National Electric Power Regulatory Authority

Islamic Republic of Pakistan

Registrar

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No. NEPRA/R/LAG - 09/7741-42

30 ·9· 2003

Chief Operating Officer
M/s. TNB Liberty Power Ltd.
92 Razia Sharif Plaza
4th Floor, Blue Area
Islamabad

Subject: **Grant of Generation Licence IPGL/08/2003**
Licence Application No. LAG 09
M/s. TNB Liberty Power Ltd.

Please refer to your application No. LPL/HQ 2.3/172 dated 10.11.2000 for a Generation Licence.

2. Enclosed here is Generation Licence No. IPGL/08/2003 granted by the Authority to M/s. TNB Liberty Power 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/08/2003

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: -

TNB Liberty Power Limited

Incorporated under the Companies Ordinance, 1984
Under Certificate of Incorporation

No. I-01785 Dated 20th January 2003

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 Six.

Registrar

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
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National Electric Power Regulatory Authority
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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 22nd November 1995 between the Licensee and the President of Pakistan;

e. "Licensee" means TNB Liberty Power Limited;

f. "Power Purchase Agreement" means the Power Purchase Agreement dated 26th November 1995 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-three (23) 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

MINIMUM FUNCTIONAL SPECIFICATIONS

The Complex consists of a gas fired unit with the following design ratings based on natural gas, and the conditions specified below :

ISO Conditions

GROSS CAPACITY (G.T. UNIT)	=	156,771 kW
TOTAL GROSS OUTPUT	=	156,771 kW
TOTAL NET OUTPUT	=	155,414 kW

Under the following conditions;

Air Temperature 15^0C
Barometric Pressure 1013 mbar
Relative Humidity 60%

GROSS CAPACITY (S.T. UNIT)	=	79,872 kW

Mean-Site Conditions :

Air Temperature	30 °C
Relative Humidity	60%
Site Elevation	99 metre
Barometric Pressure	1000.5 mbar

GROSS CAPACITY (G.T. UNIT)	=	139,080	kW
GROSS CAPACITY (S.T. UNIT)	=	77,610	kW
TOTAL GROSS OUTPUT	=	216,700	kW
TOTAL AUXILIARY POWER	=	4,770	kW
TOTAL NET OUTPUT	=	211,930	kW

The Site is located within the jurisdiction of Mirpur Mathelo, 7 km west of the town of Daharki of the Province of Sind. The area is bordered on the northern edge by the Karachi-Multan main National Railway and on the Southeast property line by the Sher Khan irrigation canal. The Site area is characterized as sub-tropical. Average rainfall 332mm per year, but this amount falls in short durations. Ambient conditions at the Site (based on data from Sukkur) are expected to be as follows :

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Maximum Temperature recorded	50 °C	(11 June 1979)
Minimum Temperature recorded	-1.5 °C	(15 December 1986)
Monthly Average Max. Temperature	36 °C	(June)
Monthly Average Min. Temperature	15.6 °C	(January)
Average Min. Relative Humidity	35%	(May)
Average Max. Relative Humidity	77%	(August)
Maximum Wind Speed	140 km/hr	

A maximum earthquake design factor of g/15 to g/20 (m/sec^2) will be utilized for the design of the plant buildings and structures and the design wind speed will be in accordance with the Building Code of Pakistan, i.e.145 km/hr in (3 second gust).

The Site will be at an elevation of 99 metre with respect to mean sea level (MSL). All structures will have a ground floor elevation of at least 99.1 above MSL. Access to the Site will be provided from the north by an access road from the main Karachi-Multan highway over the railway line mentioned above.

The Complex will compise a combined cycle unit based an ANSALDO V94.2 gas turbine, a heat recovery steam generator (HRSG), a steam turbine, two electrical generators and all necessary auxulliaries including condenser, pressurized deaerator, preheater for the condensate water, pumps and piping systems for steam and feedwater. All of this equipment (except for theHRSG)is located in a turbine/generator building of steel structure with cladding and equipped with an overhead crane for errection and maintenance. The HRSG, the by-pass stack and the main stack are located behind the turbine/generator building. Other plant buildings, equipment and structures include :

Main Transformers
Water Treatment Plant
Waste Treatment Plant
Gas Reducing Station
Compressed Air System
Electrical/Control Building
Fire Fighting System
Auxiliary Boiler
Cooling Tower
132kV Substation
Emergency Diesel Generator
Administration Building
Workshop/Warehouse
Black Start Facility
Residential Colony
Liquid Fuel Storage Tanks

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The high pressure (H.P.) section of the turbine receives the steam produced in the H.P. stage of the HRSG.The low pressure (L.P.) section of the turbine receives exhaust steam from the H.P. turbine and the L.P. section of the HRSG. The plant is equipped with H.P. and L.P. steam by-pass (50% capability) which provides high operational flexibility and ensures minimum water losses. The H.P.bypass and the L.P. bypass are provided with pressure reducing valves and water attemperation. A turbine steam extraction line supplies steam from the L.P. turbine section to the deaerator. The line is equipped with a motor operated isolation valve and a check valve as protection against steam reverse flow and turbine water entering. Upstream of the deaerator condensate is preheated by an L.P. heater fed by extraction from the steam turbine.

Steam from the turbine is condensed in a double pass condenser located below of the steam turbine. The cooling system for the condensate comprises a wet cooling tower using make-up water from a water well system.

The main pumps are as follows:

Two 100% duty, motor driven, vertical, multi-stage canned type, centrifugal condensate extraction pumps.

Two 100% duty single suction, multistage centrifugal type L.P. feedwater pumps

Two 100% duty single suction, multistage centrifugal type H.P. feedwater pumps.

An auxiliary boiler of adequate capacity is installed to provide auxiliary steam for start-up.

The HRSG has an horizontal arrangement, with a self supporting box type casing; it is a drum type natural circulation water tube boiler, with two pressure levels, without supplementary firing, designed for sliding pressure operation. A gas turbine flue-gas by-pass is provided in order to allow the gas turbine to be started independently from the steam cycle. The unit is formed in a multiple bank arrangement; all banks are located in a horizontal duct with the gas flowing from the outlet of the gas turbine to the stack. The boiler has a high pressure (H.P.) section, and a low pressure (L.P.) section which generate superheated steam for the high pressure turbine and for auxiliary services. Each pressure section of the boiler includes a superheater, an evaporator and an economizer. The L.P. section is fed by two 100% duty feedwater pumps which take suction from the deaerator. The H.P. section is fed by two 100% feedwater pumps which also take suction from the L.P. drum.

The cooling tower is an induced draught, counterflow type, with film filling , comprises four cells and the design will comply with CTI Standards.The hot water delivered through the riser is evenly distributed over the cell area by means of spray nozzles.The four induced draught fans are driven by electric motors.

The gas turbine generator will be nominally rated at 200 MVA, 0.8 lagging and 0.9 leading power factor, 15.000V ± 5%, 3 phase, 50 cycle, >0.5 short circuit ratio and air cooled .

The steam turbine generator will be nominally rated at 100 MVA, 0.8 lagging and 0.9 leading power factor, 11.500V ± 5%, 3 phase, 50 cycle, >0.5 short circuit ratio and air cooled.

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The Complex will be capable of operation within a voltage range of ± 10 % on the 132 kV system and will be provided with Automatic Generation Control (AGC) equipment.

The following power transformers will be provided:

One Gas Turbine Generator transformer, rated at 206 MVA with an ambient temperature of 40° C, a voltage ratio of 132/15 kVand fitted with an on-load tap changer.

One Steam Turbine Generator Transformer, rated at 100 MVA with an ambient temperature of 40° C, a voltage ratio of 132/11.5 kV and fitted with an on-load tap changer.

The generator transformers will be a three-phase, two winding transformer for outdoor installation equipped with on-load tap changer, with forced oil-forced air cooling (ONAF)

Interconnection with the WAPDA 132kV system will be via an outdoor type substation. using SF6 circuit breakers, incorporating a one-and-a-half breaker scheme or an alternative acceptable to WAPDA.

The plant automation system is a microprocessor based system, using distributed logic and designed to support integrated functions (open and closed loops implemented together on the same controller)

The equipment for the main plant automation system will be located in the equipment room near the central control room and will be designed and sub-divided according to the following plant functional areas :

Gas Turbine and Generator
Heat Recovery Steam Generator
Steam Turbine & Balance of Plant

Fuel supply to the Complex will be via gas pipelines from gasfields located at East Kandhkot and East Badin (Extension) Block B. Liquid back-up fuel facility will be provided sufficient for up to 15 days operation.

All material, plant, equipment and machinery incorporated in the construction of the Complex shall be brand 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 for the gas turbine (GT) and the steam turbine (ST).

Table 1

Length of / Shutdown			Time required to synchronize the comined cycle	
			GAS TURBINE	STEAM TURBINE
HOT	(i)	Not more than 2 hours	15 min before GT firing + 4 min for GT set synchronizing and a further 5 min for full load	15 min after GT firing ST generator synchronization + 20 min for full load
	(ii)	More than 2 hours but not more than 8 hours	15 min. before GT firing + 4 min. for GT set synchronizing and a further 5 min for full load	25 min after GT firing ST generator synchronization + 25 min for full load
WARM	(iii)	More than 8 hours but not more than 48 hours	15 min. before firing + 4 min. for GT set synchronizing and a further 5 min for full load	35 min. after GT firing ST generator synchronization + 70 min for full load
	(iv)	More than 48 hours but not more than 150 hours	15 min. before firing + 4 min. for GT set synchronizing and a further 5 min for full load	intermediate values between (iii) and (v)
COLD	(v)	More than 150 hours	15 min before GT firing + 4 min for GT set synchronizing and a further 14 min for full load	70 min after GT firing ST generator synchronization + 120 min for full load

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

(c) The notice required to syncronise in Table 1 above shall apply provided the previous shutdown was not the result of a trip.

(d) Starting of the Complex shall be subject to the following limits.

Table 2 Steam Turbine

Type of Starts	Total aggregate maximum number of starts (based on 30 years operating)	Maximum number of starts per year
Hot Starts	7500	250
Warm Starts	1800	60
Cold Starts	210	7

For the purpose of this subsection (d), a start shall be deemed to have occurred upon synchronization of the Complex to the WAPDA Grid System.

Gas turbine starts are not limited.

1.2 Complex loading

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

Table 3 - Steam Turbine

	Complex Load Range	Cold Start % per minute	Warm Start % per minute	Hot Start % per minute
(i)	0 <25	1.0 %	1.5 %	4.0%
(ii)	>25 <50	1.5 %	2.0 %	5.0%
(iii)	>50 <100	2.0%	2.5%	5.0%

The gas turbine loading rate in open cycle operation is 30MW/min

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

(c) Ramping rates following a Warm Start shall be greater and less respectively than the levels for a Cold Start but shall not be greater or less respectively than the levels for a Hot Start and shall determined by the Company with due regard to turbine conditions.

(d) Step changes (increases or decreases) in Despatched load of up to 20% are allowable provided that Complex load is greater than 25%.

(e) The Complex shall be able to withstand a full or part load rejection and continue to operate in a safe condition, with the Complex auxiliaries in continuous operation. After any full load rejection, the Complex shall be able to be re-synchronized within one hour of the occurrence of such full load rejection has been removed.

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

1.3 Frequency, Power Factor, Voltage Limits and Droop Settings

(a) The Generators will operate at 100% load with a power factor, at generator terminals, in the range :
- 0.8 lagging to 0.9 leading for the GT unit.
- 0.8 lagging to 0.9 leading for the ST unit

which range shall not be exceeded.
At 0% load the Generators have a Reactive Power capability of :
- 162 MVAR/84 MVAR lagging/leading for the GT unit
- 82 MVAR/47 MVAR lagging/leading for the ST unit

At 100% load, the Generators have a Reactive Power capability of :
- 120 MVAR/78MVAR lagging/leading for the GT unit
- 60 MVAR/42 MVAR lagging/leading for the ST unit

(b) The Complex can operate within the range ± 10% on the 132 kV high voltage system which range shall not be exceeded.

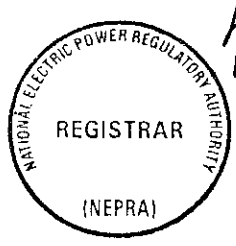
(c) The Complex can operate within the frequency range 47.5 Hertz to [52.0] Hertz without any time limits. Operation in the range [52.0] Hertz to 53 Hertz shall be limited to 30 minutes over the life of the plant.

(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 2% to 8%. The automatic voltage regulator droop setting is adjustable in the range ± 10% of rated voltage.

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

TABLE 4

EQUIVALENT OPERATING HOURS	SCHEDULED MAINTENANCE	OUTAGES
8000	GT m HRSG m	18 days
16000	GT m HRSG m ST m	30 days
24000	GT M HRSG I	60 days
32000	GT m HRSG m ST m	30 days
40000	GT m HRSG m	18 days
48000	GT M HRSG M ST M	60 days

Schedules Outage period are subject to the provision of section 6.3(a)

LEGEND :

GT m:	Gas Turbine Minor Inspection
GT M:	Gas Turbine Major Inspection
HRSG m:	Heat Recovery Steam Generator Minor Inspection
HRSG M:	Heat Recovery Steam Generator General Inspection
HRSG I:	Heat Recovery Steam Generator Intermediate Inspection
ST m:	Steam Turbine Partial Overhaul
ST M:	Steam Turbine Major Overhaul

Schedule Outages thereafter continue on a 48000 hour cycle which must be maintained. All boiler and turbine inspections will be completed within the above timescales.

The scheduling of maintenance inspections will be compatible with regulatory requirements. All regulatory inspections will be carried out during Scheduled Outages. Subject to regulatory requirements, the timing of Scheduled Outages shall be within a range 9 months to 15 months from the start of the previous Scheduled Outage, provided that the commencement of the Scheduled Outage in each successive three year cycle shall be no less than 33 months and no more than 39 months apart.

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3. Prudent Utility Practice

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 grid system shall be made by diverting the existing 132kV lines between Guddu and Ghotki and the line between Daharki and Mirpur Mathello. The transmission lines will terminate in the substation of the Complex. The circuits of the transmission lines will connect via insulator strips at the outgoing gantry provided by the Company in the 132kV sub-station at the Complex. The boundary of responsibility between the Company and WAPDA will be at the connection to the insulator strips (the "Interconnection Point"). The Company will provide WAPDA with an earth connection from the earthing system of the Complex. WAPDA will provide (and the Company will install) the Metering System and WAPDA will install the transmission lines referred to above which together shall comprise the "Interconnection Facilities." This equipment will remain the property of WAPDA and shall be commissioned and maintained thereafter by WAPDA.

The Company hereby undertakes that in the event that the Second Phase of the Project is completed thereby increasing the capacity to 470 MW the Complex will be equipped with a 500 kV substation so that all of the electrical output can be supplied to the WAPDA Grid System at 500 kV. The 132kV substation will also remain available for use by WAPDA. The Company will endeavour to meet WAPDA's requirement to be able to supply power between Guddu, Ghotki, Mirpur Mathelo and Daharki in the event that the Complex is partly or completely out of operation.

(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 Guddu, Ghotki, Mirpur Mathelo and Daharki owned by WAPDA.

2. Design Data

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

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2.1. Generator Design Data

(a) Rating

	G.T. SET	S.T. SET
Nominal rated capacity	200,000 kVA	100,000 kVA
Power factor	0.8 lagging 0.9 leading	0.8 lagging 0.9 leading
Rated hydrogen pressure	N.A.	N.A.
Number of phases	3	3
Number of poles	2	2
Frequency	50 Hz	50 Hz
Rated speed	3000 rpm	3000 rpm
Terminal voltage	15 kV	11.5 kV
Short circuit ratio at rated MVA	> 0.5	> 0.5
Excitation system	static	static

(b) Generator Reactances (at the rated MVA & kV base) (calculated values) :

Unsaturated direct axis synchronous reactance	[190 %]	193%
Saturated direct axis sub-transient reactance	12 %	11.7%
Saturated direct axis transient reactance	19.6 %	18.5%
Negative phase sequence reactance	12.6 %	12.4%
Zero phase sequence reactance	5 %	5%
Leakage reactance	14.5 %	14.3%

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(c) Generator time constants		G.T SET	S.T. SET
Direct axis open circuit transient time constant	T'DO	[8.0 seconds]	7.1 second
Direct axis open circuit sub-transient time constant	T''DO	0.03 seconds	0.022 second
Direct axis short circuit trans-transient time constant	T'D	1 seconds	0.78 second
Direct axis short circuit sub-transient time constant	T''D	0.023 seconds	0.017 second

(d) Inertia constant

Generator + Turbine	later	later

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

2.2 Gas Turbine Generator Excitation System

Excitation of the main generator is provided by a static excitation system. The excitation control system has two automatic voltage regulation channels each of them with one (1) manual voltage regulation mode. 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% - 110 % Generator nominal voltage

(ii) Voltage adjusting range for MEC operation:
from 10% of field current at no load
to 110% of nominal field current

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(iii) Generator terminal voltage is held within ± 0.5% 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 ≥ 2.0 p.u.

(v) The transfer function diagram of excitation system as shown in Figure 6ER 396 (to be provided).

2.3 Steam Turbine Generator Excitation System

Excitation of the main generator is provided by a static excitation system. The excitation control system has two automatic voltage regulation channels each of them with one (1) manual voltage regulation mode. 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% - 110% Generator nominal voltage

(ii) Voltage adjusting range for MEC operation:from 10% of field current at no load to 110% of nominal field current

(iii) Generator terminal voltage is held within ± 0.5% 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 ≥ 2.0 p.u.

(iv) The transfer function diagram of excitation system as shown in Figure 3ERO 168 (to be provided).

2.4 Generator Transformer (two winding type)

	Gas Turbine Generator Transf.	Steam Turbine Generator Transf.
MVA rating (ONAF)	206 MVA	100 MVA
Rated voltage	132 /15kV	132/11.5 kV
Maximum and minimum operating voltages	132 ± 10% kV (rms)	132±10% kV(rms)
Connection of winding	YNd1	YNd1
Taps of winding (on-load)	±8 x 1.25%	± 8 x 1.25%
Positive reactances (reference only)	13% on rated kV and 200 MVA base (*)	13% on rated kV and 100 MVA base (*)
Zero sequence reactance (*)		

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i. HE-L (Leakage)
ii. HE-T (Leakage)
iii. L-T (Leakage)

Magnetizing reactance at rated (*) voltage (from H.V. terminal)

X air core (from H.V. terminal) (*)

X air core (from L.V. terminal) (*)

Saturation curve at no load V (rms) versus I (rms)

* Design data, acceptable to WAPDA, to be supplied before financial close

2.5 The governor droop will be adjustable from 2 % to 8 % and is designed to operate over the frequency range 47.5 to 52.5 Hz.

2.6 The AVR droop setting is ± 5 % of rated voltage.

0.5% in Kathmandu PPA

NOTE : The full Schedule 3 must be completed by the Construction Contractor within two weeks from the date of signing the PPA so that WAPDA may complete the necessary design studies to confirm that the Complex is compatible with the Grid System.

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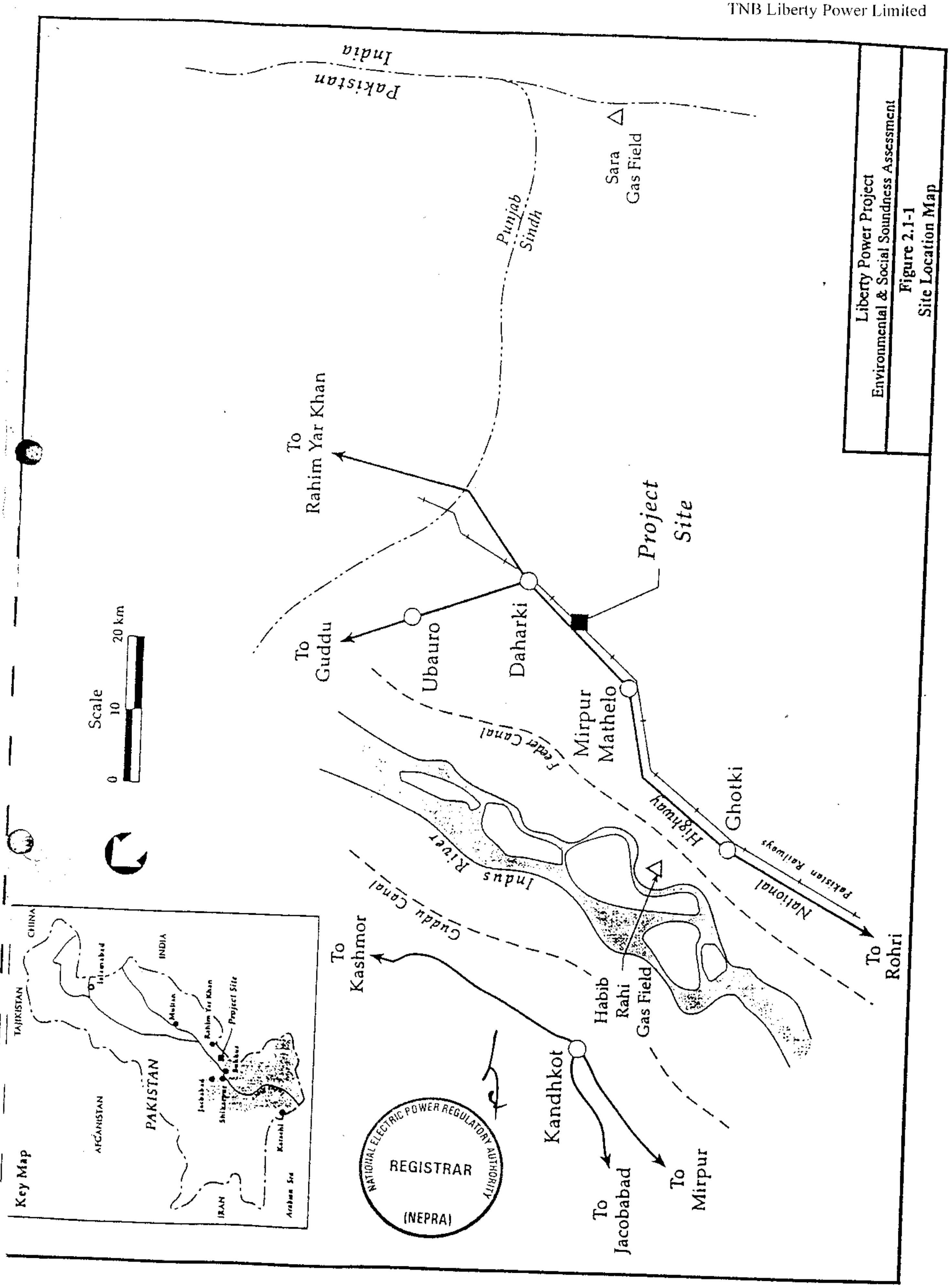
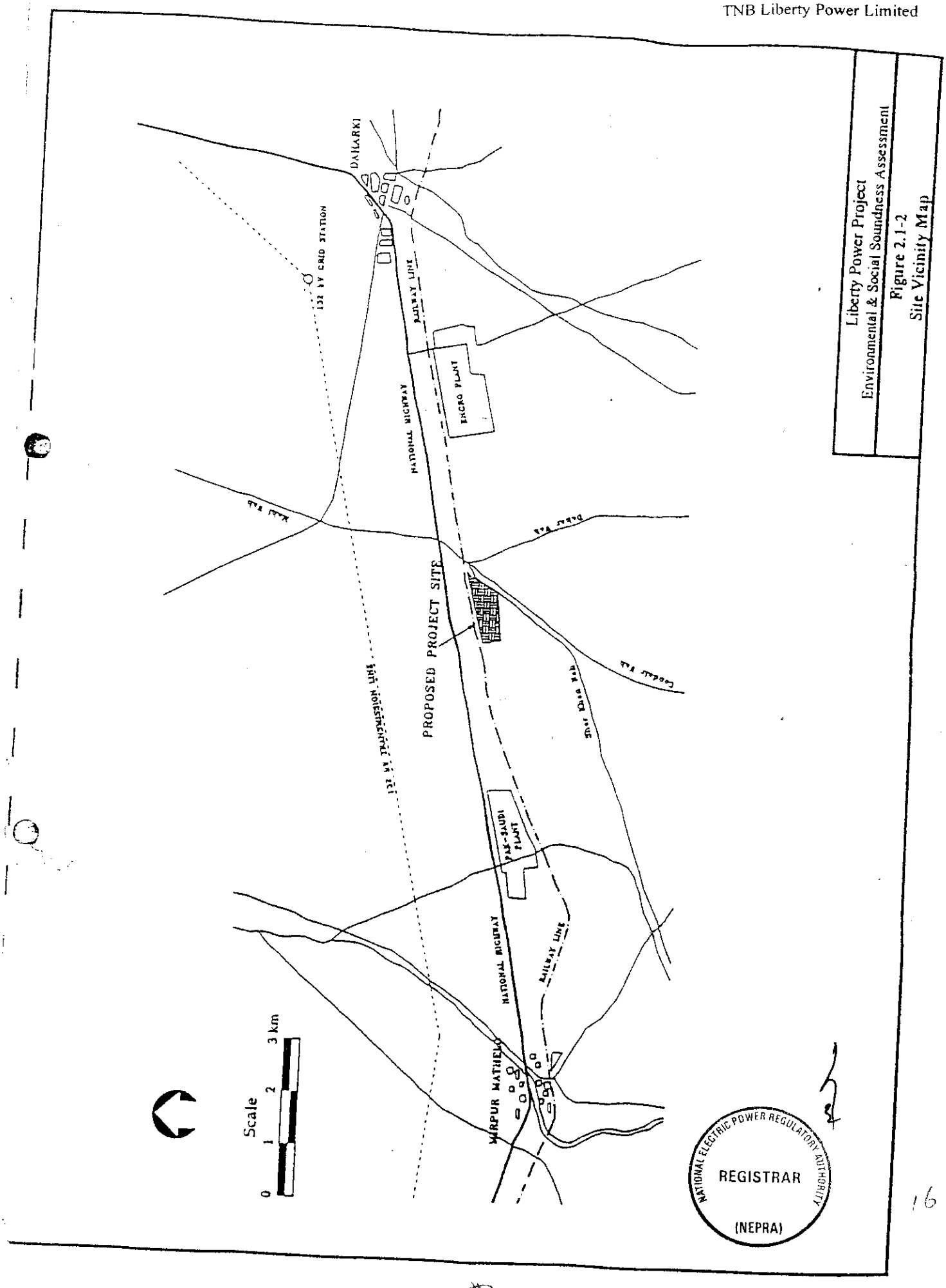


Liberty Power Project
Environmental & Social Soundness Assessment
Figure 2.1-1
Site Location Map



Liberty Power Project
Environmental & Social Soundness Assessment
Figure 2.1-2
Site Vicinity Map

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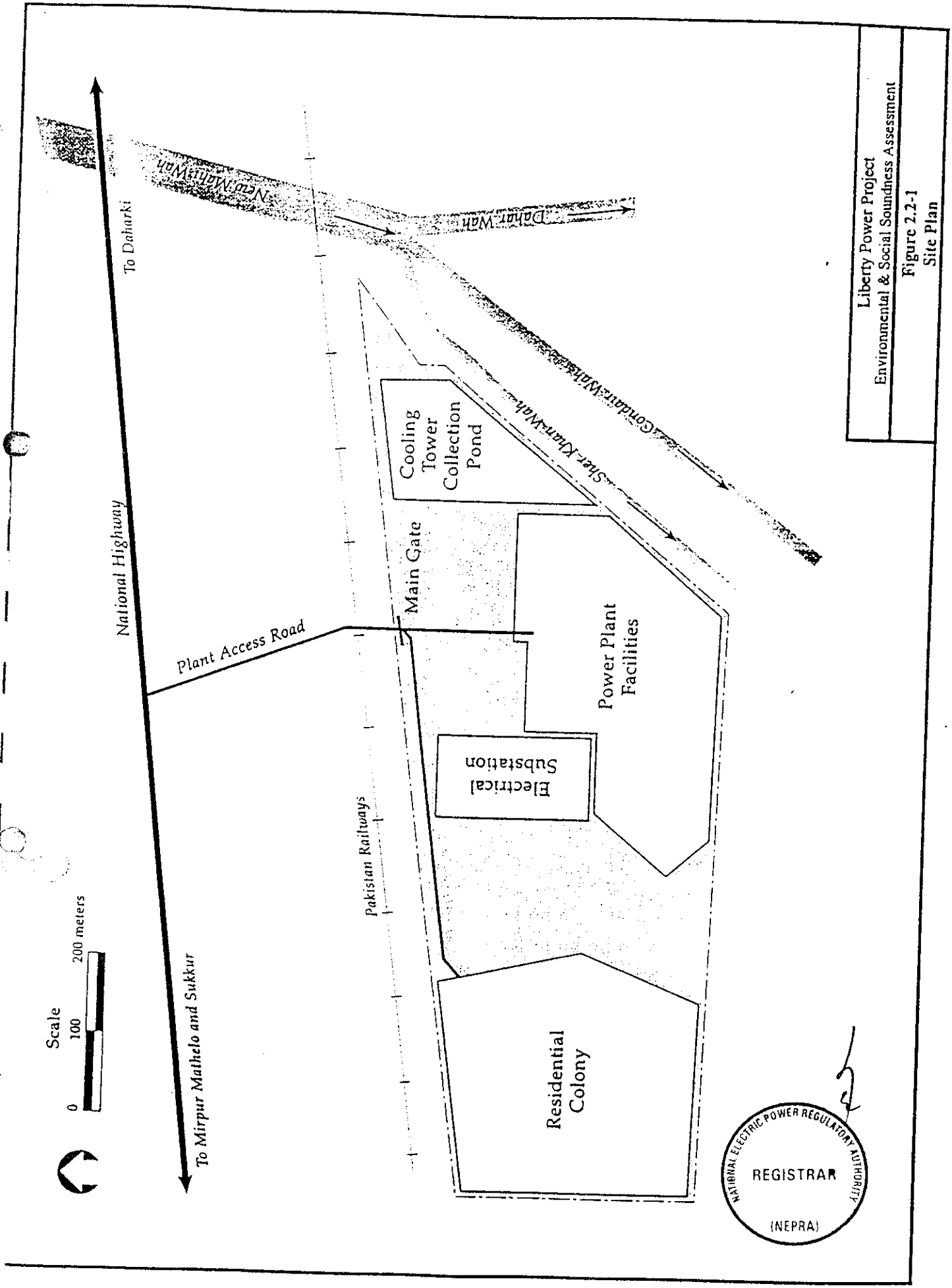
(NEPRA)



Schedule II

INSTALLED CAPACITY (GROSS) & NET CAPACITY

Installed ISO (Gross) Capacity	235MW
Net Capacity	212MW

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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