Energy That Moves Life

Mr. Syed Safeer Hussain,
Registrar,
NEPRA Tower, Attaturk Avenue (East),
Sector G-5/1,
NEPRA
Islamabad

Ref # KE/BPR/NEPRA/2018/248
May 21, 2018

SUBJECT: MODIFICATION OF GENERATION LICENCE [GL/04/2002]

Dear Sir,

KE was issued Generation Licence No. GL/04/2002 on November 18, 2002 (**"Generation Licence"**) under Section 25 of the NEPRA Act, 1997. In the past, Generation Licence has been modified by NEPRA with the latest modification (Modification VII) granted vide NEPRA letter # NEPRA/ADG (L)/LAG-243/3183-87 dated February 28, 2018.

Since 2009, KE has added 1,057 MW of efficient power generation, as a result of which, KE's average fleet efficiency has improved from 30% in FY 09 to 37% in FY 17. Currently there is a shortfall of approximately 400 MW against peak demand. In order to address this shortfall and cater for future increase in power demand, KE has embarked on various new projects. Furthermore, to ensure adequate supply of power to meet the growing demand of the city and to maintain a spinning reserve in future to enable uninterrupted and reliable power supply, KE has also undertaken rehabilitation of the Units 1 and 2 of BQPS I to extend their useful life.

In the light of above, this application is being submitted under Sub Rule (2) of the Rule 10 of the NEPRA Licensing (Application and Modification Procedure) Regulations, 1999 for modifications of the useful life of Unit 1 and 2 of BQPS-I in the Generation License. In relation, hereto, this is to certify that the following documents enclosed in support with this modification application are prepared and submitted in conformity with the provisions of the Regulations, and that the Company undertakes to abide by the terms and provisions of the Regulations.

a) Text of Proposed Modifications
b) Statement of Reasons and Specifications in support of Modifications
c) Statement showing the impact of tariff, quality of service and the performances by KE of its obligations under the License
d) Certified True Copy of Board Resolution
e) Authority Letter in favor of signatory
f) Affidavit

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Additionally, please find enclosed cross Cheque of Rs. 716,165/- (**copy of workings enclosed herewith**) having # 00000286 dated 21-05-2018 of Habib Bank Ltd. being the license modification fee after deduction of withholding tax, calculated in accordance with Schedule II to the NEPRA Licensing (Application and Modification Procedure) Regulations, 1999.

At the end, we humbly request the Authority that modifications in the Generation License of KE be allowed and approved as per the Regulation 10 (11) of the NEPRA Licensing (Application and Modification Procedure) Regulations, 1999.

Sincerely,

Muhammad Aamir Ghaziani,
Director – Finance and Regulations

Enclosures: documents mentioned in serial (a) to (f)

Workings of LPM Fees Payable

[SCHEDULE II]10
[regulations 3(2) and 10(3)]
Table of Fees

Licence Application and Modification Fee

Generation	Fees (Rs.)
Above 100 MW	400,000

CALCULATION

Respective Fee Set Out in Part I of Schedule II	400,000
Prevalent CPI (CPIpd) (The recent CPI-April 2018)	224.25
Base CPI (CPIrd) (The reference or base CPI as on September, 2008)	115.23

Actual Fee Pyable	**778,440**

Tax to be deducted (8% WHT)	**(62,275)**

Amount payable after tax	**716,165**

HBL HABIB BANK حبیب بینک

Habib Bank Limited, Pakistan
HBL PLAZA BR,KARACHI
HBL PLAZA I.I.CHUNDRIGAR ROAD

Not Negotiable
Payee's A/C Only

Cheque No. 00000286

Date D D 21-May-2018 Y Y

Pay NEPRA ELECTRIC POWER REGULATORY AUTHORITY (NEPRA) or bearer

Rupees Seven Hundred Sixteen Thousand One Hundred Sixty Five only

PKR 716,165/-

PK86 HABB 0007867000959117

K-ELECTRIC LIMITED

Please do not write below this line

Signature

⑈00000286⑈ ⑆054078⑆ ⑆000786700095911 7⑈ 000⑈

ENHANCEMENT IN LIFE OF UNITS 1 AND 2 OF BIN QASIM POWER STATION – I (BQPS – I)

A. Text of Proposed Modification

Through the proposed modification in its Generation License, KE seeks to modify the useful life of two of its units namely Units 1 and 2 of its existing power plant i.e. Bin Qasim Power Station – I (BQPS-I) whose useful lives as per Generation License is due to expire in August 2018 and August 2019 respectively. The useful life of Units 1 and 2 are proposed to be extended for five years and be revised to August 2023 and August 2024 respectively.

B. Statement of Reasons and Specification in Support of Modification

KE has the sole responsibility of providing electric power services in the metropolitan city of Karachi and its adjoining areas. In this regard, the Authority had granted three (03) separate licenses to KE for generation, transmission and distribution services.

KE has planned addition of around 3,000 MW of generation capacity through its own generation fleet as well as power purchases from IPPs in the next five years which will take it to a surplus position. Until such time the planned projects materialize, it is important that the existing fleet is maintained and utilized to its maximum, considering the current shortfall in supply and rising demand of the city of Karachi and its adjoining areas. Furthermore, KE has undertaken rehabilitation of Units 1 and 2 of BQPS I as detailed below to extend their useful life to ensure adequate supply of power to meet the growing demand of the city and to maintain a spinning reserve to enable uninterrupted and reliable power supply.

The aforementioned two identical units each of 210 MW installed capacity were commissioned in the year 1983 and 1984 respectively. Throughout the years, these turbines have been overhauled at regular intervals. Additionally, the turbines and associated auxiliaries are fully capable of operating at optimum load. The expected / estimated useful life of the Units 1 and 2 of BQPS – I as per the latest License Modification-VII is due to expire in August 2018 and August 2019 respectively. However, through major and minor rehabilitation/overhaul it is estimated that the Units can operate reliably for another five years after expiry of their current licensed term.

Furthermore, Units 1 and 2 of BQPS I are dual fuel (gas and FO) and hence provide flexibility of operations in case of shortage of gas supply and are cheaper than other comparative alternates like HSD.

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MAJOR REHABILITATION FOR UNITS 1 AND 2 OF BQPS – I

OVERVIEW

In purview of above and in order to manage the demand supply gap, KE in 2013 planned major investment for rehabilitation of Units 1 and 2 (BQPS-I) so as to ensure safe, efficient & reliable dispatch from these units. After detailed examination of all critical equipment of the ageing Units 1 and 2, Generation Long Term Investment Plan (GLTIP) was prepared. Key features of GLTIP aimed at achieving sustainable Capacity, Efficiency & Reliability Gains through following means:

- Upgrades & Rehabilitation
- OEM Services and Recommended material
- Complete replacement of equipment having recurring failure history.

Status of major items of the proposed plan pertaining to Units 1 and 2, as listed below have been completed with few under progress:

EQUIPMENTS	UNIT 1	UNIT 2
Boiler	• Complete rehabilitation of flue gas ducts with bellows • Replacement of Steam Coil Air Heater Panels • Replacement of Secondary & tertiary Super heater, Re-heater, Water Wall Tubes along with Bends, spacers, End Supports • Replacement of Economizer first bank with inlet header. • Replacement of Regenerative Air Heater Seals & Sector Plates • Rehabilitation of Drum, Super Heater Safety Valve and Electro-Magnetic Relief Valve • Replacement of Gas burner pipes, HFO burner tips and impeller brackets • Boiler Tuning on Gas and HFO by OEM expert • Installation of New Rack Soot Blower system with PLC	• Complete rehabilitation of flue gas ducts with bellows • Replacement of Steam Coil Air Heater Panels • Replacement of secondary and tertiary Super heater, Re-heater, Water Wall Tubes along with Bends, spacers, End Supports • Replacement of economizer first bank with inlet header. • Replacement of Regenerative Air Heater Seals & Sector Plates • Rehabilitation of Drum, Super Heater Safety Valve and Electro-Magnetic Relief Valve • Replacement of Gas burner pipes, HFO burner tips and impeller brackets • Boiler Tuning on Gas and HFO by OEM expert • Installation of New Rack Soot Blower system with PLC (Expected Completion FY 18)

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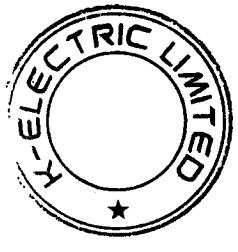
Control System	• Design, Engineering, Installation and commissioning of New State of the Art DCS system • Continuous Emission Monitoring System (CEMS)	• Design, Engineering, Installation and commissioning of New State of the Art DCS system (Under Planning Stage) • Continuous Emission Monitoring System (CEMS) • HP/ LP Bypass System Replacement (Planned FY-19)
Turbine & Ancillary Equipment	• Condenser hard scale removal • Installation, Testing and commissioning of HP Feed Water Heater-5&6 • Turbine Efficiency Overhaul & Life Assessment (Replacement/Machining of Diaphragm, Radial Fins, alignment parts, Rehab of Steam Turbine Valves (MSV, RSV, ICV, CV), Shroud Cover for LP Rotor 18th (L1), Turbine and Gen end and tie wire, shroud cover) • FeSO4 dosing system Rehabilitation	• Condenser hard scale removal • Turbine Major Overhaul (Replacement/Machining of Diaphragm, Radial Fins, alignment parts, Rehab of Steam Turbine Valves (MSV, RSV, ICV, CV), Shroud Cover for LP Rotor 18th stage (L1), LP Turbine: Turbine and Gen end and tie wire 18th & 19th Stage, shroud cover) (Expected Completion FY 18) • FeSO4 dosing system Rehabilitation
BOP	• Installation of discharge butterfly valve with hydraulic actuator for main cooling water pump • Replacement of main cooling water pump (without Motor) including complete lubrication system • Obsolete control system has been replaced with the new state of the art ABB Symphony S Plus	• Installation of discharge butterfly valve with hydraulic actuator for MCWP
Generator	• Generator Major Overhaul (Planned for FY-19)	• Generator Stator Rewinding & Major Overhaul (Expected Completion FY 18)

The total planned investment for rehabilitation of Units 1 and 2 amounts to PKR 1,761 Million. Out of the total amount, a sum of PKR 1,522 Million has already been invested in rehabilitation of the aforementioned units over the last three years. Major Rehabilitation of Unit 1 of BQPS I has been completed, whereas the Major Rehabilitation Works of Unit 2 shall be completed by May 2018.



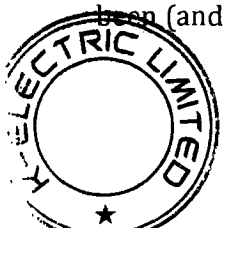
OTHER MAINTENANCE ACTIVITIES

Additionally, these units went under frequent major and minor overhauls during their lifetime. In this respect, please find below summary of other maintenance activities carried out on the aforementioned units during the past three years:

EQUIPMENTS	UNIT 1	UNIT 2
BOILER	• RAH Intermediate element replacement • Replacement of Economizer 1st bank with inlet header. • RAH 1&2 Elements cold side replacement • Drum, SH safety valves nozzle seats replacement • Air Heater-1,2 Fire detection system installation and commissioning • Long Range Ultrasonic Testing of Boiler High pressure lines • Combustion system parts replacement. With Boiler Combustion Tuning	• Ducts and bellows replacement • Boiler piping health assessment • Soot blowing system replacement • Complete rehabilitation of Boiler Pressure Parts • Combustion parts replacement and boiler tuning • Complete replacement of Boiler Safety Valves • Economizer tube replacement (1st bank and header) • RAH section plate replacement
TURBINE	• Turbine Major Efficiency overhauling • HP Heaters-5 and 6 replacements. • BFP-3 motor installation and commissioning • BFP-3 overhauling	• Eddy current testing of condenser • Major Overhaul
GENERATOR	• GIS Partial discharge test (successful) • Following test performed with satisfactory results 1. Stator Insulation resistance test 2. Tan delta and capacitance tip up 3. Offline Partial discharge test 4. Winding Resistance test 5. RSO Generator rotor	Major Overhaul
BALANCE OF PLANT (BOP)	• Installation of DCS • MCWP#2 overhauling • IAC-1&2, SAC-2&3 overhauling • New Discharge Valve installation MCWP-1B	• Overhauling of MCWP-1 • Condenser hard scale removal • BFP-1 Overhauling • RAH washing / Cleaning • Installation of rotor assembly for CP & Booster pump • HP/LP bypass system

EFFECTS OF REHABILITATION:

Through i) Maintenance of the units including extensive periodic major & minor maintenance carried out on Turbine, Boiler & BOP Equipment; and ii) The Implementation of the GLTIP rehabilitation plan through which critical equipment like Boiler, Turbine, Control System, have been (and are) being replaced/rehabilitated & Overhauled as mentioned earlier; it is estimated



that Units 1 and 2 of BQPS –I can be operated safely at a maximum operating load of 180 MW for the **five (5) years** after the expiry of initial useful life of 35 years with regular maintenance as recommended by Original Equipment Manufacturer.

C. **Impact on Tariff**

Under KE's Multi Year Tariff (MYT) fuel and power purchase cost are passed through to the consumers as per NEPRA determined benchmarks. Currently, Units 1 and 2 are a part of KE's generation fleet and further operation through enhancement in useful life of these units will not have any additional impact on the fuel cost to be passed through to consumers. Further, under the Determined MYT for the control period starting July 01, 2016, which is currently under reconsideration, the investments on Unit 1 and 2 should be considered in the investment plan for the purpose of tariff. To ensure consumer interests are protected the plants will be utilized based on Economic Merit Order.

D. **Impact on Quality of Service and the Performances by KE of its Obligations Under the License**

The proposal to enhance the life of Units 1 and 2 of BQPS I in the Generation Portfolio of KE is necessary for providing continuous power supply and will maintain the demand supply gap until future projects materialize with their generation added into the system and subsequently to maintain spinning reserve.

The requested modification would benefit consumers as it would ensure that the generation capacity continues to be available and maintained. Moreover, there will be no adverse impact on the quality of service provided by KE if this Licensee Proposed Modification (LPM) Application is accepted. The Company certifies that it has been fully diligent and dedicated in the performance of its services and aspires to ensure uninterrupted and reliable supply of power to its consumers.

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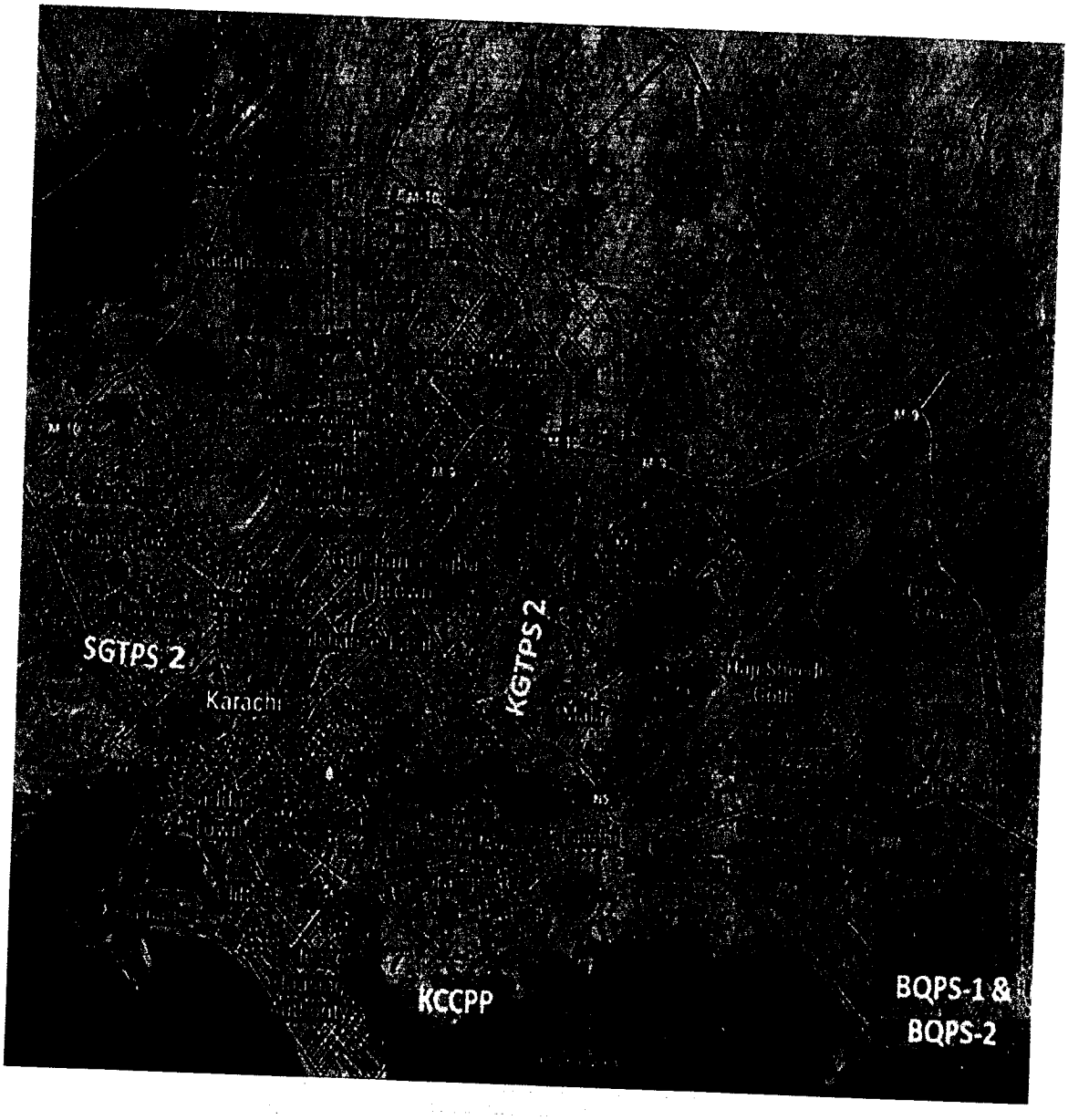
ANNEXURE A

Location of Bin Qasim Power Station - I



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Details of Units 1 and 2 of Bin Qasim Power Station – I

(A). Plant Configuration

		Unit No. - 1	Unit No. - 2
(i).	Plant Size Installed Capacity (Gross ISO)	210 MW	210 MW
(ii)	De-rated Capacity	180 MW	180 MW
(iii)	Expected Remaining Life	5 years	5 years
(ii).	Type of Technology	Conventional Thermal Power Generation Plant with Sub-Critical Boilers and Steam Turbines	
(iv).	Unit Make & Model	Hitachi	Hitachi
(v).	Commissioning/Commercial Operation date (of each Unit)	1983	1984

(B). Fuel Details

			Unit No. - 1	Unit No. - 2
(i).	Primary Fuel		Natural Gas	Natural Gas
(ii).	Alternative Fuel		Residual Furnace Oil (RFO)	Residual Furnace Oil (RFO)
			Re-Gasified Liquefied Natural Gas (RLNG)	Re-Gasified Liquefied Natural Gas (RLNG)
(iii).	Start-Up Fuel		Light Diesel Oil (LDO) / Natural Gas	Light Diesel Oil (LDO) / Natural Gas
(iv).	Fuel Source for each of the above (i.e. Imported/ Indigenous)		Imported / Indigenous	
(v).	Fuel Supplier for each of the above	Natural Gas	SSGC	
		RFO	PSO/BYCO	
		RLNG	SSGC	
		LDO	PSO	
(vi).	Supply Arrangement for each of the above	Natural Gas	Through Pipeline	
		RFO	PSO – through pipeline	
			BYCO – through tankers	
		RLNG	Through Pipeline	
		LDO	Tankers	
(vii).	No of Storage Tanks		• Six tanks for RFO. Tank 1,2 : Under BYCO for Storage and transfer to KE. Tank 3,4,5 : For storage and use By KE. Tank 6: Under PSO for storage and transfer to KE.)	

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		• Two tanks for LDO
(viii).	Storage Capacity of each Tank	LDO : Two tanks of 500 m^3 each RFO: Tank # 1 & 2: 10000 m^3 each. Tank # 3, 4,5, 6 : 25000 m^3 each
(ix).	Gross Storage	RFO / LDO : 1,20,000 / 1000 m^3

(C). Emission/Effluents Values

(i).	SO_x (mg/Nm^3)	The Plant is old and Emission Equipment not Installed.
(ii).	NO_x(mg/Nm^3)	
(iii).	CO_2 (%)	
(iv).	Effluents	
(v).	CO (mg/Nm^3)	
(vi).	PM_{10}	

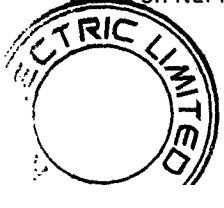
(D). Cooling System

		Unit No. - 1	Unit No. - 2
(i).	Cooling Water Source/Cycle	Sea Water / open and once through	

(E). Plant Characteristics

		Unit No. - 1	Unit No. - 2
(i).	Generation Voltage	21 KV	21 KV
(ii).	Frequency	50 Hz	50 Hz
(iii).	Power Factor	0.85	0.85
(iv).	Automatic Generation Control (AGC) (MW control is the general practice)	MW / Hz	MW / Hz
(v)	Auxiliary Consumption[1]	8.11 %	8.00 %
(vi).	**Ramping Rate**		
	(a). Light mode	1 %	1 %
	(b). Medium mode	3 %	3 %
	(c). Heavy mode	5 %	5 %
(vii).	**Time required to Synchronize to Grid and loading the complex to full load.**		
	Ambient cold start(hours)	22 + 2	22 + 2
	Cold start mode	07 + 2	07 + 2
	Warm start mode	03 + 1.5	03 + 1.5
	Hot start mode	2.25 + 0.5	2.25 + 0.5
	Very hot mode	0.25 + 0.5	0.25 + 0.5

[1] Based on NEPRA Determined Heat Rates and Auxiliary Consumption which is subject to Heat Rate Test.



(F). Efficiency Parameters

		Unit No. - 1	Unit No. - 2
(i).	Designed Efficiency of power plant (%)	**38.7** (On HFO, HHV basis)	**38.7** (On HFO, HHV basis)
(ii).	Gross Efficiency of power plant at Mean Site Conditions (%)[2]	**34.38** (HHV Basis)	**34.83** (HHV Basis)
(iii).	Net Efficiency of power plant at Mean Site Conditions (%)[2]	**31.59** (HHV Basis)	**32.04** (HHV Basis)

(G). Interconnection Arrangement

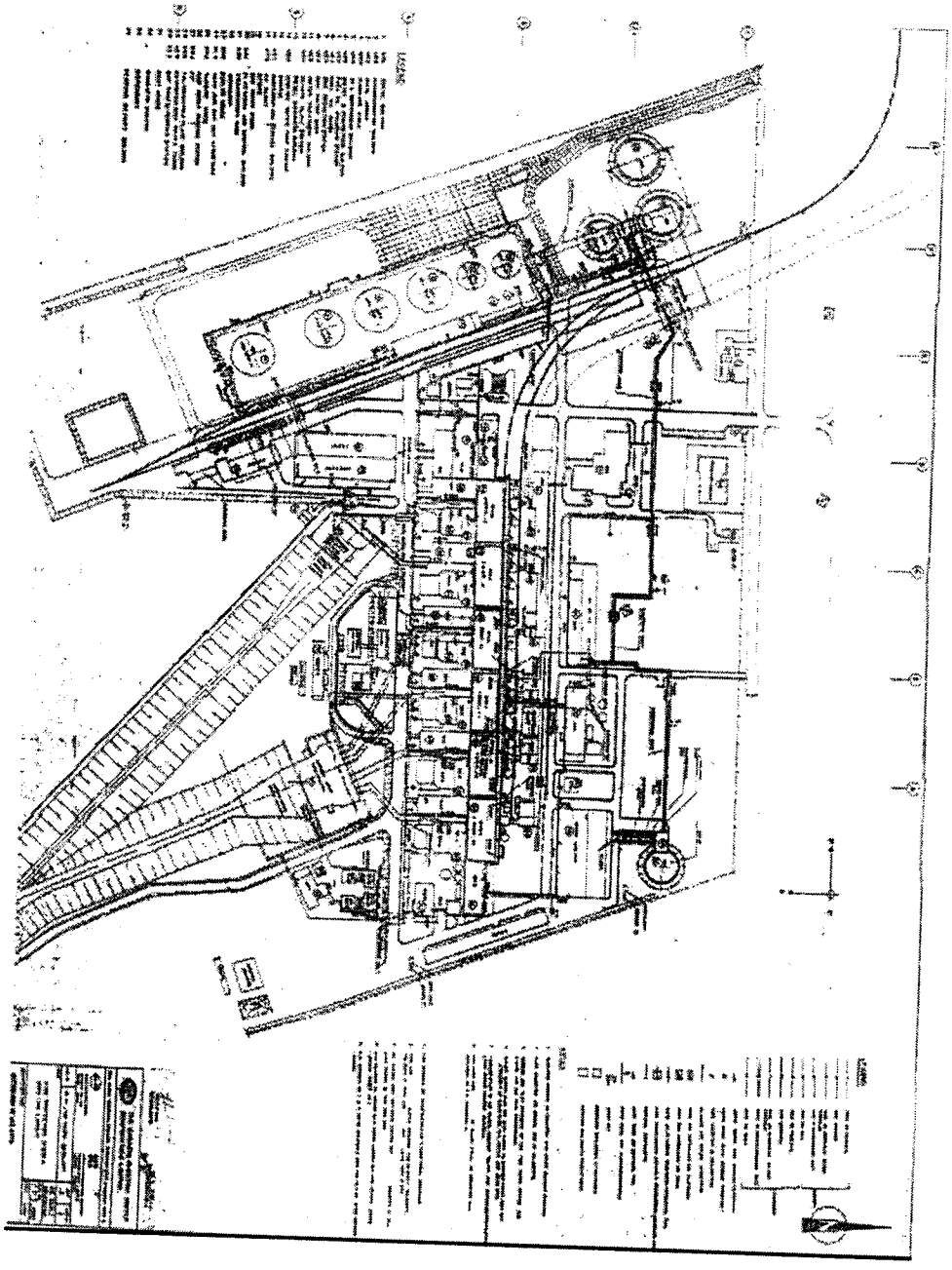
(i).	Interconnection &Transmission Arrangement for Power Plant-I	(a). 220KV Circuit No. 1 to Pipri West Grid (b). 220KV Circuit No. 2 to Pipri West Grid (c). 220KV Circuit No. 3 to Pipri West Grid (d). 220KV Circuit No. 4 to Pipri West Grid with Loop in / loop out to ICI Grid (e). 220KV Short Line link-1 (interconnection with Bin Qasim Power Plant-2) (f). 220KV Short Line link-2 (interconnection with Bin Qasim Power Plant-2)

(H). Other Details

		Unit No. - 1	Unit No. - 2
(i).	Project cost	These Units are part of an existing plant and all capital expenditure incurred in their rehabilitation has been funded from equity sources	
(ii).	Training and Development	These Units are part of existing plant and are sufficiently manned and the staff is equipped with adequate training skills, which are regularly updated through our training and development programs.	
(iii).	Environmental Data	KE regularly submits its environmental compliance reports to relevant authorities. Copy of reports sent are **enclosed in CD**	
(iv).	Due Diligence Report	Already submitted at the time of initial commission. Copy of the same is attached herewith as **Annexure B**	

[2] Based on NEPRA Determined Heat Rates and Auxiliary Consumption which is subject to Heat Rate Test.

Layout of Bin Qasim Power Station - I



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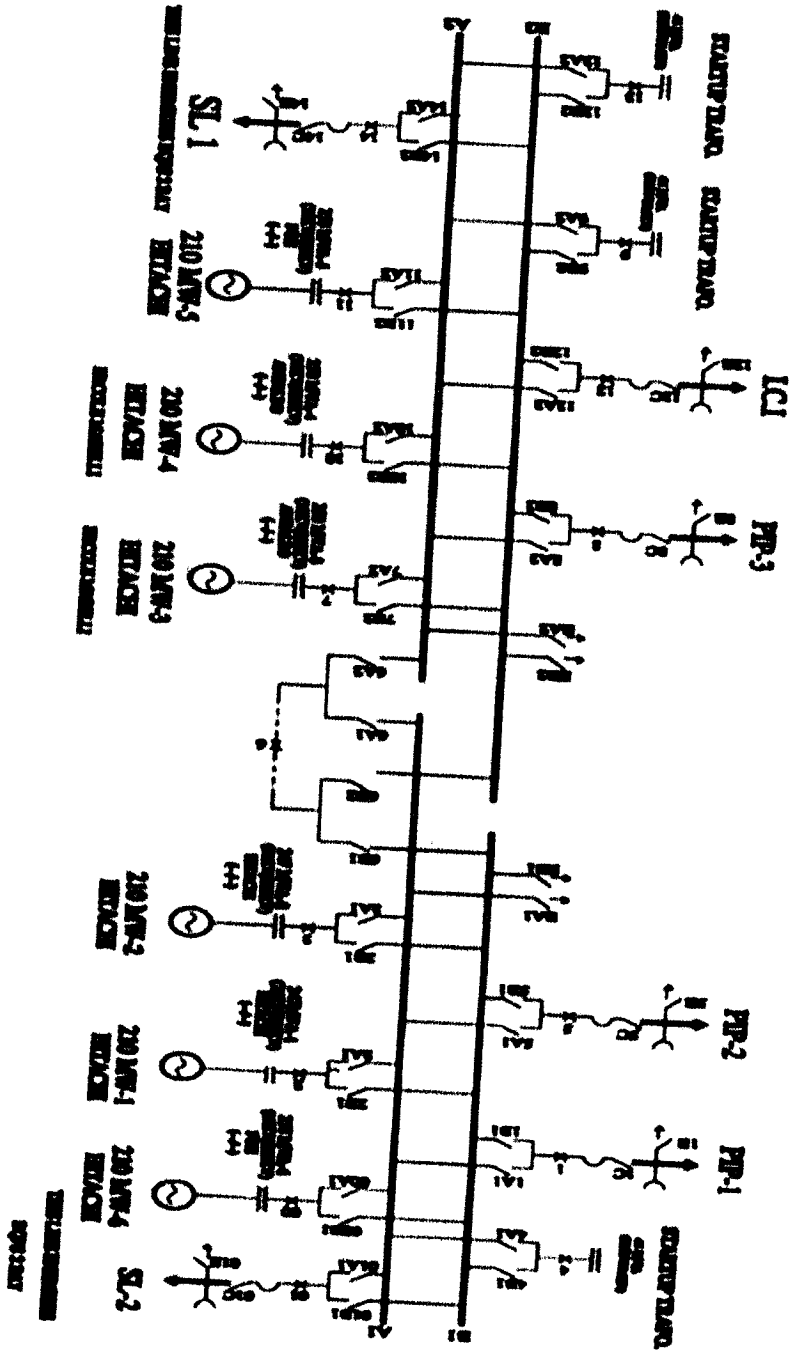
Single Line Electrical Diagram of Bin Qasim Power Plant-I



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		1260	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 (Nr)	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	Ercolle Marrelli	247.06	18	Hydrogen
4	Ansaldo		250	18/220	Ercolle 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 last 10 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 Coordination Department June 1998

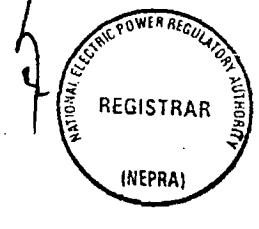


TABLE A3.6 BIN QASIM UNIT PERFORMANCE 1994 TO 1998

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	0.87
		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 Coordination 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	7
					1995-96	9,943	10,213	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	23
					1995-96	10,754	11,580	26
					1996-97	11,115	11,984	30
					May-98	Outage	Outage	N/A
5	1991	210	8442	8352	1994-95	9,363	9,964	12
					1995-96	9,063	9,588	9
					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.

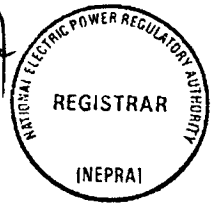


TABLE A3.8 BIN QASIM PLANT OPERATIONAL LIMITS

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	484	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	49
		May-98	180	N/A	0.01	3	2	N/A	3
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

i) 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 over-speed 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.

31

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
(NEPRA)

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.

III) TRAINING

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 or purification 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.

Energy That Moves Life

Certified True Copy (CTC) of Resolutions
Passed by K-Electric Board of Directors at its Meeting No. 1185
Held on Thursday, 27 November 2014 at 11:00 a.m. in KE's Board Room,
3RD Floor, KE House, 39-B, Sunset Boulevard, Phase-II, DHA, Karachi

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Re: Appointment of Chief Executive Officer (CEO)

RESOLVED THAT a General Power of Attorney as per draft set out in **Appendix "A"** be and is hereby given to Mr. Muhammad Tayyab Tareen, CEO, KE and any two (2) Directors of the Company be and are hereby jointly authorized to sign, on behalf of the Board of Directors, the General Power of Attorney for Mr. Muhammad Tayyab Tareen and place the common seal of the Company on the instrument.

Muhammad Rizwan Dalia
Company Secretary

Certified True Extract of the General Power of Attorney given to Mr. Muhammad Tayyab Tareen, CEO, K-Electric pursuant to above resolution passed by KE BOD

Clause 14) To make and sign applications to appropriate Federal, Provincial or Local Government departments, authorities or other competent authority for all and any licenses, filing of any and all applications, petitions with NEPRA which include Licensee Proposed Modifications (LPMs) and others, permissions and consents required by any order, statutory instrument, regulation, byelaw or otherwise in connection with the business, management and affairs of the Company;

Clause 26) To delegate to any person such of the powers as he deems fit and revoke the same at his discretion.

Muhammad Rizwan Dalia
Company Secretary

APPENDIX "A"

1000 Rupees

MUHAMMAD UMAR STAMP VENDOR
City Courts Karachi 0 2 DEC 2014
STAMP VENDOR'S SIGNATURE

GENERAL POWER OF ATTORNEY

TO ALL TO WHOM these presents shall come, K-ELECTRIC LIMITED (KE), having its registered office at KE House, 39-B, Sunset Boulevard, Phase-II, DHA, Karachi (hereinafter called the "Company") send greetings.

WHEREAS the Company was incorporated under the Companies Act 1882 as a company limited by shares and continues to operate as such under the Companies Ordinance 1984;

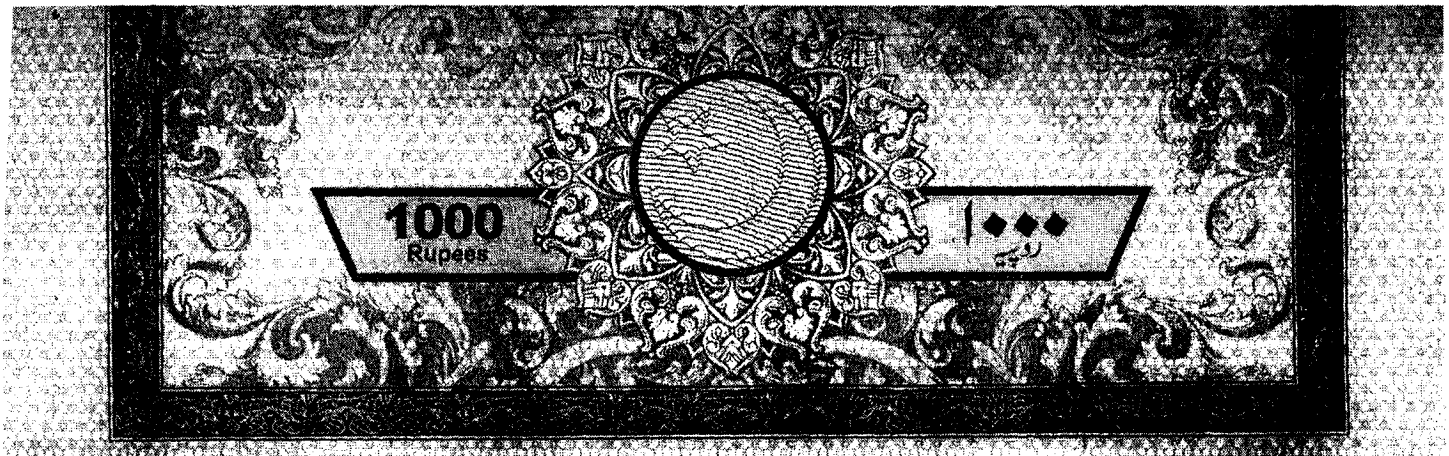
AND WHEREAS by virtue of the powers conferred upon them by Article 77 of the Company's Articles of Association, the Board of Directors of the Company have passed the resolution dated 27 November 2014 and entrusted to and conferred upon **Mr. Muhammad Tayyab Tareen**, the Chief Executive Officer of the Company, the following powers which shall be exercisable by him from the date that a Power of Attorney enumerating the same is executed in his favor by any two (2) directors of the Company.

NOW THESE PRESENTS WITNESS THAT Mr. Muhammad Tayyab Tareen son of Muhammad Ajmal Tareen CNIC # 35202-3534433-1, the Chief Executive Officer of the Company, is hereby appointed Attorney of the Company to act in the name and on behalf of the Company to do and perform the following acts and things only:

1) To purchase, sell, endorse, transfer, negotiate, encash, receive interest or otherwise deal in securities of all kinds including Government of Pakistan securities and securities of the Provincial Governments of Pakistan;

2) To sign all registers, reports and returns and others documents as may be required by law to be signed or filed with any Federal, Provincial or Local Governmental authority including but not limited to the Securities and Exchange Commission of Pakistan, Stock Exchanges, Registrar Joint Stock Companies, State Bank of Pakistan and Income Tax, Customs and other authorities;

3) To sign all acceptances and endorsements on bills of exchanges, hundies, securities and cheques drawn on behalf of the Company and to receive the amount of bills, hundies, securities and cheques and to give receipts and discharge for the same and to sign all documents drawn on or by the Company to which the signature of the Company as agents is required;



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STAMP VENDOR'S SIGNATURE

SHAMSUDDIN Sr. ADVOCATE NOTARY PUBLIC South Karachi-Pakistan

4) To sign for and on behalf of the Company all documents, assurances, deeds, and matters or things in or about the business of the Company as fully and effectively as the Company could do if personally present, to present such documents and deeds to the registering authority and admit execution thereof;

5) To process certificates of shares of the Company and to sign all papers relating to the transfer of shares including temporary receipts thereof;

6) To process Dividend Warrants and their revalidation;

7) To authenticate and or cancel the registration of Debentures;

8) To sign all correspondence that may be necessary in the ordinary course of the business of the Company;

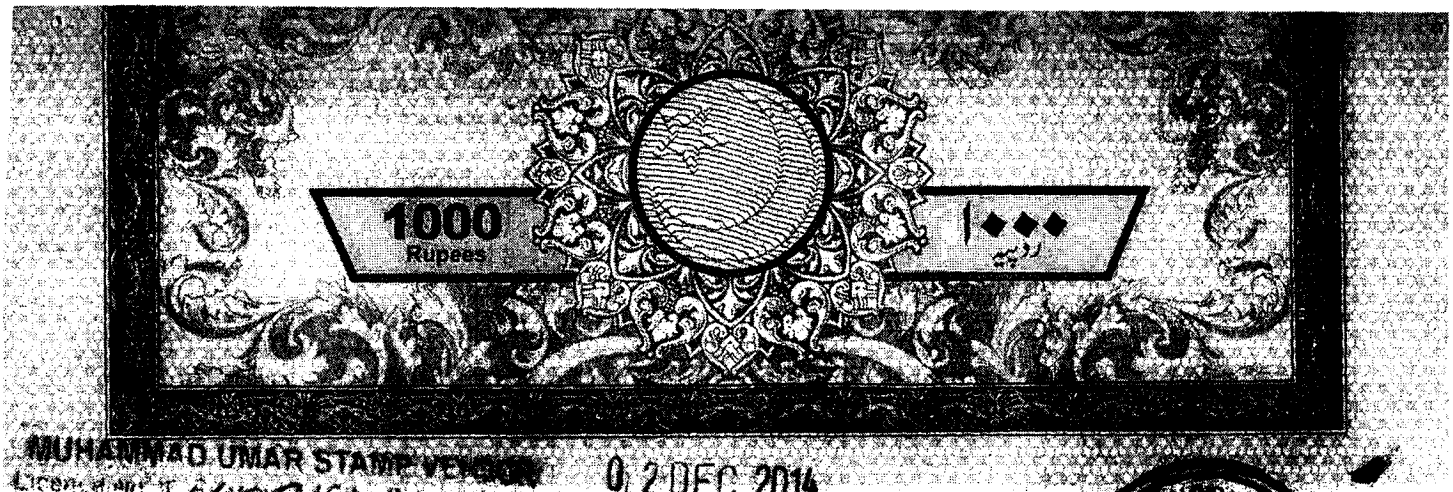
9) To sign all deeds of sale, purchase, lease, mortgage, redemption, re-conveyance and present them before the registering authority and admit execution thereof;

10) To execute all bonds, deeds and documents and give such security as may be required now or at any future time by the Government of Pakistan or by any person, corporate body, company or firm to enable the Company to carry on its business;

11) To appoint and authorize any officer of the Company as his agent or agents to admit execution of deeds and documents of whatsoever nature before the registering authority and to revoke such appointment or appointments;

12) To sign, execute, determine or terminate and negotiate terms and conditions thereto agreements/appointment for employment and training with employees and trainees, in line with requirements of the Companies Ordinance and Code of Corporate Governance as applicable;

13) To sign for and on behalf of the Company all documents, agreements, contracts, assurances, deeds, matters or things in or about the business of the Company as fully and effectively as the Company could do personally and to present such documents, agreements, contracts, assurances, deeds, matters or things to the registering authorities and appear before such authorities and admit execution thereof and to do all such other things and acts that may be necessary for registration;



MUHAMMAD UMAR STAMP VENDOR
License No. 16381 City Courts Karachi
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STAMP VENDOR'S SIGNATURE

02 DEC 2014

ADVOCATE NOTARY PUBLIC

14) To make and sign applications to appropriate Federal, Provincial or Local Government departments, authorities or other competent authority for all and any licenses, filing of any and all applications, petitions with NEPRA which include Licensee Proposed Modifications (LPMs) and others, permissions and consents required by any order, statutory instrument, regulation, byelaw or otherwise in connection with the business, management and affairs of the Company;

15) To obtain securities from any person, corporate body, company or firm for the due performance of any contract in respect of rendering any service or supplying any material to the Company and to accept the same on such terms as may be deemed proper or expedient by the Attorney;

16) To realize debts due to the Company and to receive any money due to the Company from any person, corporate body, company or firm and to grant receipts and discharges for the same;

17) To make payments to any person, corporate body, company or firm for any service rendered to the Company and for such other purposes of the Company and for carrying on of the Company's business and to sign and deliver all receipts, charges and drafts on the bank and other accounts of the Company or on the customers of the Company and to endorse all bills and bills of exchange received by the Company which may be necessary or expedient to be signed, endorsed or given for the purpose of carrying on of the Company's business;

18) To represent the Company before any Court of law, Federal, Provincial or Local Government authority or any other authority in all matters concerning the business or property of the Company;

19) To commence, institute, prosecute, and to defend, compound and abandon all proceedings, actions, suits, petitions, appeals, claims and demands by or against the Company or its officers in relation to the business or property of the Company or otherwise and for such purpose to sign, verify and present any document, pleading, complaint, writ, affidavit application or other instrument in writing and to appear and make statements on oath or otherwise in relation to the affairs of the Company and to appoint and remunerate any barrister, solicitor, advocate, pleader, vakil, mukhtar, or any legal practitioner or any revenue agent, accountants, valuers or surveyors for the said purpose and to obtain legal advice on behalf of the Company on any matter, contentious or otherwise, affecting the Company;

1000 Rupees

MUHAMMAD UMAR STAMP VENDOR

Licence No ... City Courts Karachi

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02 DEC 2014

STAMP VENDOR'S SIGNATURE

20) To write off amounts as approved by the Board of Directors arising as a result of correction / cancellation / adjustment of electricity bills in the normal course of business of the Company. To approve formula for write offs, adjustment and settlement of electricity bills based on prudent business practices / judgement and within the policy framework approved by the Board of Directors. To sub-delegate such of the powers as he deems fit to the concerned executives / officers of the Company, to fix authority limits, thereof, and to revoke the same at his discretion.

21) To obtain refund of stamp duty or repayment of court fees;

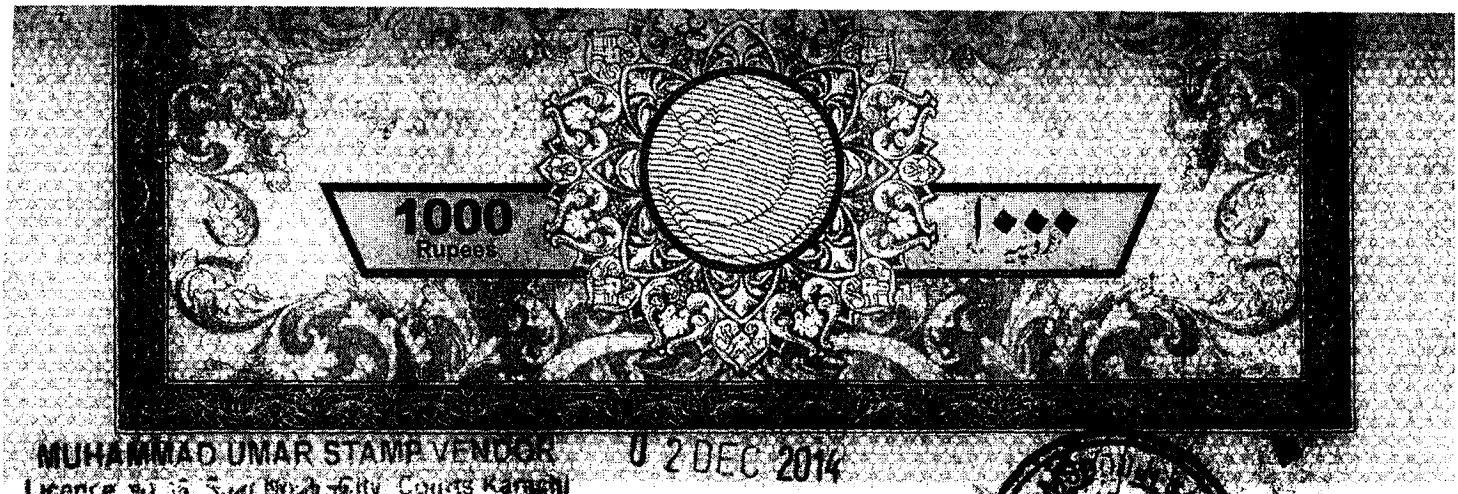
22) To appear and act in the offices of the District Registrar and Sub- Registrar of Deeds and Assurances for registration of documents and in any other office of the Federal, Provincial and local Government, including without prejudice to the generality of the foregoing, City District Government Karachi, any Union Council, District Council, Cantonment Board, Municipal Corporation, any Co-operative Society, State Bank of Pakistan, Collector of Customs, Excise & Taxation Offices and the Chief Controller of Imports and Exports in all matters concerning the business or property of the Company;

23) To file and receive back documents, to deposit and withdraw money and to grant receipts therefore;

24) To negotiate and to enter into and complete contracts with any person, corporate body, company or firm for the lease or purchase of any lands and buildings and to alter, repair, add to, and improve any building or structure and to let or sub-let any immovable property held by the Company and to submit plans of buildings relating to the Company's properties or lands on the Company's behalf before any competent authority and to obtain receipts therefor;

25) To use, sign and attest the name and style of the Company in any transaction, deed, document or muniment of title on all such occasions as may be necessary or expedient for conducting the business of the Company or for the due and proper management of the lands and buildings leased or purchased or to be leased or purchased by the Company and to execute and sign all such deeds and documents as may be required or proper for or in relation to all or any of the matters or purposes aforesaid;

26) To delegate to any person such of the powers as he deems fit and revoke the same at his discretion.



27) Generally to do all other acts and things incidental to the exercise of the aforesaid powers; and

28) The Company hereby agrees to ratify and confirm all and whatever the said Attorney shall lawfully do or cause to be done by virtue of this Power of Attorney.

The Power of Attorney executed in favor of Mr. Nayyer Hussain pursuant to the Resolution of the Board of Directors passed on 11 February 2013 is hereby revoked. This Power of Attorney will be valid till the time Mr. Muhammad Tayyab Tareen holds the position of Chief Executive Officer of KE.

IN WITNESS WHEREOF the Common Seal of the Company has been affixed hereto at Karachi on this the **02ND day of December 2014** by the undersigned directors of the Company pursuant to the resolution dated 27 November 2014 passed by the Board of Directors of the Company.

Signature of Mr. **Muhammad Tayyab Tareen**
Attorney

THE COMMON SEAL of)
the Company is hereunto)
affixed in the presence of)

Nayyer Hussain
Director

Syed Arshad Masood Zahidi
Director

ATTESTED
SHAMSUDDIN SHAIKH
B.A.LL.B
ADVOCATE
NOTARY PUBLIC
Karachi (South) Pakistan
03 DEC 2014

Energy That Moves Life

Dated: 21st May 2018

Authority Letter

WHEREAS, I, **Muhammad Tayyab Tareen** s/o Muhammad Ajmal Tareen, Muslim, adult, holder of CNIC No. 35202-3534433-1, the Chief Executive Officer of K-Electric Limited (the "Company"), having its registered office at KE House, 39-B, Sunset Boulevard DHA, Phase-II, Karachi, in terms of clause 14 of General Power Attorney (GPA) dated 2nd December 2014 given to me by the Board of Directors (BOD) of the Company, am empowered to make and sign applications to appropriate Federal, Provincial or Local Government Departments, authorities or other competent authority for all and any licenses, filing of any and all applications, petitions with NEPRA which include Licensee Proposed Modifications (LPMs) and others, permissions and consents required by any order, statutory instrument, regulation, byelaw or otherwise in connection with the business, management and affairs of the Company.

WHEREAS, Clause 26 of the GPA empowers me to delegate to any person such of the powers as I deem fit.

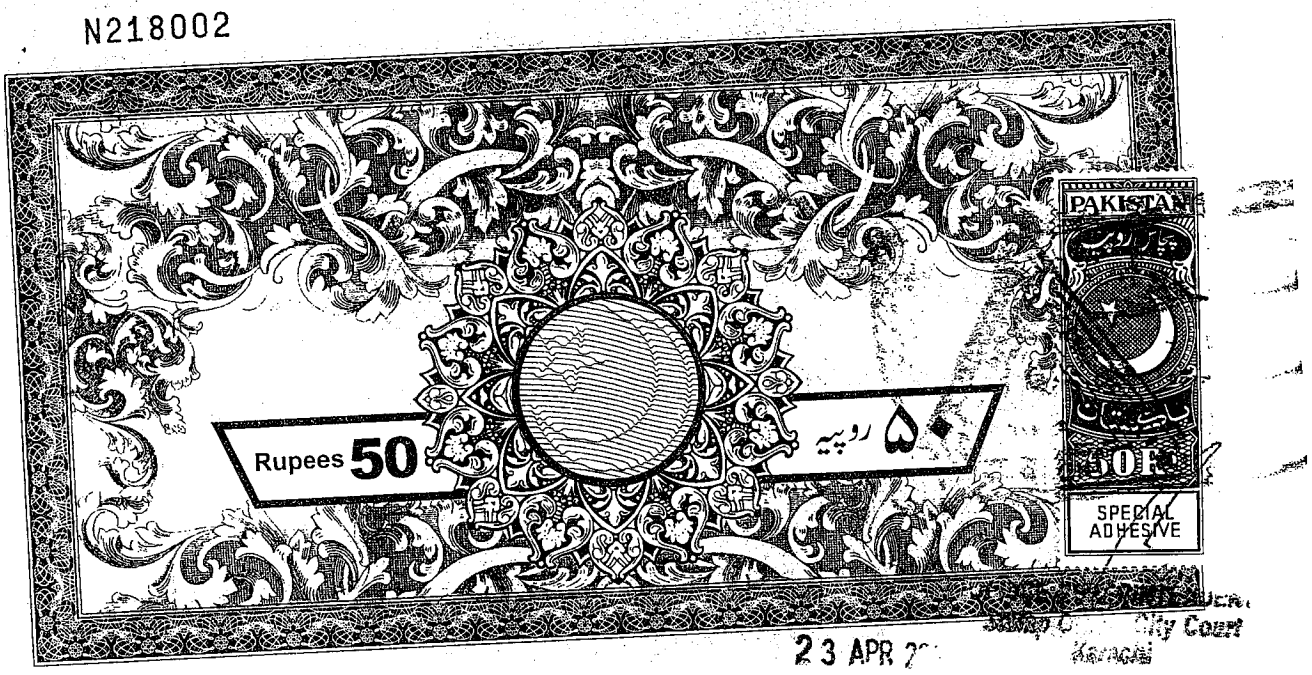
Now, therefore, in exercise of powers vested in me by the BOD of the Company through the above GPA, I, hereby authorize Muhammad Aamir Ghaziani s/o Muhammad Anwer, CNIC No. 42301-1189331-3, resident of House no. 74L-I, Block 2 PECHS, Karachi, Director Finance, KE to sign and file LPM with NEPRA related to enhancement in useful life of Units 1 and 2 of Bin Qasim Power Station – I (BQPS I) and such other deeds, documents, instruments, etc. and take all necessary actions incidental and related to the LPM and appear before the Authority for and behalf of the Company.

Muhammad Tayyab Tareen
Chief Executive Officer
K-Electric Limited

Authorized Person:

Muhammad Aamir Ghaziani
Director Finance
K-Electric Limited

N218002



KHTAR ALI STAMP VENDOR
...DATE...
...(ATTACHED)...
...VENDOR'S SIGNATURE...

M. Javed
Advocate
No: 4103

16 APR 2018

(RUPEES FIFTY ONLY)

LICENSEE PROPOSED MODIFICATION (LPM) IN GENERATION LICENSE (NO. GL/04/2002) BEFORE THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

AFFIDAVIT

I, Muhammad Aamir Ghaziani s/o Muhammad Anwar, having CNIC # 42301-1189331-3, Muslim, adult, resident of House No. 74L-1, Block 2, PECHS, Karachi, Director Finance & Regulations - KE, do hereby solemnly affirm and declare as under:

1. That I am the applicant in the subject matter and well conversant with the facts of the Licensee Proposed Modification (LPM).

2. The contents of the enclosed modification to the Generation License under Regulation 10(2) of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, are true and correct to the best of my knowledge and belief.

3. I affirm that all further documentation and information to be provided by me in connection with the aforesaid modification to the Generation License shall be true and correct to the best of my knowledge and belief.

4. That, I am authorized to sign and file the LPM with NEPRA and such other deeds, documents, instruments etc. and take all necessary actions incidental and related to the LPM and appear before the Authority and admit execution thereof for and on behalf of the Company.

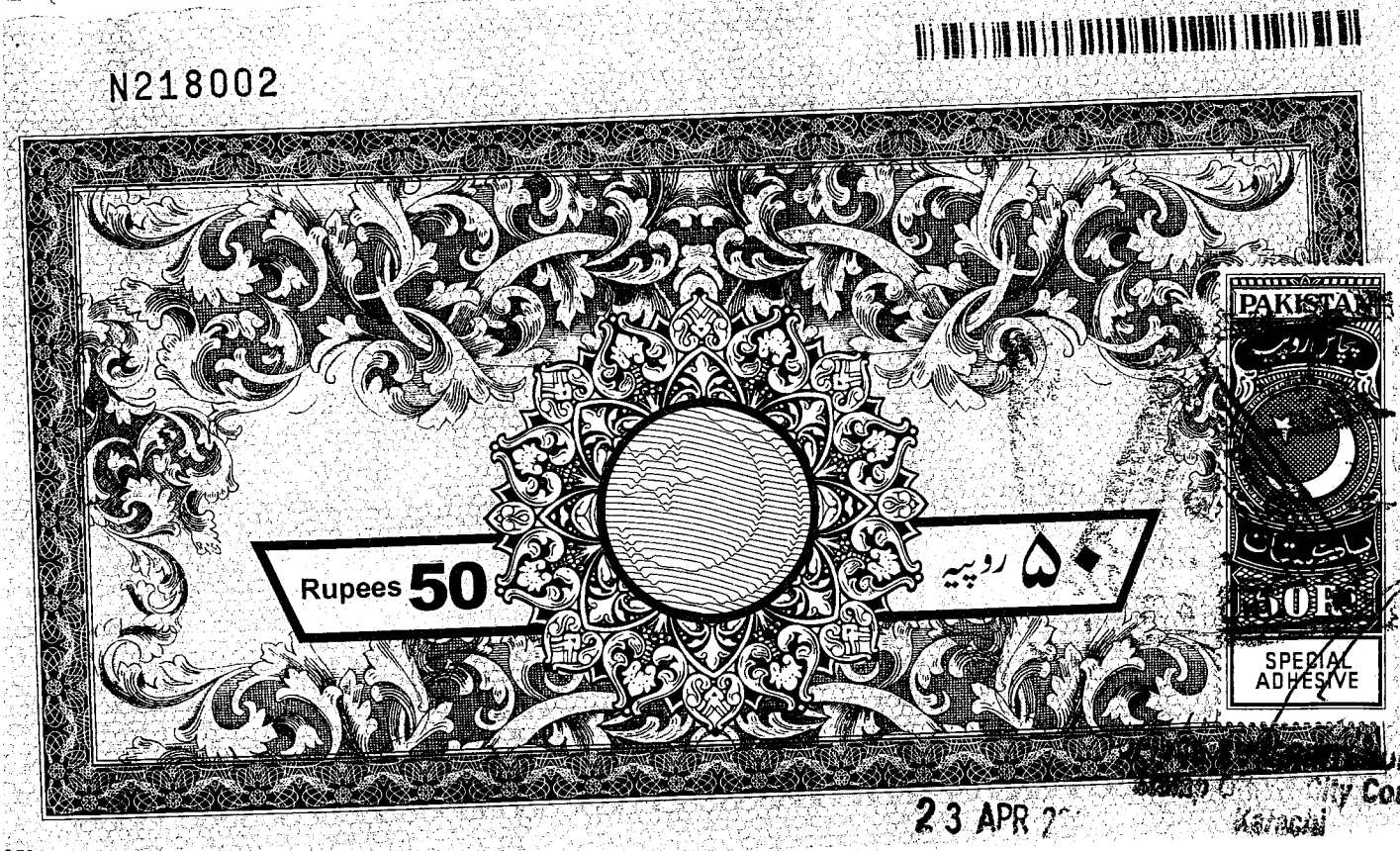
Dated: May 21, 2018

Deponent

M. AAMIR GHAZIANI
Director Finance & Regulations
K-ELECTRIC LIMITED

K-ELECTRIC LIMITED

N218002



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p. NADRA Office, S.I.T.E., Karachi
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UGH WITH ADDRESS.....
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RS .....(ATTACHED).....
P VENDOR'S SIGNATURE .....
mp paper is not valid for Divorce and Free Will purpose

M. Javed
Advocate
L.No. 4103

16 APR 2018

(RUPEES FIFTY ONLY)

LICENSEE PROPOSED MODIFICATION (LPM) IN GENERATION LICENSE (NO. GL/04/2002) BEFORE THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

AFFIDAVIT

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