		
	c) HSDO	RS.	1710490.49	47788170.02	24093497.97	62064308.50		13765[illegible]
	d) LDO	RS.	—	—		—	—	—
	TOTAL	RS.	66458961.82	133826172.58	101797672.65	129493960.59		431570767.64
COST OF FUEL/ U.G.	a) GAS	Ps.	153.76	149.13	147.58	147.87	—	149.42
	b) F.O.	Ps.	—	—		—		
	c) HSDO	Ps.	308.32	302.31	29[illegible].81	306.09	—	302.54
	d) LDO	Ps.	—			—	—	
	AVERAGE	Ps.	155.79	183.77	167.29	196.57	—	178.78
COST OF FUEL / UNITS SENT OUT		Ps./KWH	161.16	190.10	173.04	203.33	—	18[illegible].32

Calorific Values & Average Costs

1- Gas 915/2	BTU/CFT ----	KJ/M³	[illegible]	Rs./MCF
2- F.O. ------	BTU/LB. ----	KJ/Kg	------	Rs./M.T
3- HSDO [illegible]	BTU/LIT ----	KJ/Lit	3.96	Rs./Lit
4- LDO ------	BTU/LIT ----	KJ/Lit	------	Rs./Lit

1 Kg = 2.205 Lbs. 1 Lb. = 0.4536 Kg
1 Km³ = 35.31 CFT. 1 CFT = 0.0283 M³
1 BTU = 1.076 KJ 1 KJ = 0.940 BTU

To: [illegible] with compliments.
To: C.E.G.S. --do--

cc: C.A/CCOF/DCEM/E.E/C.E.
D.C.E.(CC[illegible]) /C.[illegible]S.

REGISTRAR
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
(NEPRA)

DY. CHIEF ENGINEER
SITE G.T.P.S.

SITE GAS TURBINE POWER STATION
GENERATION STATISTICS
JULY 1996 - JUNE 1997

ITEMS	UNITS	UNIT-1	UNIT-2	UNIT-3	UNIT4	UNIT 4	COMBINED
INSTALLED CAPACITY	MW	25	25	25	25	25	125
ACTUAL CAPACITY	MW	20	20	20	20	20	100
UNITS GENERATED ON GAS	KWH	58 675 930	43 849 400	50,353 100	40 134 160	0	193,012,990
UNITS GENERATED ON F OIL	KWH						0
UNITS GENERATED ON HSDO	KWH	24 758 970	24 708 900	15,472 600	23 699 940	0	88,640,410
UNITS GENERATED ON LDO	KWH						0
UNITS GENERATED ON TOTAL	KWH	83 434 900	68 558 300	65 825 700	63 834 100	0	281,653,000
AUX CONSUMPTION	KWH	2 427 [illegible]	1 994,681	1 915 177	1 857 232	0	8,194,604
UNIT SENT OUT	KWH	81 007 389	66 563 619	63 910 523	61 976 868	0	273,458,400
REACTIVE UNITS	KVARH	44 000 300	36 042,400	38,776 800	39 081 100	0	157,930,600
Operating Hours	Hrs	4,542 90	3,846 00	3,882 60	3,620 20		6,872.30
Forced Shut Down Hours	Hrs						
Planned Shut Down Hours	Hrs						
Stand By Hours	Hrs					-	
Total Hours	Hrs					-	
NO OF STARTS	Nos						
Total Shut Down	Nos	0	0	0	0	0	0
Forced Shut Down	Nos						
MAXIMUM LOAD	MW	21 3	21	20.5	20	0	82.8
MINIMUM LOAD	MW	17 5	10	17.1	17 2		10
LOAD FACTOR	%	86.23	84.91	87.19	88.16	-	86.82
PLANT FACTOR	%	-			-	-	#VALUE!
AVAIL FACTOR	%	93 10	92.10	91 10	91.10	-	#VALUE!
POWER FACTOR		0 88	0 89	0.86	0.85	-	0.87
% AUX CONSUMTION	%	2 91	2 91	2 91	2 91	-	2.91
FUEL CONSUMP							
GAS	MCF	1 006,890	761,897	872,137	696,851	0	3,336,771
Furnace Oil	M TON						
HSDO	LITRE	10 236 868	10,423,412	6,606 633	9,921,102	0	37,187,915
LDO	LITRE						
FUEL CONSUMPTION / UG							
ON GAS	CFT/KWH	17 16	17 38	17 32	17 34	0 00	17.29
ON FUR OIL	KG/KWH						
ON HSDO	LIT/KWH	0 413	0 422	0 427	0 419	0 000	0.420
ON LDO	LIT/KWH						
GROSS HEAT RATE	BTU/KWH	15 878	15,905	16,251	15,877	#DIV/0!	15,984
NET HEAT RATE	BTU/KWH	16 354	16,444	16,738	16,363	#DIV/0!	16,466
HEAT RATE ON KVA BASIS	BTU/KVAH	14 042	14,132	14 002	13,541	#DIV/0!	13,944
THERMAL EFFICIENCY	%	21 50	21 38	21 00	21 50	#DIV/0!	21.35
COST OF GAS	Rs	100 386,933 00	75,961,130 80	86,952,058.90	69,376,344 70	0.00	332,676,467.30
COST OF FURNACE OIL	Rs						
COST OF HSDO	Rs	98,878,484 88	100,890,159 92	63,820,074 78	95,837,846.32	0.00	359,226,564.90
COST OF LDO	Rs						
TOTAL	Rs	199 265 417 88	176,851 290 82	150,772,133 68	165,214,190 02	0.00	691,903,032.40
COST A/G ON GAS	Ps /KWH	171 09	173 23	172 68	172 86	#DIV/0!	172.36
COST A/G ON FURNACE OIL	Ps /KWH						
COST A/G ON HSDO	Ps /KWH	399 36	407 51	412 47	404 38	#DIV/0!	405.26
COST A/G ON LDO	Ps /KWH						
COST A/G ON AVERAGE	Ps /KWH	238 83	257 87	229 05	258 82	0 00	245.64
COST OF FUEL / USO	Ps /KWH	245 99	265 30	235 91	266 57	#DIV/0!	253.02

C/VALUE AND AVG COSTS		
PRICE OF GAS	Rs /MCF	99 7
PRICE OF HSDO	Rs /Ltr	9 66
CAL VALUE OF GAS	Btu/CFT	950
CAL VALUE OF HSDO	Btu/Ltr	34460

CC: GM(GC) with compliments
CC: CE(G) with compliments
CC: C A/CCOF/DCE/DCE(GC)
✓CC E·E

EXECUTIVE ENGINEER(EFF.)
SITE G.T.P.S

DEPUTY CHIEF ENGINEER
SITE G.T.P.S

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Ref.No: SGTPS/3.02/...
Date: [illegible]

Month: July 1995 - June 1996

ITEMS		UNITS	UNIT # 1	UNIT # 2	UNIT # 3	UNIT # 4	UNIT 5	COMBINED
INSTALLED/ ACTUAL CAPACITY		M W	25 20/1.51	25-24/1.55	25 [illegible]	25-24/100	[illegible]	125-100/[illegible]
UNITS GENERATED.	GAS	K W H	42163416	50348624	52652796	45601683	—	[illegible]
	OIL	K W H	554784	16469076	8200424	20276367	—	[illegible]
	TOTAL	K W H	42658200	128177000	60852700	65878000	—	45507[illegible]
AUX. CONSUMPTION		K W H	1419500	2423092	2024443	2192165		2420[illegible]
UNITS SENT OUT		K W H	41238700	70394608	58829757	63685835		305[illegible]
REACTIVE UNITS GENERATED.		KVARH	22936200	40952700	35836100	38941500		1341[illegible]
RUNNING/FORCED SHUT-DOWN/HOURS		HRS-MIN	2325.93	4106.80	3385.05	3754.33		[illegible]
NO. OF SHUT DOWNS TOTAL / FORCED		NOS.	187/1	258	276/1	291		[illegible]
MAX/MIN. DEMAND		M W	20.5	21	21	20.6		[illegible]
LOAD / PLANT FACTOR		%	59.64	54.43	85.66	85.18		[illegible]
AVAILABILITY FACTOR		%	65.23	95.18	94.21	95.10		[illegible]
AUX. CONSUMPTION		%	3.33	3.33	3.33	3.33		[illegible]
FUEL CONSUMPTION.	a) GAS	MCF.	756340	994313	915008	791835		[illegible]
	b) F.O.	M.TONS	—	—	—	—		
	c) HSDO	LITRES	231253	6884237	3381899	8486940		18985329
	d) LDO	LITRES	—	—	—	—		
FUEL CONSUM-/	a) GAS	CFT/KWH	17.98	17.65	17.38	17.50		17.61
	b) F.O.	KG/KWH	—	—	—	—		
	c) HSDO	LIT/KWH	0.42	0.42	0.41	0.42		0.42
	d) LDO	LIT/KWH	—	—	—	—		
GROSS HEAT RATE		[illegible]/KWH	17041	16229	16200	15944		16257
PLANT EFFICIENCY		%	20.02	21.02	21.06	21.40		[illegible]
COST OF FUEL	a) GAS	RS.	6474847.33	84032002.56	77041774.68	67429652.09		293714[illegible]
	b) F.O.	RS.	—	—	—	—		
	c) HSDO	RS.	1710490.49	47788170.02	24093497.97	62064308.50		13563[illegible]
	d) LDO	RS.	—	—	—	—		—
	TOTAL	RS.	66458961.82	133826172.58	101737692.65	129493960.59		431537[illegible]
COST OF FUEL/ U.G.	a) GAS	Ps.	153.76	149.13	147.58	147.87	—	149.42
	b) F.O.	Ps.	—	—	—	—		
	c) HSDO	Ps.	308.32	302.31	293.81	306.09	—	302.54
	d) LDO	Ps.	—	—	—	—		
	AVERAGE	Ps.	155.79	183.77	167.29	196.57	—	178.78
COST OF FUEL / UNITS SENT OUT		PS./KWH	161.16	190110	173.04	203.33	—	1[illegible]

C/V Used & Average Costs

1- GAS [illegible] BTU/CFT ---- KJ/M3 [illegible] Rs./MCF
2- F.O. ------- BTU/LB. ---- KJ/Kg ------- Rs./M.T
3- HSDO [illegible] BTU/LIT ---- KJ/Lit 3.46 Rs./Lit
4- LDO ------- BTU/LIT ---- KJ/Lit ------- Rs./Lit

1 Kg = 2.205 Lbs. 1 Lb. = 0.4536 Kg
1 Km3 = 35.31 CFT. 1 CFT = 0.0283 M3
1 BTU = 1.076 KJ 1 KJ = 0.940 BTU

To: [illegible] - with compliments.
TO: C.E.G.S. --do--

cc: C.A/CCOF/DCEM/E.E/Q.E.
C.C.E.(CCL[illegible]) /C.T.P.S.

DY. CHIEF ENGINEER
SITE G.T.P.S.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

S.I.T.E. GAS TURBINE POWER STATION
(GENERATION STATISTICS)
Month: JULY-1997 - JUNE-1998

REF.NO: SGTPS/3.02/99/
DATE : 10TH FEB-1999

SR. NO.	I T E M S		UNITS	UNIT-1	UNIT-2	UNIT-3	UNIT-4	UNIT-5	GLOBAL
1.	INSTALLED/ ACTUAL CAPACITY		M W	25-20/20 ISO	25-20/20 ISO	25-20/20 ISO	25-20/20 ISO	25-20/20 ISO	125-100/100 ISO
2.	UNITS GENERATED.	GAS	K W H	59463100	48534500	60406900	48629200	-	217033700
		OIL	K W H	12616600	1583000	1422300	14460700	-	30082600
		TOTAL	K W H	72079700	50117500	61829200	63089900	-	247116300
3.	AUX. CONSUMPTION		K W H	2220751	1544103	1904937	1943779	-	7613370
4.	UNITS SENT OUT		K W H	69858949	48573397	59924263	61146121	-	239502730
5.	REACTIVE UNITS GENERATED.		KVARH	41317200	19294100	37038000	35632000	-	133982300
6.	RUNNING/FORCED SHUT-OCUR/HOURS		HRS-MIN	4111.20	2742.15	3592.17	3726.28	-	14679.36
7.	NO. OF SHUT DOWNS TOTAL/FORCED		NOS.	-	-	-	-	-	-
8.	MAX/MIN. DEMAND		M W	18.5	20	18	17.6	-	74.1/17.1
9.	LOAD/PLANT FACTOR		%	94.77	91.38	95.62	96.20	-	94.27/22.37
	AVAILABILITY FACTOR		%	95.10	82.10	94.10	91.10	-	100%
	AUX. CONSUMPTION		%	3.08	3.08	3.08	3.08	-	3.08
12.	FUEL CONSUMPTION.	a) GAS	M.CF	1006511	815201	1028375	820301	-	3670388
		b) F.O.	M.TONS	-	-	-	-	-	-
		c) HSDO	LITRES	5204464	663249	594410	6052652	-	12514775
		d) L D O	LITRES	-	-	-	-	-	-
13.	FUEL CONSUMPTION/ C.F.	a) GAS	CFT/KWH	16.93	16.80	17.12	16.87	-	16.91
		b) F.O.	KG/KWH	-	-	-	-	-	-
		c) HSDO	LIT/KWH	0.41	0.41	0.41	0.41	-	0.41
		d) L D O	LIT/KWH	-	-	-	-	-	-
14.	GROSS HEAT RATE		BTU/KWH	15754	15908	16132	15657	-	15855
15.	PLANT EFFICIENCY		%	21.65	21.44	21.15	21.79	-	21.52
16.	COST OF FUEL	a) GAS	RS.	168088130.07	90788935.37	114530123.75	91356922.37	-	464774111.56
		b) F.O.	RS.	-	-	-	-	-	-
		c) HSDO	Rs.	50275122.24	6406985.34	5742000.60	5846818.32	-	109271126.50
		d) L D O	Rs.	-	-	-	-	-	-
		TOTAL	Rs.	218363252.31	97195920.71	120272124.35	149825540.69	-	574156838
17.	COST PER UNIT	a) GAS	PAISAS	168.51	187.06	189.59	187.86	-	188.34
		b) F.O.	PAISAS	-	-	-	-	-	-
		c) HSDO	PAISAS	398.48	404.73	403.71	404.32	-	404.00
		d) L D O	PAISAS	-	-	-	-	-	-
		AVERAGE	PAISAS	225.26	193.93	194.52	237.47	-	214.33
18.	COST OF FUEL / UNITS SENT OUT		PS/KWH	232.42	200.10	200.71	245.02	-	221.40

1. Gas GCV	BTU/CFT	Kj/M³ 111.37	RS./MCF	1 KG = 2.205 LBS.
2. F.O.	BTU/Lb.	Kj/kg	RS./M.T	1 KM³ = 35.31 CFT
3. HSDO 19446	BTU/LIT	Kj/LIT 5.66	PS/LIT	1 BTU = 1.076 KJ
4. LDO	BTU/LIT	Kj/LIT	RS./LIT	

1 LB. =	0.4536 KG
1 CFT =	0.0283 M³
1 KJ =	0.9400 BTU

...with compliments
-do-

(HEAD OF DEPARTMENT)

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

Ref. No SGTPS/3 02/98/

Date : 23-Jul-99

SITE GAS TURBINE POWER STATION

GENERATION STATISTICS

FOR JULY 98 - JUN 99

ITEMS	UNITS	UNIT-1	UNIT-2	UNIT-3	UNIT4	UNIT-5	COMBINED
INSTALLED CAPACITY	MW	25	25	25	25	25	125
ACTUAL CAPACITY	MW	20	20	20	20	20	100
UNITS GENERATED ON GAS	KWH	63,437,300	71,201,800	39,795,600	29,327,500	0	203,762,200
UNITS GENERATED ON F OIL	KWH						0
UNITS GENERATED ON HSDO	KWH	3,172,600	348,500	1,735,000	566,100	0	5,822,200
UNITS GENERATED ON LDO	KWH						0
UNITS GENERATED ON TOTAL	KWH	66,609,900	71,550,300	41,530,600	29,393,600	0	209,584,400
AUX. CONSUMPTION	KWH	2,405,508	2,583,923	1,499,810	1,079,559	0	7,568,800
UNIT SENT OUT	KWH	64,204,392	68,966,377	40,030,790	28,814,041	0	202,015,600
REACTIVE UNITS	KVARH	40,247,900	40,164,900	27,880,500	6,589,500	0	114,982,700
Operating Hours	Hrs	3,887	3,969	2,502	1,791	0	8,092
Forced Shut Down Hours	Hrs						
Planned Shut Down Hours	Hrs						
Stand By Hours	Hrs	4,873.02	4,791.14	6,258.39	6,969.01	-	2,668.36
Total Hours	Hrs	8,760.00	8,760.00	8,760.00	8,760.00	8,760.00	8,760.00
NO. OF STARTS	Nos	24	25	10	7		66
Total Shut Down	Nos	0	0	0	0	0	0
Forced Shut Down	Nos	2	3	2	0	0	7
MAXIMUM LOAD	MW	18.5	20	18	17.8	0	74.1
MINIMIM LOAD	MW	17.5	17.6	17.1	17.2	-	17.1
LOAD FACTOR	%	92.63	90.14	92.23	94.84	-	46.43
PLANT FACTOR	%	30.42	32.67	18.96	13.65	-	19.14
AVAIL. FACTOR	%	100.00	100.00	100.00	100.00	-	100.00
POWER FACTOR		0.86	0.87	0.83	0.98	-	0.88
% AUX CONSUMTION	%	3.61	3.61	3.61	3.61	-	3.61
FUEL CONSUMP							
GAS	MCF	1,080,546	1,199,517	671,893	499,504	0	3,451,460
Furnace Oil	M.TON						
HSDO	LITRE	1,333,507	148,128	743,820	259,392	0	2,484,847
LDO	LITRE						
FUEL CONSUMPTION / UG							
ON GAS	CFT/KWH	17.03	16.85	16.88	17.03	0.00	16.94
ON FUR OIL	KG/KWH						
ON HSDO	LIT/KWH	0.420	0.425	0.429	0.458	0.000	0.427
ON LDO	LIT/KWH						
GROSS HEAT RATE	BTU/KWH	16,359	16,266	16,244	16,440	#DIV/0!	16,316
NET HEAT RATE	BTU/KWH	16,972	16,875	16,853	17,056	#DIV/0!	16,927
HEAT RATE ON KVA BASIS	BTU/KVAH	14,002	14,184	13,487	16,043	#DIV/0!	14,305
THERMAL EFFICIENCY	%	20.86	20.98	21.01	20.76	#DIV/0!	20.92
COST OF GAS	Rs.	120,338,114.74	133,587,578.11	74,827,261.28	55,628,715.55	0.00	384,381,869.68
COST OF FURNACE OIL	Rs.						
COST OF HSDO	Rs.	12,988,358.18	1,442,766.72	7,244,806.80	2,526,478.08	0.00	24,202,409.78
COST OF LDO	Rs.						
TOTAL	Rs.	133,326,472.92	135,030,344.83	82,072,068.08	58,155,193.63	0.00	408,584,079.46
COST /UG ON GAS	Ps./KWH	189.70	187.67	188.03	189.68	#DIV/0!	188.84
COST /UG ON FURNACE OIL	Ps./KWH						
COST /UG ON HSDO	Ps./KWH	409.39	413.99	417.57	446.30	#DIV/0!	415.69
COST /UG ON LDO	Ps./KWH						
COST /UG ON AVERAGE	Ps./KWH	200.16	188.72	197.62	194.54	0.00	194.95
COST OF FUEL / USO	Ps./KWH	207.66	195.79	205.02	201.83	#DIV/0!	202.25

C/VALUE AND AVG COSTS

PRICE OF GAS	Rs./MCF	111.3678471
PRICE OF HSDO	Rs./Litre	9.74
CAL VALUE OF GAS	Btu/CFT	966
CAL VALUE OF HSDO	Btu/Litre	34400

CC: GM(GC) with compliments
CC: CE(G) with compliments
CC: C.A/CCOF/DCEK/DCE(GC)

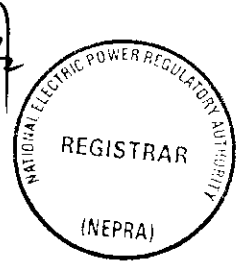
NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

EXECUTIVE ENGINEER(EFF.)
SITE G.T.P.S

DEPUTY CHIEF ENGINEER
SITE G.T.P.S

SCHEDULE - II

- The net capacity of the licensee's generation facilities



INSTALLED CAPACITY (GROSS) & NET CAPACITY

The Karachi Electric Supply Corporation Limited (KESC)

Power Station	Installed Capacity MW		Derated Capacity (MW)		Net Capacity after *Aux. Consumption (MW)	
BIN QASIM POWER STATION	Unit # 1	**210.0**	Unit # 1	**190.0**	Unit # 1	**174.80**
	Unit # 2	**210.0**	Unit # 2	**190.0**	Unit # 2	**174.80**
	Unit # 3	**210.0**	Unit # 3	**120.0**	Unit # 3	**110.40**
	Unit # 4	**210.0**	Unit # 4	**140.0**	Unit # 4	**128.80**
	Unit # 5	**210.0**	Unit # 5	**190.0**	Unit # 5	**174.80**
	Unit # 6	**210.0**	Unit # 6	**210.0**	Unit # 6	**193.20**
KORANGI THERMAL POWER STATION	Unit # 1	**66.0**	Unit # 1	**40.0**	Unit # 1	**37.0**
	Unit # 2	-	Unit # 2	-	Unit # 2	-
	Unit # 3	**125.0**	Unit # 3	**95.0**	Unit # 3	**87.90**
	Unit # 4	**125.0**	Unit # 4	**70.0**	Unit # 4	**64.80**
KORANGI TOWN GAS TURBINE POWER STATION	Unit # 1	**25.0**	Unit # 1	**20.0**	Unit # 1	**19.12**
	Unit # 2	**25.0**	Unit # 2	**20.0**	Unit # 2	**19.12**
	Unit # 3	**25.0**	Unit # 3	**20.0**	Unit # 3	**19.12**
	Unit # 4	**25.0**	Unit # 4	**20.0**	Unit # 4	**19.12**
SITE GAS TURBINE POWER STATION	Unit # 1	**25.0**	Unit # 1	**17.40**	Unit # 1	**16.95**
	Unit # 2	**25.0**	Unit # 2	**17.40**	Unit # 2	**16.95**
	Unit # 3	**25.0**	Unit # 3	**17.40**	Unit # 3	**16.95**
	Unit # 4	**25.0**	Unit # 4	**17.40**	Unit # 4	**16.95**
	Unit # 5	**25.0**	Unit # 5	**17.40**	Unit # 5	**16.95**
TOTAL		**1801 MW**		**1412 MW**		**1307.70 MW**

* **Indicative Figures only**: These figures have been based on historic average auxiliary consumption provided by the licensee. The net capacity available for dispatch and other purchasers will be determined through procedures contained in the Grid Code, applicable documents or the bilateral contracts.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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