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 - 07/7737-38 30-8-2003

Senior Engineer (Operations),
M/s. AES Lal Pir (Pvt) Ltd.
AES Thermal Power Station
Near Mahmud Kot
Muzaffargarh

Subject: **Grant of Generation Licence IPGL/06/2003**
Licence Application No. LAG 07
M/s. AES Lal Pir (Pvt) Ltd.

Please refer to your application No. Nil, dated 18.09.2000 for a Generation Licence.

2. Enclosed here is Generation Licence No. IPGL/06/2003 granted by the Authority to M/s. AES Lal Pir (Pvt) Ltd. The Licence is granted to you pursuant to Section 15 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)

(Mahjoob Ahmad Mirza)

Copy for information to Director General, Pakistan Environmental Protection Agency, 44-E, Office Tower, Blue Area, Islamabad.

National Electric Power Regulatory Authority
(NEPRA)
Islamabad – Pakistan

GENERATION LICENCE

NO. IPGL/06/2003

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

AES Lalpir (Pvt) Limited

Incorporated under the Companies Ordinance, 1984
Under Certificate of Incorporation

No. L07085 Dated 8th May 1994

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

Given under my hand this 26th day of August Two Thousand & Three and expires on 25th day of August Two Thousand & Twenty Seven.

Registrar

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REGISTRAR
(NEPRA)

National Electric Power Regulatory Authority
(NEPRA)
Islamabad – Pakistan

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Article 1
Definitions

(1) In this Licence:

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

b. "Agreements" means any or both of the Implementation Agreement and the Power Purchase Agreement,

c. "Authority" means the National Electric Power Regulatory Authority constituted under Section 3 of the Act, or any successor thereof;

d. "Implementation Agreement" means the Implementation Agreement dated 24th September 1994 between the Licensee and the President of Pakistan;

e. "Licensee" means AES Lalpir (Pvt) Limited;

f. "Power Purchase Agreement" means the Power Purchase Agreement dated 03rd November 1994 as amended between the Licensee and the power purchaser thereof and for the due performance of which a sovereign guarantee has been executed by the Government of Pakistan;

g. "Rules" means the National Electric Power Regulatory Authority Licensing (Generation) Rules, 2000, as amended from time to time;

(2) 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

(1) This Licence is issued subject to the provisions of the Rules, as amended from time to time.

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(2) During the subsistence of the Agreements entered into by the Licensee prior to the enactment of the Act, nothing contained in the Rules or this Licence shall be applied in a manner which is inconsistent with the Agreements and materially increases the obligations or impairs the rights of the Licensee under the Agreements.

Article 3
Generation Facilities

(1) 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.

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

Article 4
Term

(1) Pursuant to Rule 5 of the Rules, this Licence is granted for a term of Twenty-four (24) years.

(2) Unless revoked earlier, the Licensee may, ninety (90) days prior to the expiry of the term of the licence, apply for renewal of the Licence under the Licensing (Application and Modification Procedure) Regulations, 1999.

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 (Fee) Rules, 2002.

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Article 6
Competitive Trading Arrangement

(1) During the subsistence of the Agreements entered into by the Licensee prior to the enactment of the Act, the Licensee shall have the option to participate in such measures as may be directed by the Authority from time to time for development of a Competitive Trading Arrangement.

(2) Any variation or modification in the Agreements under the foregoing sub-article (1), for allowing the Licensee 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.

(3) In the event that the Licensee exercises its option to participate wholly or partially in development of the Competitive Trading Arrangement under the fore-going sub-article (1), 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 and in doing so, the Licensee shall not by any act or omission impede the development, implementation or operation of the Competitive Trading Arrangement.

Article 7
Maintenance of Records

For the purpose of sub-rule (1) of Rule 19 of the Rules, copies of records and data shall be retained in standard and electronic form and all such records and data shall, subject to just claims of confidentiality, be accessible by authorized officers of the Authority.

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Article 8
Compliance with Performance Standards

Subject to the provisions of Article 2(2), the Licensee shall comply with the relevant rules on performance standards as may be prescribed by the Authority from time to time.

Article 9
Compliance with Environmental Standards

The Licensee shall, to the full satisfaction of the relevant competent authority, comply with the environmental standards as may be prescribed by the aforesaid relevant competent authority from time to time.

Article 10
Provision of Information

Subject to the provisions of Article 2(2), the Licensee shall provide to the Authority all such information as the Authority may require.

Article 11
Revocation and Suspension

(1) In exercising its powers to suspend or revoke the Licence under Section 28 of the Act, the Authority shall issue a show cause notice of a period not less than 30 days.

(2) Pursuant to the powers under Rule 8(4), the obligations of the Licensee under Rule 8(3) stand modified to the extent of inconsistencies with the Agreements and in the event of termination of the Agreements, the Authority may revoke or suspend this Licence.

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Article 12

Approvals and Authorisations

Notwithstanding the provisions of Article 11(2), the Licensee shall apply to the Authority, where required, for approvals and authorizations under the Rules, including without limitation, the approvals and authorisations under Rule 8, Rule 10 and Rule 14.

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Schedule I

SCHEDULE 1

POWER PURCHASE AGREEMENT

MINIMUM FUNCTIONAL SPECIFICATIONS

The Complex consists of a single oil-fired unit with the following design ratings:

GROSS CAPACITY	=	362 MW
NET CAPACITY (AT MEAN SITE CONDITIONS)	=	337 (±5%) MW

The Site is located in the District of Muzaffargarh, Punjab Province near the town of Mahmud Kot. The Site area is characterized by dry tropical climate. Average rainfall is 195 mm per year, but this amount falls in short durations. Ambient conditions at the Site are expected to be as follows:

MEAN MAXIMUM AIR TEMPERATURE	=	43°C
MEAN MINIMUM AIR TEMPERATURE	=	5°C
MEAN ANNUAL SITE TEMPERATURE	=	25°C
EXTREME MAXIMUM AIR TEMPERATURE	=	50°C
EXTREME MINIMUM AIR TEMPERATURE	=	0°C
AVERAGE RELATIVE HUMIDITY	=	52%

A maximum earthquake design factor of 0.15 g will be utilized for the design of the plant buildings and structures and the design wind speed will be 162 km\hr.

The average Site elevation is approximately 117m to 122m with respect to mean sea level (MSL). All key structures will have an elevation of approximately 0.3m above the surrounding ground elevation. Access to the Site will be provided by paved road off the D.G. Khan-Kot Addu highway.

The main power block consists of a single, residual fuel oil-fired 1,200,000 kg/h, forced draft boiler and a single 362 MW reheat, condensing, two casing, double flow type steam turbine generator. The turbine generator is arranged in the turbine house which is connected to the control and electrical building. The boiler is located outdoors, perpendicular to the turbine house. Other plant buildings and structures

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outside of the main power block include the following:

- Administrative building
- Workshop and store
- Fuel oil pumphouse
- Chlorination building
- Fuel storage facilities
- Diesel generator building
- Auxiliary boiler house
- Water treatment plant house
- Firefighting pumphouse
- Gate house
- Hydrogen generator building
- Cooling water pumphouse
- Air compressor building
- Housing Colony

The Complex will use a regenerative reheat cycle. The turbine generator will be designed for 169 kg/cm^{2}g, 538/538°C steam conditions and constant pressure operation. The feedwater heating stages will consist of three high pressure heaters, a dearator, and four low pressure heaters. The high pressure drains will cascade to the dearator, and the low pressure drains will cascade to the condenser. The main condenser shall be a two pass split design. The electric-driven boiler feed pumps will be located on the ground floor taking suction from the dearator.

Cooling will be supplied via a closed cycle cooling system using canal water or tube well water as a makeup source.

The boiler is a drum type, forced circulation, outdoor type boiler with a pressurized furnace. The boiler steam output at boiler MCR is 1,200,000 kg/h, 176 kg/cm^{2}g, 541/541°C. The primary fuel will be residual fuel oil, with diesel being available for light-off if required.

The turbine generator will have a designed gross rating of 362 MW at the generator terminals at 68 mm Hg backpressure, 0 percent makeup, with extractions for 8 stages of feedwater heating, two air rejectors and inlet steam conditions of 169 kg/cm^{2}g, 538°C/538°C, with a circulating water temperature of 30°C.

The generator will be nominally rated at 426 MVA, 0.85 lagging and 0.90 leading power factor, 24 kV, 3 phase, 50 cycle, 0.569 short circuit ratio and 4.5 bar abs rated hydrogen pressure.

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The Complex will be capable of operation within a voltage range of ± 10% on the 220 kV system.

The Complex will be supplied with a 426 MVA generator transformer, a start-up transformer and a unit auxiliary transformer.

Interconnection with the WAPDA system will be via a 220 kV, conventional type, 5-circuit breaker outdoor substation. Provisions will be made for two 220 kV transmission lines. The circuit breakers will be SF6, for outdoor installation, 3 single pole type.

A common control room is provided to monitor and control the Complex. Operator interfaces for control of the Complex will be via an integrated microprocessor based control system with hard-wired switches for plant trip action. The plant control systems will include a data acquisition system.

Fuel supply to the Complex will be via railroad to Mahmud Kot and an approximately 1.5 km pipeline to the Site. The Site will have sufficient residual fuel oil storage capacity to support operation of the Complex for the equivalent of 100% of full load for 30 Days.

All material, plant, equipment and machinery incorporated in the construction of the Complex shall be new and unused.

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SCHEDULE 2

TECHNICAL LIMITS

1. Design Limits

1.1 Unit Starts

(a) The notice required by the Company to start-up the Complex and synchronize to the WAPDA Grid System will vary according to the length of time the Unit has been shutdown. Table 1 below shows the length of notice required against various periods of shutdown.

Table I

Length of Shutdown		Notice required to synchronize
(i)	Not more than 2 hours	30 minutes
(ii)	More than 2 hours but not more than 8 hours	90 minutes
(iii)	More than 8 hours but not more than 32 hours	130 minutes
(iv)	More than 32 hours but not more than 150 hours	300 minutes
(v)	More than 150 hours	400 minutes

(b) For the purposes of this Schedule start up of the Complex is classified as follows:

"Hot Start" - A start following a shutdown period as per (i) or (ii) above.

"Warm Start" - A start following a shutdown period as per (iii) or (iv) above.

"Cold Start" - A start following a shutdown period as per (v) above.

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and the reference to starts, starting or started means the process of firing the boiler, running up the turbine generator and synchronizing it to the WAPDA Grid System.

(c) The notice required to synchronize under item (i) above shall apply provided the previous shutdown was not the result of a trip or a planned outage or a maintenance outage.

(d) Starting of the Complex shall be subject to the following limits for each Unit:

Table 2

Type of Starts	Total number of starts over 30 years	Maximum number of starts per year
Hot Starts	1500	52
Warm Starts	600	26
Cold Starts	60	6

For the purpose of this subsection (d), a start shall be deemed to have occurred upon synchronization of the Unit to the WAPDA Grid System, or a boiler having been brought to 70 bars at the request of WAPDA and subsequently depressurized.

(e) Availability of the Hot Standby option shall be subject to WAPDA giving notice to the Company to put the Complex on Hot Standby within two hours of the Complex being shutdown and shall be subject to turbine status to be advised by the Company.

1.2 Complex loading

(a) The Complex load ramping rate is the steady rate at which the load can be raised. The maximum load ramping rates are shown below in Table 3:

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Table 3

Complex Load Range		Cold Start % per minute	Hot Start % per minute
(i)	0 < 25	1.0	1.0
(ii)	> 25 < 50	1.0	2.0
(iii)	> 50 < 100	1.0	3.0

(b) Complex load percentages in this Schedule refer to the load at the generator terminals as a percentage of gross capacity.

(c) Complex loads will be required to be held steady for the following periods for temperature stabilization of the turbine during load increases as follows:

	Cold Start	Hot Start
upon synchronization	30 minutes	0 minutes
at 25% unit load	10 minutes	10 minutes
at 50% unit load	10 minutes	10 minutes

Subject to turbine conditions the Company may shorten or waive the requirement for one or more of the stabilization periods.

(d) Ramping rates and stabilization periods following a Warm Start shall be greater and less respectively than the levels of Cold Start but shall be greater or less respectively than the levels for Hot Start and shall be determined by the Company with due regard to turbine conditions.

(e) Step changes in Despatched load of up to 5% are allowable provided that Complex load is in the range of 25% to 95%. After such step change the new complex load must be held constant for 30 minutes for stabilization purposes, or for a pro rata period for lesser step changes.

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(f) The Complex can withstand a full load rejection and remain in a safe condition. Provided the Complex auxiliaries are operated continuously, the Complex can be re-synchronized within one hour provided that the reason for the load rejection has been removed.

(g) The Complex minimum continuous loading shall be 20%.

1.3 Frequency, Power Factor, Voltage Limits and Droop Settings

(a) The Complex will operate at 100% load with a power factor in the range 0.85 lagging to 0.90 leading which range shall not be exceeded. At 0% load the Complex has a Reactive Power capability of 225 MVAR leading and 345 MVAR lagging at the 24 kV base.

(b) The Complex can operate within the range ± 10% on the 220 kV high voltage system which range shall not be exceeded.

(c) The Complex can operate within the frequency range 47.5 Hertz to 52.5 Hertz which range shall not be exceeded.

(d) The Complex will be subject to tripping if frequency and/or voltage fluctuations outside the ranges stated in 1.3(b) and 1.3(c) occur.

(e) The Unit governor droop is adjustable in the range 1.5% to 8%. The AVR will control the generator voltage over the range of ± 10% of rated voltage with a droop characteristic of ± 0.5%.

1.4 General

(a) The Company shall advise WAPDA of any temporary operating constraints and limits which may from time to time apply to the Complex.

2. Design Maintenance Limits

The estimated cycle of Scheduled Outages is set out in Table 4 below together with a manufacturer's recommended durations for such inspections.

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TABLE 4

Approximate 12 Month Periods	Estimated Duration of Scheduled Outage (days)	Nature of Inspection
First	30 days	Total plant inspection
Second	30 days	Minor overhaul
Third	30 days	Simple overhaul
Fourth	30 days	Simple overhaul
Fifth	60 days	Major overhaul

Scheduled Outages thereafter continue on a 4 year cycle as per years Second to Fifth above. The scheduling of maintenance inspections will be compatible with applicable government regulations and Prudent Utility Practices.

3. Prudent Utility Practices

Notwithstanding anything to the contrary, the Company shall operate and maintain the Complex in accordance with Prudent Utility Practices.

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SCHEDULE 3

INTERCONNECTION FACILITIES AND TRANSMISSION FACILITIES

1. Interconnection and Transmission Facilities

(a) The connection between the Complex and WAPDA's 220 kV substation at Muzaffargarh shall be by dual circuit 220 kV transmission lines. The transmission lines will terminate in the substation of the Complex, the location of which is shown on the Site plan Figure 1. The circuits of the transmission lines will connect at line ganteries provided by the Company as shown on the single line diagram of the substation at Figure 2. The boundary of responsibility between the Company and WAPDA will be at the top of the line ganteries (the "Interconnection Point"). The Company will provide WAPDA with an earth connection from the earthing system of the Complex. WAPDA will install the Metering System which together with the transmission line referred to above within the Site boundary shall comprise the "Interconnection Facilities." This equipment will remain the property of WAPDA and shall be commissioned and maintained thereafter by WAPDA.

(b) Protection. A carrier intertripping circuit for each transmission line shall be provided between the line circuit breakers at the Complex owned by the Company and the line circuit breakers at Muzaffargarh owned by WAPDA.

2. Design Data

The following design data has been provided by the Company to WAPDA to enable completion of the design of the Interconnection Facilities and the Transmission Facilities.

2.1 Generator design Data

(a) Rating:

Rating	362 MW
Nominal Rated Capacity at 4.5 bar abs hydrogen pressure	425,880 kVA

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	Power factor	0.85 lagging 0.90 leading
	Rated hydrogen pressure	4.5 bar abs
	Number of phases	3
	Number of poles	2
	Frequency	50 Hz
	Rated speed	3000 rpm
	Terminal voltage	24 kV
	Short circuit ratio at rated MVA	0.569 (tolerance is according to IEC)
	Excitation system	static excitation
(b)	Generator Reactances (at the rated MVA & kV base)	
	Unsaturated direct axis synchronous reactance	193%
	Saturated direct axis sub-transient reactance	23%
	Saturated direct axis transient reactance	< 30%
	Negative; phases sequence reactance: - unsaturated - saturated	 24% 21%
	Zero phase sequence reactance	10%
	Leakage reactance	19%
(c)	Generator time constants	
	Direct axis open circuit time constant.	5.3 seconds

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Direct axis open circuit subtransient time constant	0.045 sec.
Direct axis short circuit transtransient time constant	0.93 sec.
Direct axis short circuit subtransient time constant	0.031 sec.

(d) Inertia constant

generator plus turbine	9.0×10^{-3} sec./MVA (3.26 kW sec/kVA)

Note: The above design values will have tolerances as specified in the relevant IEC standards.

2.2 Excitation System

Excitation of the main generator is provided by a static excitation system using a thyristor rectifier. The excitation control system has two voltage regulators which are automatic voltage regulator (AVR) and manual excitation control (MEC). During normal operation, the whole excitation system is subject to automatic control by means of AVR.

Technical Characteristics:

(i) Voltage setting range for AVR operation. 90 to 110% of Un.

(ii) Voltage adjusting range for MEC operation. 50% of Ifo to 110% of Ifn.

(iii) Generator terminal voltage is held within ± 10% from no load to full load at rated frequency

(iv) Under the maximum direct current supplied from the excitation system for a specified time, the ceiling voltage to the generator field voltage is 5.4 p.u.

(v) The transfer function diagram of excitation system will be provided later.

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2.3 Generator Transformer

MVA rating	426 MVA OFAF
Rated voltage	HV: 220 kV; LV: 24 kV
Maximum and minimum operating voltages	245/176 kV (rms)
Connection of winding	HV: Star; LV: Delta (YNdl)
Taps of winding:	220 $\pm$10% kV
Positive and zero sequence reactances	19% on rated kV and MVA base
i. HE-L (Leakage):	Short circuit impedance 20.0% V_{oc} of rated MVA and kV base.
ii. HE-T (Leakage):	N/A
iii. L-T (Leakage):	N/A
Magnetizing reactance at rated voltage (from H.V. terminal)	45,360 ohm/phase
X air core (from H.V. terminal)	40 ohm/phase
X air core (from L.V. terminal) Saturation curve at no load V (rms) versus I (rms)	0.84 ohm/phase

2.4 The governor droop will be adjustable from 1.5% to 8% and is designed to operate over the frequency range 47.5 to 52.5 Hz.

2.5 The AVR will control the generator voltage over the range of ± 10% of rated voltage with a droop characteristic of ± 0.5%.

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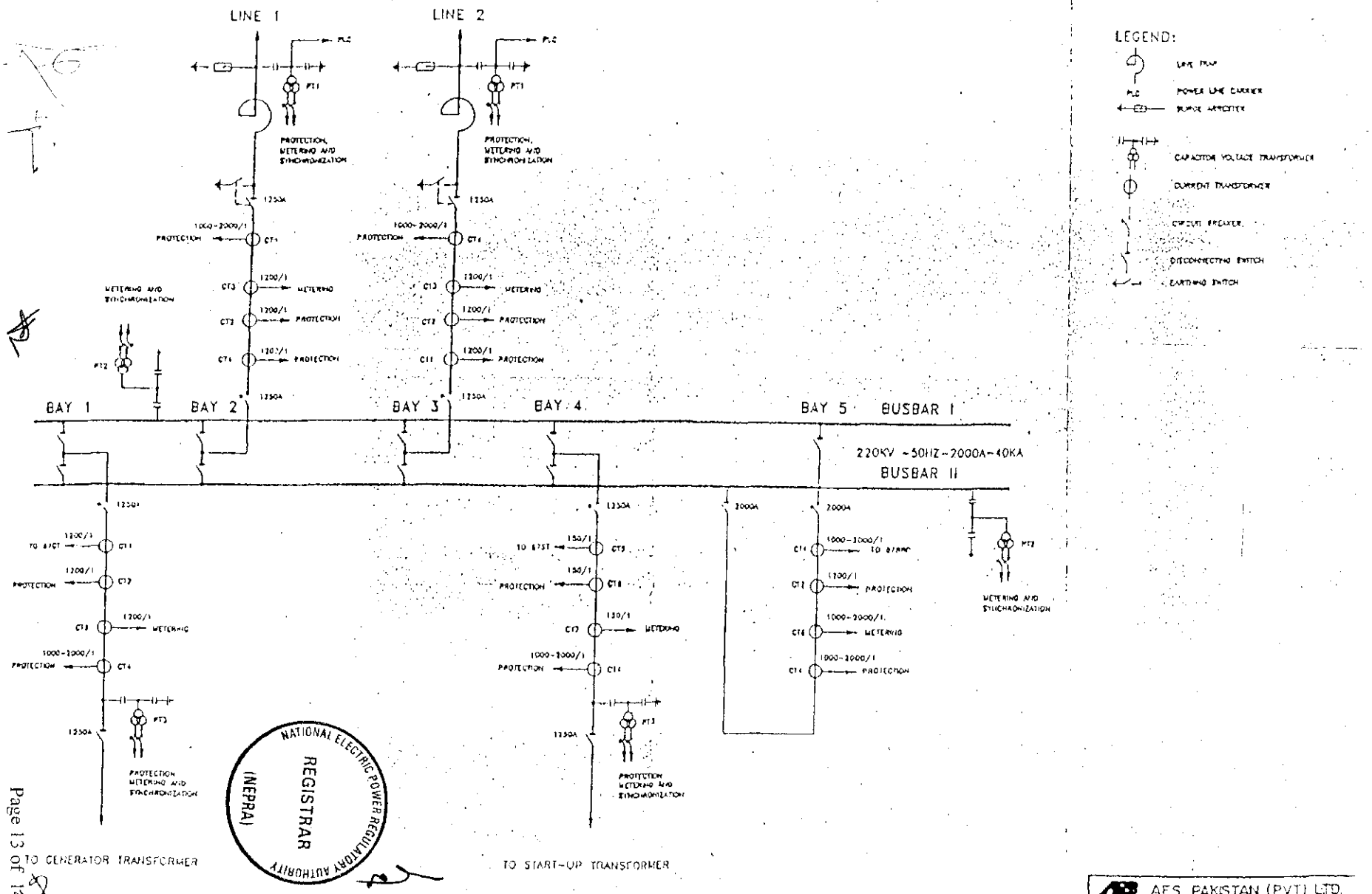

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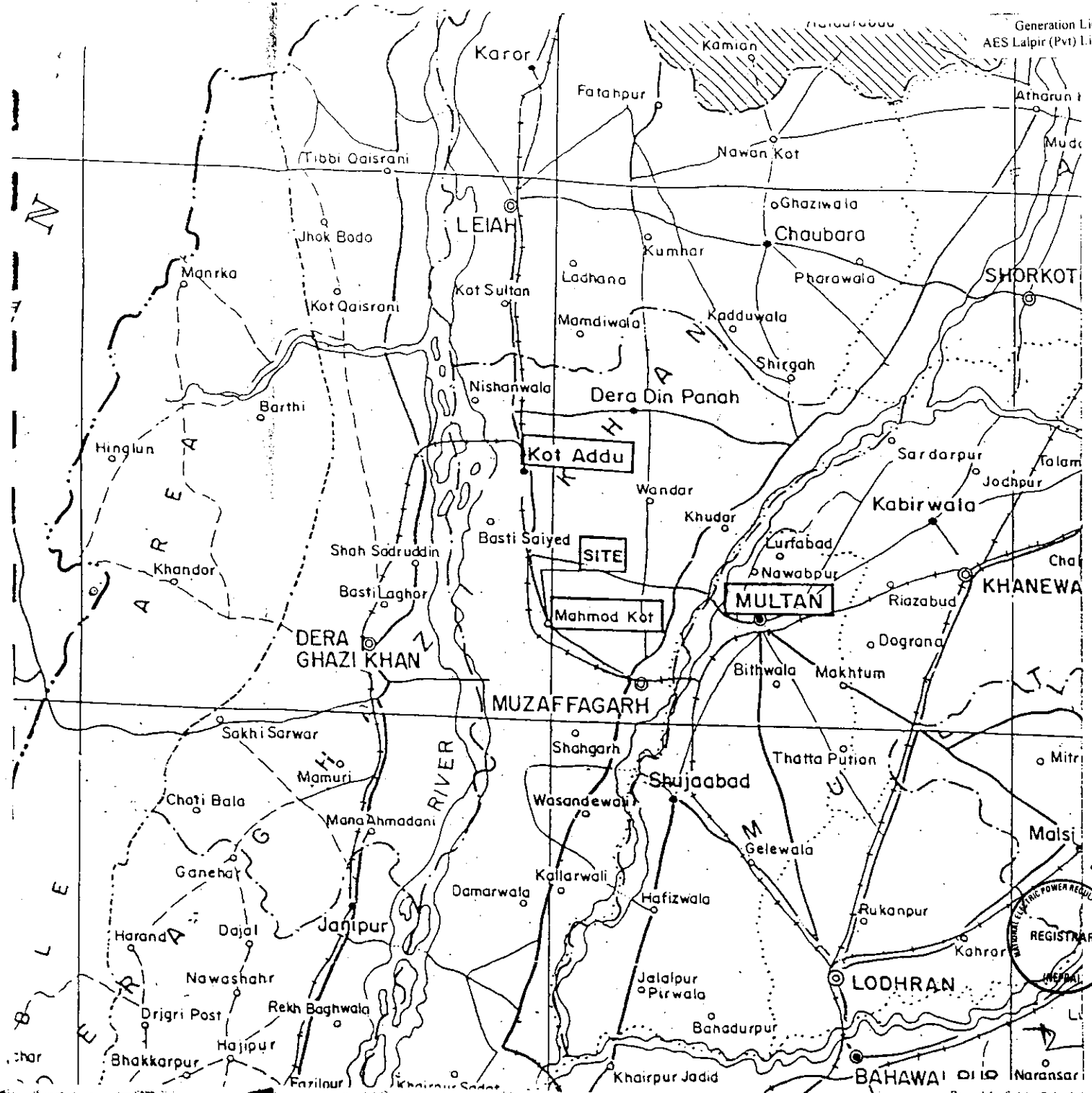
Figure 2

POWER PURCHASE AGREEMENT

AES PAKISTAN (PVT) LTD.
LALPIR & PAK GEN - OIL-FIRED POWER PLANT PROJECT
NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED CONSULTING ENGINEERS
SINGLE LINE DIAGRAM 220KV SWITCHGEAR


Karor
Kamian
Fatahpur
Tibbi Qaisrani
Nawan Kot
Ghaziwala
LEIAH
Chaubara
Jhok Bodo
Kumhar
Manrka
Ladhana
Pharawala
SHORKOT
Kot Sultan
Kot Qaisrani
Mamdiwala
Kadduwala
Shirgah
Nishanwala
Dera Din Panah
Barthi
Hinglun
Kot Addu
Sardarpur
Jochpur
Wandar
Kabirwala
Khudar
Basti Saiyed
SITE
Lurfabad
Shah Sadruddin
Khandor
Nawabpur
MULTAN
KHANEWA
Basti Laghor
Riazabud
Mahmod Kot
DERA
GHAZI KHAN
Dograna
Bithwala
Makhtum
MUZAFFAGARH
Sakhi Sarwar
Shahgarh
Thatta Pution
Mamuri
Shujaabad
Chati Bala
Wasandewali
Mana Ahmadani
Gelewala
Malsi
Ganehar
Kallarwali
Damarwala
Hafizwala
Rukanpur
Harand
Dajal
Janipur
Kahror
Nawashahr
Jalalpur
Pirwala
LODHRAN
Drigri Post
Rekh Baghwala
Bahadurpur
Hajipur
Bhakkarpur
Khairpur Jadid
BAHAWAL
Naransar
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Schedule II

INSTALLED CAPACITY (GROSS) & NET CAPACITY

Installed Gross Capacity	362MW
Net Capacity	337±5%MW

Note: Net Capacity – These are indicative figures only as provided by the Licensee. The net capacity available to NTDC for dispatch and other purchasers will be determined through procedures contained in the Agreements or Grid Code.

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