Lootah Energy (Pvt) Ltd.

LOOTAH ENERGY (PVT) LTD.
201-202, Fareed Chambers,
Abdullah Haroon Road, Karachi.
74400 Pakistan.

P:(92-21) 35662096
35620647
35620648
F:(92-21) 35211243

Email : khalidmasood123@hotmail.com

The Registrar
National Electric Power Regulatory Authority
2nd Floor, OPF Building,
Sector G-5/2,
Islamabad.

Date: ___ January 2018

SUBJECT: Application for a Generation License for LOOTAH ENERGY(Pvt.) Ltd.
50 MW Wind Power Project at JHIMPIR

I, Khalid Masood the Chief Executive, being the duly authorized representative of Lootah Energy (Pvt.) Limited by virtue of Board Resolution dated October , 2017, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to Lootah Energy (Pvt.) Limited pursuant to Section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999 **("AMPR")**, and undertake to abide by the terms and provisions of the above-said regulations. I further undertake and confirm that the information provided in the attached documents-in-support is true and correct to the best of my knowledge and belief.

A Bank Draft in the sum of Rs. /- being the non-refundable license application fee calculated in accordance with Schedule II of the AMPR, is also attached herewith. Further, additional documents /information, pursuant to the AMPR, are attached herewith.

Regards,

LOOTAH ENERGY (PVT.) LTD.

Khalid Masood
CEO

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Owned by: Nasser Abdulla Lootah Group

APPLICATION FOR THE GRANT OF A
GENERATION LICENSE
UNDER SECTION 15 OF THE ACT AND
REGULATION 3 OF THE AMP REGULATIONS

1. NEPRA's Participation in the Process

1.1. Section15 of the Regulation of Generation, Transmission, and Distribution of Electric Power Act, 1997 (the **"Act")** provides, *inter alia,* that:

"(1) No person except under the authority of a license issued by the Authority under this Act and subject to the conditions specified in this Act and as may be imposed by the Authority, construct own or operate a generation facility.

(2) An application for the grant of a license for a generation facility shall specify-

(I) the type of facility for which the license is applied;

(ii) the location of the generation facility; and

(iii) the expected life of the generation facility."

1.2. Furthermore, Regulation3 of the National Electric Power Regulatory Authority(Application and Modification Procedure) Regulations, 1999 (the **"AMP Regulations")** provides that an application for a license shall be made in the form specified in the AMP Regulations and further enumerates the documents required to be submitted to the Authority along with the requisite application.

1.3. This Application for the grant of a generation license is made pursuant to Section 15 of the Act and Regulation 3 of the AMP Regulations (this **"Application").**

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2. Introduction of the Applicant/Sponsors

2.1 As required under the Section 24 of Act Lootah Energy (Pvt) Limited the ("Applicant" or the "Company" or the "Project Company")

Is a Private Limited Company incorporated under the Company Ordinance 1984, to act as a special purpose vehicle (the "SPV") and develop a 50MW Wind Power Generation Project located at Jhipir,District Thatta, Province of Sindh (The "Project").The required documents and other details of the applicant and description of the Project are annexed herewith as **Annex-A** hereto

Sponsors- Lootah Group of Companies UAE, with His Excellency Nasser Abdulla Lootah as Chairman of the Group.

2.2 The sole project sponsor for the Wind Farm is ,His Excellency Nasser Abdulla Lootah is the chairman of Nasser Abdulla Lootah Group. Headquartered in Dubai, Nasser Abdulla Lootah Group is one of the largest diversified groups in the Middle East region founded more than 25 years ago. H.E. Nasser Abdulla Lootah is also the chairman of Summit Bank (Pakistan) and of Emirates Park Limited (a 50 000 acre horse breeding facility in Australia). Dubai Islamic Bank was founded by the Lootah family and he is a major shareholder.

His Excellency was also the head of the Ruler's Court of Dubai for more than 35 years.

Nasser Abdulla Lootah Group provides innovative technologies and comprehensive know-how to benefit customers in the Gulf countries, and is active in the areas of Travel, Shipping, Cargo, Logistics, Mineral Water, Real Estates, Trading, Finance, Information Technology, Interactive Media, Production and Brand Media Communication.

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Guided by the visionary leadership of His Excellency Nasser Abdulla Lootah, the group has continued to develop, innovate, fortify and find new ways to gain greater confidence in their clients, associates and employees.

His Excellency is a sponsor(local UAE partner) for numerous international brands us multinational companies like Brookfield Multiplex (Real Estate Construction), Dubai Lagoon (Real Estate Developer), Mediclinic - Middle East Hospitals, Wilhemsen Shipping Company, Zurich International and Qatar General Insurance Company.

His net worth encompasses various real estate properties including hotels, hospitals and residential units worldwide. Soon a 53 storey Tower belonging to His Excellency will fancify the skyline over Sheikh Zayed Road within close proximity of Downtown Dubai, Burj Khalifa.

3. The Project Overview

3.1 Project Company

3.1.1 The Company established for this purpose of a 50MW Wind Farm is Lootah Energy Pvt. Limited, and will develop this project under the Tariff Regime approved by NEPRA. Currently we are planning to apply under Cost Plus regime as Upfront Tariff had expired in December 2016. Incase NEPRA introduce an Upfront Tariff , then Company will follow that regime.

Two Letter of Intent for 2x50MW Wind Farms were issued by Directorate Of Alternate Energy Energy Department Government of Sindh No: 107-1/2016 & 107-2/2016 and company is taking up the first phase under those LOI by developing a 50MW Wind Power Plant.

Lootah Group has used its own land in Jhimpir Area for these Projects.

Company is diligently working towards implementation of the Project and substantial progress has been made towards it, leading to a stage where we are ready to apply for a Generation License.

The Project Company proposes to contract with a leading manufacturer of WTG to design, engineer, construct, insure, commission, operate and maintain the Project. The construction of 50 MW wind power plant on Gamesa G114-2.0MW technology (briefly explained in Para 8) will take approximately 18 months from the issuance of notice to proceed to the project contractors, so that plant commissioning is expected in the 2nd Quarter of 2018. The LOI for this Project is annexed as **Annex-B** hereto.

3.1.2 The Project Company will develop, own and operate a 50 MW wind farm as an independent power project (the **"IPP")** in Sindh. The Project Company shall develop wind farm and the sub-stations while CPPA will be the purchaser of power and NTDC will evacuate the power from project Battery Limits.

3.2 Issuance of "Letter of Intent"

3.2.1 The project development phase has recently started after getting the Letter of Intent (LOI) from Directorate of Alternative Energy, Energy Department Government of Sindh, Company had to acquire own Land for this project. The Sponsor used its own Land to develop this Project.

3.2.2 Although the Applicant will opt for the Upfront Tariff and as such all risks associated with the Project are to be borne by the Applicant, nevertheless, the Company has undertaken various studies to assess the feasibility of the Project.

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These studies *inter alga* include the following:

a. Wind resources assessment;

b. Geo technical investigation;

c. Digital topographic map;

d. Initial environmental examination;

e Grid interconnection study.

f. Transport Study

A complete feasibility study which has already been submitted by the Project Company to DAE, Government of Sindh is annexed as **Annex-C** hereto.

4. <u>Power Purchaser</u>

4.1. The electricity generated from this Project would be supplied to Central Power Purchasing Agency (Guarantee) Limited. The power generated by the Project will be sold for the term of 20 years under the standard Energy Purchase Agreement (the "EPA") starting from commencement of commercial operations.

5. Site

5.1. The proposed Project site is located at Jhimpir, District Thatta, Province of Sindh, Pakistan (the "Site"). The Site proposed for the implementation of the Project has been selected by considering the following:

a. Location in the wind corridor;

b. Wind conditions at the Site

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c. Topographic conditions;

d. Site accessibility; and

e. Location of the grid with reference to the Site for interconnection.

5.2. The Site is located within the wind corridor identified by DAE, GOS. As already mentioned above the Site is located in Jhimpir, District Thatta, Sindh, which is one of the most promising areas where wind power projects can be viably installed. The Project's wind farm site is located 138 KM from Port Qasim Karachi in the East direction with easy road access. Nooriabad Industrial Estate (situated on the M9 motorway connecting Karachi and Hyderabad) is 53 KM from the wind farm.

5.3 The Land Coordinates

THE Land allocated by Lootah Group to Wind Farms from its 5000 Acres land holding is as per following coordinates. It is estimated to be 1500 Acres for 100MW and more Wind Farms

A. 25 04 29.43 N 67 53 24.21 E

B. 25 02 35.79 N 67 54 15.31 E

C. 25 03 57.77 N 67 55 41.63 E

D. 25 04 53.45 N 67 53 40.75 E

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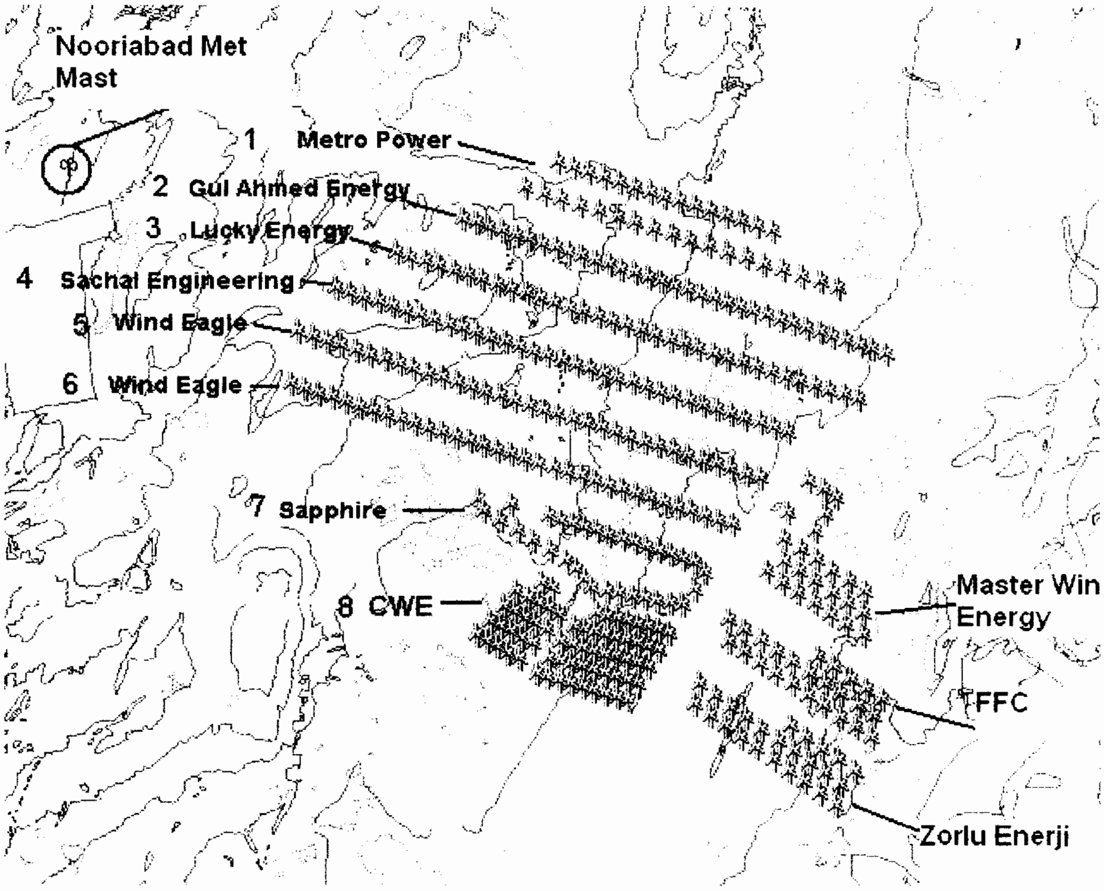

5.4 The Project Site is exposed to very strong westerly winds, wind data analysis of the area suggests that, 80% wind blows from the south west direction. The terrain of the area is flat with small change in altitude. The proposed site lies under roughness class 1.5 as there is low or no vegetation. The site is easily accessible through metallic roads. The ground is hard and rocky; the subsurface soil also includes clay and silt. Complete details are given in Geo study.

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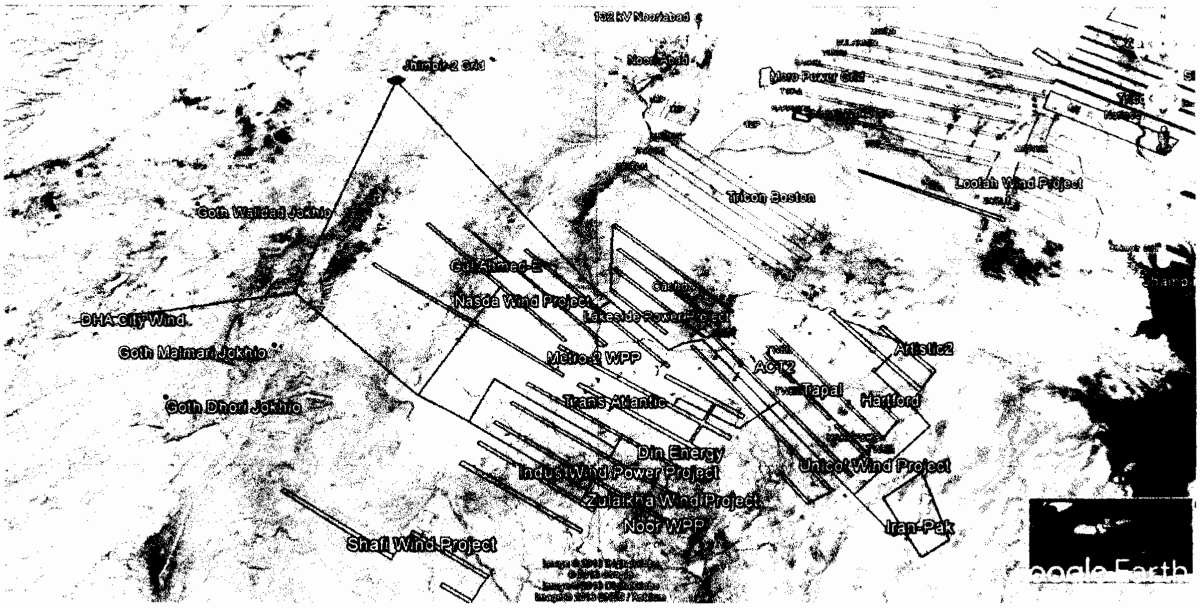
5.5 The proposed wind farms lies on a flat inland area with hard and rocky ground conditions. The site would be categorized as inland wind development as opposed to offshore/coastal wind project development (which is more difficult to develop due to tides and soft subsoil clay). The general terrain at the site can be described as simple and—flat terrain. Internal access roads are the roads connecting the single wind turbine locations with each other and the external access roads and grid station would be constructed during the civil works of the wind farm. The general layout of 50 MW Lootah Energy and neighbouring wind farms is shown in figure below:



The wind farms site is in triangular in shape, the topography is relatively flat and the elevation above sea level is approximately 37-97m. There is little vegetation at the wind farm site. Its located at south of the three Gorges Wind Farm, with Noriabad Jhimpir Road Bordering the Northern side of of Wind Farm

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Topographic conditions

The Site is on a plain area at an elevation of 37-97m, which is generally flat, but a bit higher on the west and lower on the east. The landform at wind farm sites is mainly of pediment and the vegetation there is less developed.

Geological Conditions

The planned wind farm sites are covered mainly by marine alluvium of Holocene and recent weathered deposit, and underlain mainly by Tertiary limestone. The bedrock in the site is generally outcropped. As the WTG is a high-rise structure, it has a high gravity center and should sustain high loads, large horizontal wind force and overturning moments. WTGs are designed to withstand these forces.

Hydrological Conditions

According to the regional hydrological data available, the Project site is in a dry area, where the water table is deeply underground, and the surface water and water in the shallow surface layers is weakly to slightly corrosive to the concrete and is corrosive to the rebars in the concrete which has been immerged in water for a long-time or alternatively in wet and dry conditions. Corrosion prevention measures will be adopted in the design and implementation of the wind farm. The Bore hole of upto 30 meters did not see any water.

The Site Map and other pertinent details regarding the project site is annexed Annex- **E** hereto.

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6. Operations & Maintenance Arrangement

6.1. For the purpose of designing, engineering, procuring, constructing, installing, testing, completing, commissioning, operation and maintenance of the Project, the Project Company is negotiating the 'Heads of Agreement' with ' Siemens Gamesa Wind (Tianjin) Co. Ltd.,' and 'Orient Energy System (Pvt) Ltd.,' and will be signed this month.

6.2. With 20 years' experience, Gamesa is a global leader in the design, manufacture, installation and maintenance of wind turbines, with over 28,800 MW installed in 43 countries across five continents. Operation & Maintenance (O&M) is one of the key activities upon which Gamesa bases its development, having 70% of its fleet under an Operation & Maintenance contract thanks to an expansion of this activity in over 30 countries. After merger of Gamesa with Siemens, it has now become the largest company , in Wind Power, with European technology giving them edge over others.

6.3. Backed by 20 years of experience in wind turbine O&M and optimization, Siemens Gamesa continues to be committed to adding value, offering cutting edge solutions, such as the useful life extension, integral solutions for the O&M of other manufacturers' wind turbines, and personalized financing options to meet the needs of each customer. Siemens Gamesa focuses intensively on programs for maximizing energy production, improving availability and reducing O&M related costs, with the goal of decreasing energy costs by 30%. Information regarding Operation & Maintenance is appended as **Annex-F**

7. Financing

7.1 Project will be financed on a Debt : Equity Ration of 75:25.

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7.2 The Project Company will arrange 25% of equity while for the remaining Debt financing arrangements, various options will be explored from International Lenders, local Banks, where assistance from OEM supplier or EPC contractor will be sought too. A consortium of International lenders or local Banks and the selection of financing source, mode and mechanism will be based on financial models.

Currently the project cost is estimated to be around USD 110.00 million. However, negotiations with suppliers are going on to reduce the project cost, in light of price competiveness in the market.

The project is expected to produce 153.3 GWh of electricity and the electrical power produced by this farm will be purchased by CPPA and distributed on national grid by NTDC.

8. Selected Technology

8.1 The proposed Project is based on 25No: Gamesa G114 CIIA/CIIIA

20MW 50/60Hz Wind Turbines, at 93 meters Hub, with capacity factor of not less than 35%. The Project Construction Time will be not more than 18 months, after issuance of notice to proceed(NTP), with 4 months Pre-NTP.

The WTG is sourced from World Renowned WTG manufacturers Siemens Gamesa Corporation, with over 20 years of experience and over 32 GW capacity Installed around the world. They are currently World Technology Leaders in the Wind Industry.

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Specifications of G114-2.0 MW CIIA /CIIIA Wind Turbine

(a). **Rotor**

(i) Number of blades	3
(ii).Rotor diameter	114 m
(iii).Swept area	10207 m2
(IV) Power Regulation	Combination of Blade Pitch angle adjustment & Generator/ Convertor Torque Control
(V) Cut in Wind Speed	3 m/s
(VI) Cut out Wind Speed	25 m/s
(VII) Extreme Wind Speed	
in 50 years over 3 sec	59.5 m/s
in 50 years over 10 min	42.5 m/s
(VIII) Pitch Regulation	Electric Motor driven ring gear mounted to the inner race of the blade pitch bearing.

(b) **Blades**

(i) Blade Length	56 m
(ii) Weight of Blade	13 tons
(iii) Blade Cord (Max/Min)m	3.865m
(iv) Torsion (0)	Max 25, Min 1.5 degrees
(V) Material	Composite Material reinforced with fibreglass through resin infusion

(c) Gearbox

(i) Type 3 combined stages, I stage

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planetary

2 parallel shift gear

(ii) Gear Ratio	1: 128.5
(iii) Main Shaft	Cast Shaft
(d) Generator	
(i) Type	Doublefed with coil rotor & slip rings
(ii) Nominal Power	2070Kw (stator + Rotor)
(iii) Voltage (Vac)	690
(iv) Frequency (Hz)	50/60
(v) Degree of protection	IP54 Turbine- IP21 Ring Body
(vi) Coupling	Main shaft: Cone Collar, High speed shaft: Flexible Coupling
(vii) Power Factor	0.95
(e) Control System	
(i) Type	Automatic or Manually controlled
(ii) Frequency	50/60 Hz
(iii) Voltage Vdc	24 V
(iv) Scope of Monitoring	Remote monitoring of different parameters, temp sensors,pitch parameter, speed , generator torque, wind speed & direction etc.
(f) Brake:	
(i) Design	Mechanical Brakes Disc Type
(ii) Operational Brakes	Aerodynamic brake achieved by Feathering blades

(iii) Secondary Brake — Mechanical Brake on high speed shaft of Gearbox

(g) Tower

(i) Type — Conical Barrel tube

(ii) Hub Height m — 93 m, in 4 sections

Standard Power Curves Of Gamesa WTG Model G114 CIIA /CIIIA 2.0 MW

P [kW]	*Density [kg/m^3]*								
Ws [m/s]	***1.225***	***0.94***	***0.97***	***1.00***	***1.03***	***1.06***	***1.09***	***1.12***	***1.15***
3	32	21	22	23	24	26	27	28	29
4	146	104	109	113	118	122	126	131	135
5	342	254	263	273	282	291	300	309	319
6	621	469	485	501	517	533	549	565	581
7	1008	764	790	815	841	866	892	918	943
8	1487	1159	1196	1233	1270	1305	1340	1375	1408
9	1858	1592	1629	1663	1695	1725	1753	1779	1804
10	1984	1893	1913	1930	1944	1956	1965	1972	1977
11	1995	1987	1989	1991	1992	1992	1993	1993	1993
12	1999	1995	1996	1997	1997	1998	1998	1998	1999
13	2000	1999	1999	1999	1999	2000	2000	2000	2000
14	2000	2000	2000	2000	2000	2000	2000	2000	2000
15	2000	2000	2000	2000	2000	2000	2000	2000	2000
16	2000	2000	2000	2000	2000	2000	2000	2000	2000
17	2000	2000	2000	2000	2000	2000	2000	2000	2000
18	2000	2000	2000	2000	2000	2000	2000	2000	2000
19	2000	2000	2000	2000	2000	2000	2000	2000	2000
20	2000	2000	2000	2000	2000	2000	2000	2000	2000
21	2000	2000	2000	2000	2000	2000	2000	2000	2000
22	1906	1906	1906	1906	1906	1906	1906	1906	1906
23	1681	1681	1681	1681	1681	1681	1681	1681	1681
24	1455	1455	1455	1455	1455	1455	1455	1455	1455
25	1230	1230	1230	1230	1230	1230	1230	1230	1230

Table-3 Electric Power (KW) of the G114 CIIA/CIIIA 2.0MW Wind Turbine

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Fig-1 Power curve of the G114 CIIA/CIIIA WTG 2.0MW

Annual Energy Production

Table-4 shows the annual output (MWh) for the G114 WTG for different Weibull K-Distribution Parameters values and annual average wind speed. The values are calculated for 1.225 Kg/m^3 standard density and 10% turbulence intensity.

P [MWh]		W_{ave} [m/s]									
		5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Weibull K	1.5	5772	6539	7239	7870	6429	8917	9357	9691	9965	[illegible]
	2	5787	6772	7691	8533	9297	9981	10587	11117	11572	11955
	2.5	5634	6789	7881	6887	9797	10609	11328	11961	12513	12991

Table 4 Annual energy production [MWh] of the WT G114 CIIA/CIIIA 2.0MW calculated in function of W_{ave} [m/s]. (ref: G114AERPCNLEV2000KW R07 13102014)

CP AND CT CURVES

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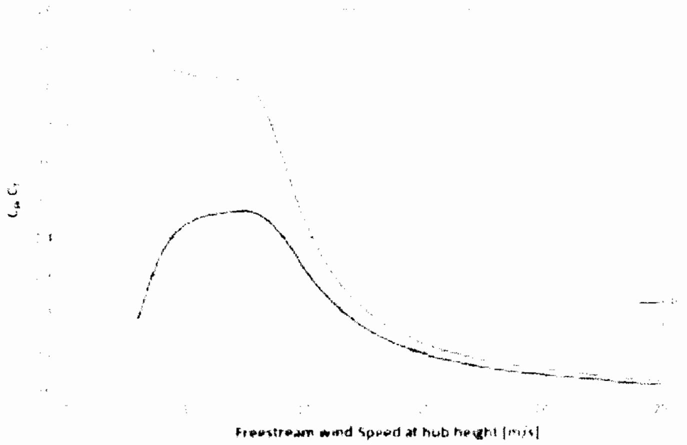

Figure 2 CP and CT curves of the G114 CIIA/CIIIA 2.0MW wind turbine. (ref: *G114AERPCNLEV2000KW_R07_13102014*

W_s [m/s]	CP	CT
3	0.187	0.934
4	0.366	0.861
5	0.437	0.834
6	0.460	0.824
7	0.470	0.822
8	0.464	0.778
9	0.408	0.621
10	0.317	0.444
11	0.240	0.320
12	0.185	0.240
13	0.146	0.187
14	0.117	0.149
15	0.095	0.122
16	0.078	0.101
17	0.065	0.086
18	0.055	0.073
19	0.047	0.064
20	0.040	0.057
21	0.035	0.048
22	0.029	0.041
23	0.022	0.033
24	0.017	0.028
25	0.013	0.023

Table-5 CP and CT Values for the G114 WTG

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The energy production of Wind Farm is given in table below:

(1).	Total Installed Gross ISO Capacity of the Generation Facility /Wind Farm (MW/GWh)	50 MW
(2).	Total Annual Full Load Hours	3066
(3).	Average Wind Turbine Generator (WTG) Availability	97%
(4).	Total Gross Generation of the Generation Facility/Wind Farm (in GWh)	173.74
(5).	Array & Miscellaneous Losses GWh	12.58
(6).	Availability Losses GWh	4.72
(7).	Balance of Plant Losses GWh	3.14
(8).	Annual Energy Generation (20 year equivalent Net AEP) GWh	153.3
(9).	Net Capacity Factor	35 %

9. Health and Safety

9.1. During **the** construction and operation of the Project, the guideline of "safety first,(accident) prevention foremost" will be practiced. Comprehensive management and supervision will be applied to all staff members and the whole operation process, in order to ensure safe operation of the equipment and personal safety of workers. The Health and safety manual of the EPC will be studied ,approved and followed as per International practices.

9.2. The Company shall ensure that the **EPC** Contractor shall take all due precautions to ensure the safety of its employees, agents and subcontractors and, in collaboration with and to the requirements of the local health authorities, to ensure that suitable arrangements such as medical staff, first aid equipment and stores, sick bay and suitable

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the construction period as necessary and that suitable arrangements are made for all necessary welfare and hygiene requirements..

9.3. The EPC Contractor shall maintain records concerning safety, health and welfareof persons and damage to property, and make such reports, as are consistent with Good Utifity-Practice arid shall-repart-deta4s-of-any accident-to-the-Company as soon as possible after its occurrence.

10. Environmental Impact

10.1 EMC Pakistan PVT Limited an Engineering, Management Experts were awarded the contract to conduct the Initial Environmental Examination (IEE) study for the 50MW Wind farm proposed by the Project Company. Since the project is located in an area which was historically reported as the major and significant migratory bird's route during winter, therefore the environmental impact related to mortality of birds due to wind turbines is also evaluated along with any human resettlement. Based on the site evaluation and wind data measurement done by National Renewable Energy Laboratories (USA) under the USAID assistance program in 2007, the project locations within this Jhimpir area falls among the best wind corridors w.r.t. wind power generation.

The wind farm will be developed in an area which is not under intensive agriculture use. There is no sensitive habitats with a high ecological value, as nothing were found during **the field survey on the proposed land and no impacts caused by** the human settlement is expected, since this land is owned by the sponsor, where initially cattle farming was carried out. The same assessment is made regarding the possible impacts on soil. The proposed project will acquire a 1500 acres of land for the two phase of projects.

No rare or threatened vegetation species grow along the proposed site or access road. Most of the plants found here have a wide ecological aptitude and populations large enough to ensure their genetic diversity. The removal of a small portion of vegetation will not harm the overall diversity of plant communities in the area. Only raptors use the

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proposed site as a hunting ground and for soaring overhead.

10.3 Given that wind power is a 'clean' source of energy, its key environmental benefit is in terms of the emission offsets it provides. The wind farm will offset between 39,409 to 87,265 tons of carbon dioxide equivalent per year depending on the efficiency of the power plant that it will replace. Over a twenty five year time horizon, i.e. the assumed life of this project, the wind farm has the potential to offset 1.5 to 2.5million tons of CO_2 equivalents. It will also offset between 145 to 400 tons of sulfur dioxide. The local benefits of this are obvious in the sense that the ingestion of SO_2 and particulates is harmful for human health. Sulfur dioxide also contributes to acid rain. Therefore, if a thermal power station option was exercised as opposed to the wind farm, the additional cost of mitigating the SO_2 and particulate emissions would have to be borne, and suffer the green house gases, which impact Globally.

10.4 It is envisaged that the wind farm will be in operation for up to 25 years. At the end of this period the wind farm will either be decommissioned or new wind turbines will be installed.

Once the wind farm has reached the end of its lifespan, the decommissioning process will include removal of the turbines and the return of the site to its condition prior to the construction of the wind farm.

11. Evidence/relevant correspondence:

11.1. Copies of the pertinent correspondence are enclosed herewith for the learned Authority's assistance and consideration.

11.2. The Applicant would be pleased to provide any other assistance proposed site as a hunting ground and for soaring overhead.

10.3 Given that wind power is a 'clean' source of energy, its key environmental benefit is in terms of the emission offsets it provides. The wind farm will offset between 39,409 to 87,265 tons of carbon dioxide equivalent per year depending on the efficiency of the power plant that it will replace. Over a twenty five year time horizon, i.e. the assumed life of this project, the wind farm has the potential to offset 1.5 to 2.5million tons of CO_2 equivalents. It will also offset between 145 to 400 tons of sulfur dioxide. The local benefits of this are obvious in the sense that the ingestion of SO_2 and particulates is harmful for human health. Sulfur dioxide also contributes to acid rain. Therefore, if a thermal power station option was exercised as opposed to the wind farm, the additional cost of mitigating the SO_2 and particulate emissions would have to be borne, and suffer the green house gases, which impact Globally.

10.4 It is envisaged that the wind farm will be in operation for up to 25 years. At the end of this period the wind farm will either be decommissioned or new wind turbines will be installed.

Once the wind farm has reached the end of its lifespan, the decommissioning process will include removal of the turbines and the return of the site to its condition prior to the construction of the wind farm.

11. Evidence/relevant correspondence:

11.1. Copies of the pertinent correspondence are enclosed herewith for the learned Authority's assistance and consideration.

11.2. The Applicant would be pleased to provide any other assistance

Generation License.

11.3. This Application and its Annexure are being submitted in triplicate, with certain documents certified as necessary, each in accordance with Regulation 3 (4) of the AMP Regulations.

12. **Additional Grounds**

12.1. The Applicant seeks to raise further additional grounds in support of this Application at the hearing stage.

ATTESTED TRUE COPY
AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.

AIJAZ ALI ADVOCATE M.A. L.L.B NOTARY PUBLIC KARACHI

PRAYER

05 JAN 2018

It is most humbly prayed to the esteemed Authority as follows:

A. That the Applicant be granted a Generation License for the development of the Project.

B. That the terms of the Generation License may kindly be made consistent with the terms of the GoP concession documents.

C. That the Authority may be pleased to treat the Applicant's request for the grant of Generation License on a non-discriminatory basis and any concession offered to comparable projects on the date of filing of this Applicant and at any stage subsequent to the grant of license may kindly be granted to the Applicant as well.

D. Any further and better relief that the Authority may deem appropriate in the circumstances may kindly be granted to the Applicant.

We trust the information/explanation provided above meets your requirements, and we remain available to assist you if you have any further queries or requirements.

Respectfully submitted for and on behalf of the Applicant

Khalid Masood

Lootah Energy Pvt Ltd

November 2017

ATTESTED TRUE COPY
AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.

AIJAZ ALI ADVOCATE M.A. L.L.B NOTARY PUBLIC

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We trust the information/explanation provided above meets your requirements, and we remain available to assist you if you have any further queries or requirements.

Respectfully submitted for and on behalf of the Applicant

LOOTAH ENERGY (PVT) LTD.

Khalid Masood

Khalid Masood

Lootah Energy Pvt Ltd

November 2017

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AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.

AIJAZ ALI ADVOCATE M.A. L.L.B NOTARY PUBLIC KARACHI

05 JAN 2018

Lootah Energy (Pvt) Ltd.

LOOTAH ENERGY (PVT) LTD.
201-202, Fareed Chambers,
Abdullah Haroon Road, Karachi.
74400 Pakistan.

P (92-21) 35662096
35620647
35620648
F (92-21) 35211243

Email : khalidmasood123@hotmail.com

EXTRACTS OF THE MEETING OF THE BOARD OF DIRECTORS OF LOOTAH ENERGY PRIVATE LIMITED (THE "COMPANY") HELD ON SEPTEMBER 22ND 2017 AT THE REGISTERED OFFICE OF THE COMPANY

Date: 24/10/2017

Ref: LE/2017/Board/01

It is RESOLVED THAT Mr. Khalid Masood, CEO of the Company, is hereby appointed as Authorized Person to apply National Electric Power Regulatory Authority (NEPRA) for Generation License of Lootah Energy Pvt. Ltd. Phase I 50 MW Wind Power Project and to undertake the following steps on behalf of the Company:

(a) to file/sign all the required documents,
(b) to comply with any of the NEPRA objections/instructions in this regard, and
(c) to make necessary changes/modifications to the documents submitted for Generation License to ensure compliance with NEPRA requirements as per related Rules/Regulation.

Certified that the abovementioned is a true and valid extract from the Meeting of the Board of Director of Lootah Energy Pvt. Ltd held on September 22nd, 2017.

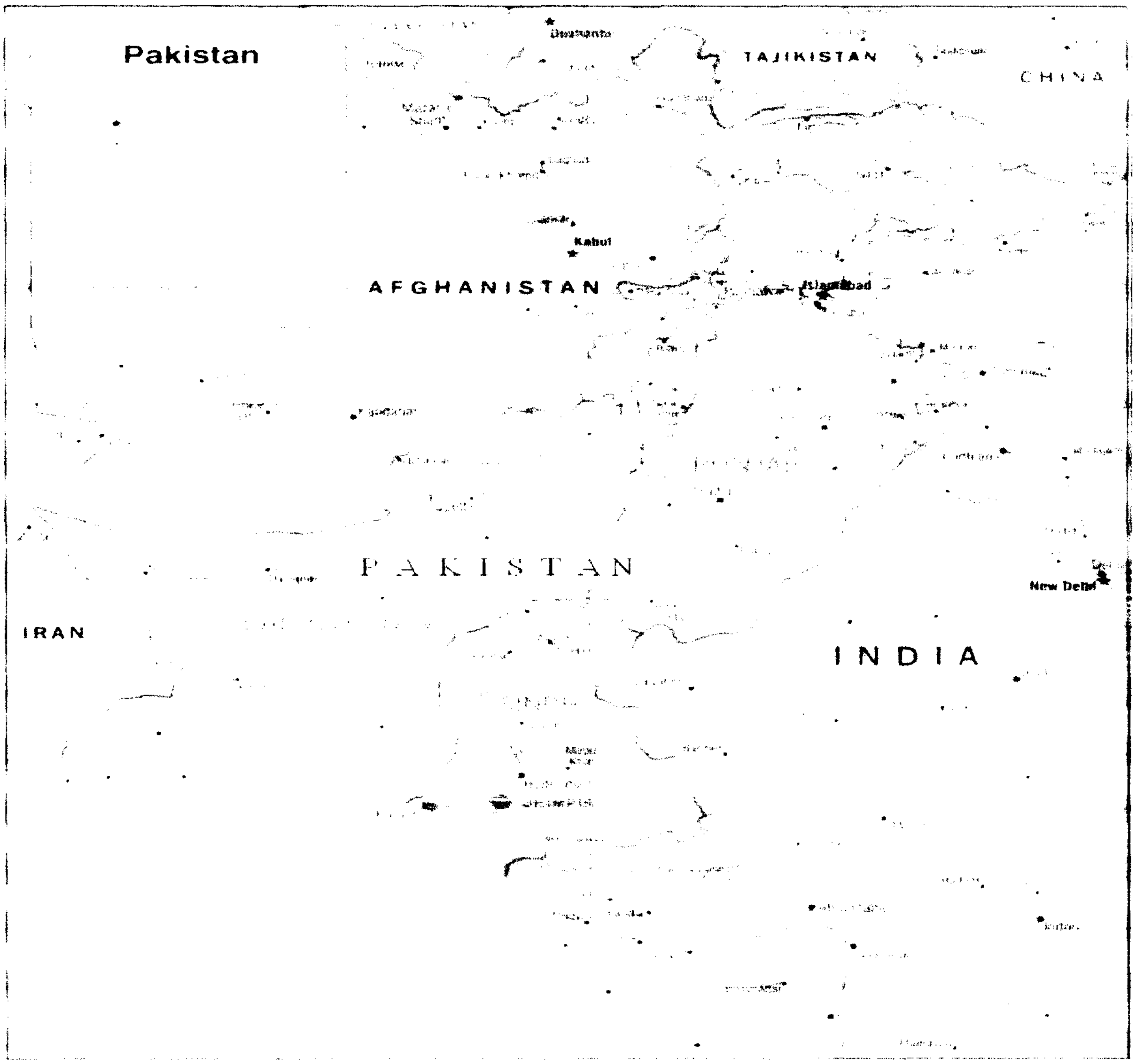
Abdul Aleem
Company Secretary

ATTESTED TRUE COPY
AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.

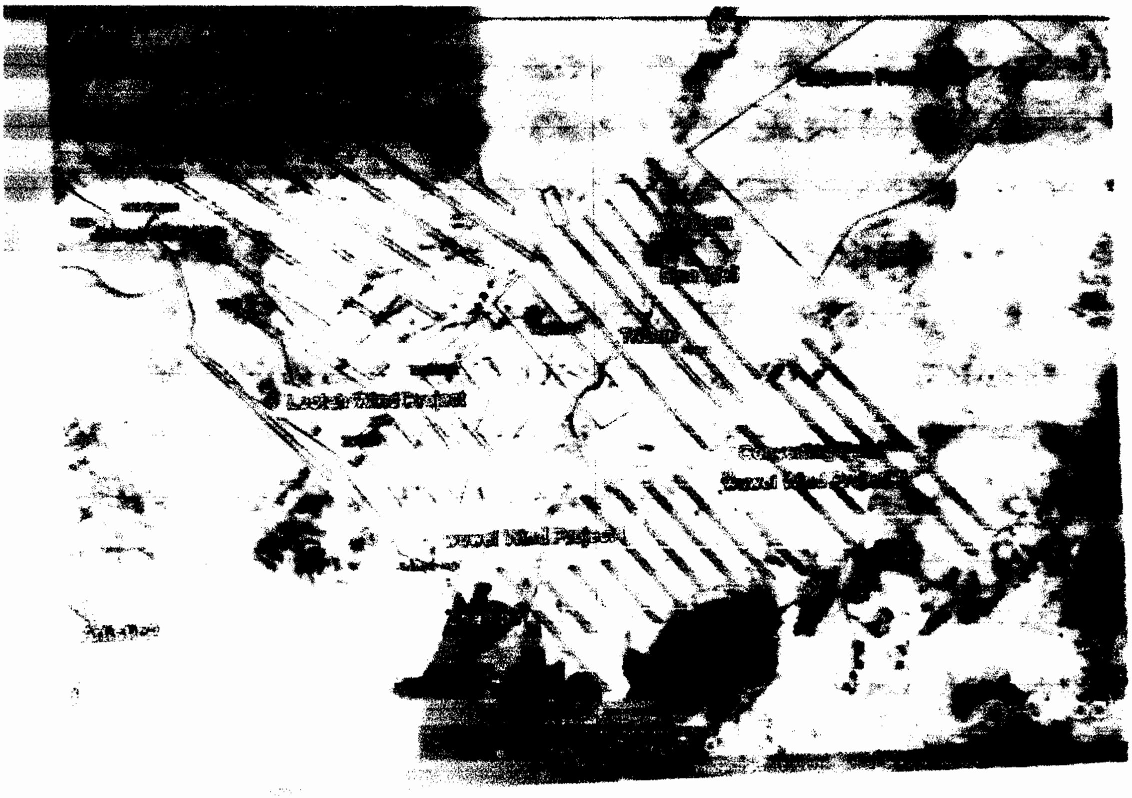
SCHEDULE-I

The Location, Size (i.e. Capacity in MW), Type of Technology, Interconnection Arrangements, Technical Limits, Technical/Functional Specifications and other details specific to the Generation Facility/Wind Farm of the Licensee are described in this Schedule.

Site Location of the Generation Facility/Wind Power Plant of Lootah Energy Limited

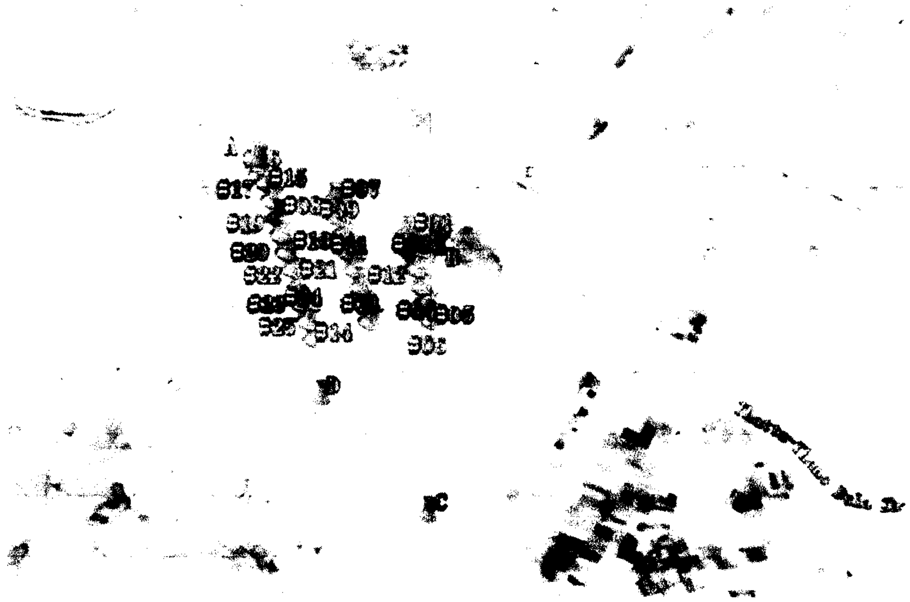


Layout of the Generation Facility/ Wind Power Plant of Lootah Energy Limited

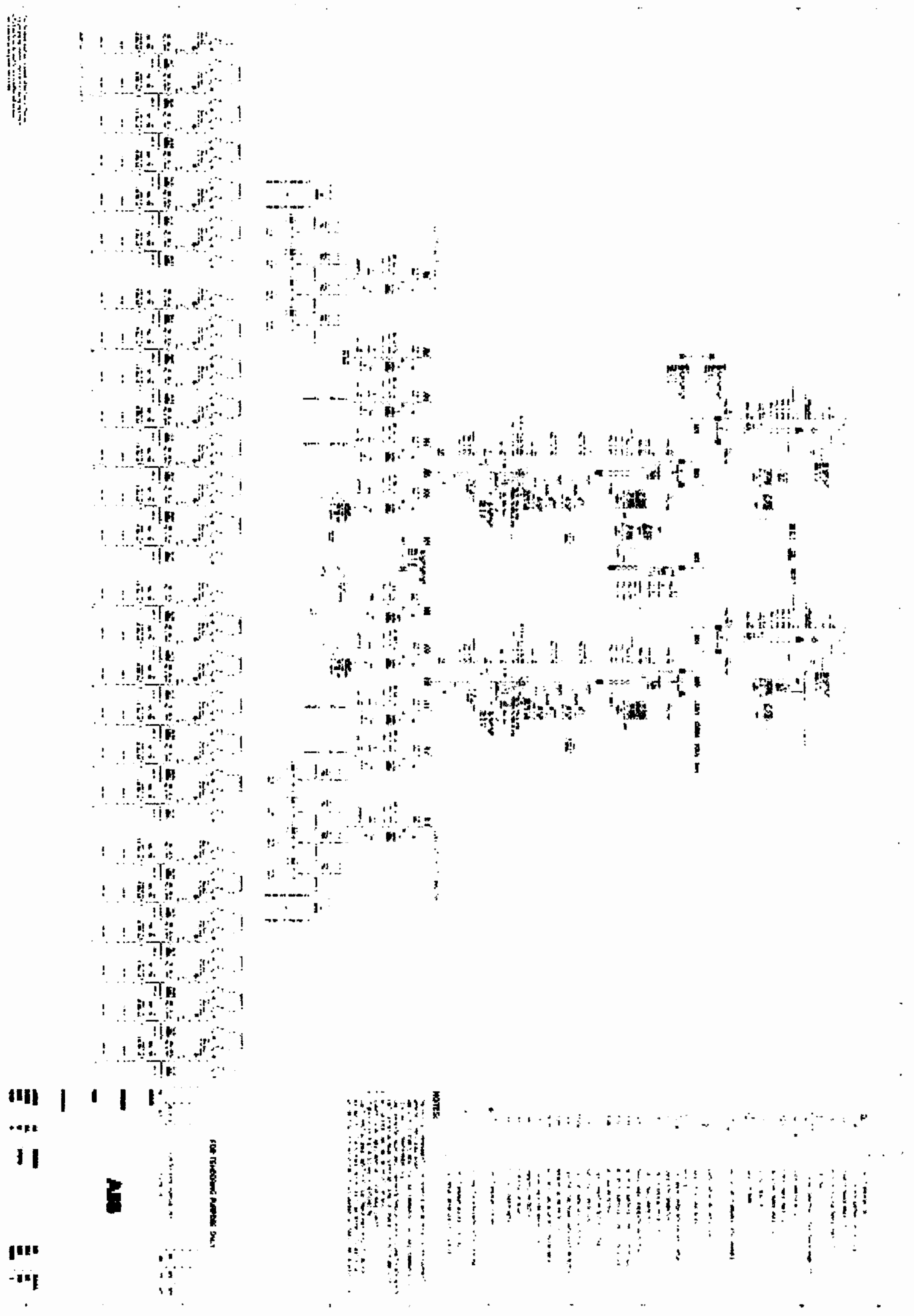


Land Coordinates of the Generation Facility/Wind Power Plant of Lootah Energy Limited

WTG No.	Position Coordinates
#01	25° 04' 06.5979" N, 67° 55' 10.3636" E
#02	25° 03' 57.2578" N, 67° 55' 13.4078" E
#03	25° 03' 47.8848" N, 67° 55' 16.4165" E
#04	25° 03' 38.5447" N, 67° 55' 19.4605" E
#05	25° 03' 29.2045" N, 67° 55' 22.5044" E
#06	25° 03' 19.8317" N, 67° 55' 25.5483" E
#07	25° 04' 25.4605" N, 67° 54' 27.0457" E
#08	25° 04' 16.0879" N, 67° 54' 30.0556" E
#09	25° 04' 06.7480" N, 67° 54' 33.1007" E
#10	25° 03' 57.3756" N, 67° 54' 36.1460" E
#11	25° 03' 48.0354" N, 67° 54' 39.1552" E
#12	25° 03' 38.6955" N, 67° 54' 42.2000" E
#13	25° 03' 29.3230" N, 67° 54' 45.2449" E
#14	25° 03' 19.9830" N, 67° 54' 48.2894" E
#15	25° 04' 44.2866" N, 67° 53' 43.6888" E
#16	25° 04' 34.9471" N, 67° 53' 46.7351" E
#17	25° 04' 25.5750" N, 67° 53' 49.7816" E
#18	25° 04' 16.2351" N, 67° 53' 52.7920" E
#19	25° 04' 06.8955" N, 67° 53' 55.8379" E
#20	25° 03' 57.5233" N, 67° 53' 58.8840" E
#21	25° 03' 48.1837" N, 67° 54' 01.9297" E
#22	25° 03' 38.8112" N, 67° 54' 04.9398" E
#23	25° 03' 29.4715" N, 67° 54' 07.9852" E
#24	25° 03' 20.1317" N, 67° 54' 11.0305" E
#25	25° 03' 10.7592" N, 67° 54' 14.0402" E



Single Line Diagram (Electrical) of the Generation Facility/Wind Power Plant of Lootah Energy Limited



Interconnection Arrangement for Dispersal of Power from the Generation Facility/Wind Power Plant of Lootah Energy Limited

The power generated from the Generation Facility/Wind Power Plant/Wind Farm of Lootah Energy Limited shall be dispersed to the National Grid through the load center of HESCO.

The scheme of interconnection of Lootah Energy WPP proposes the following reinstatements in place at Jhimpir cluster:

(1). The proposed Interconnection Arrangement /Transmission Facilities for dispersal of power will consist of the following:-

(a). Upgradation of 220/132 kV Jhimpir-2 grid station to 500/220/132kV Jhimpir-2 grid station

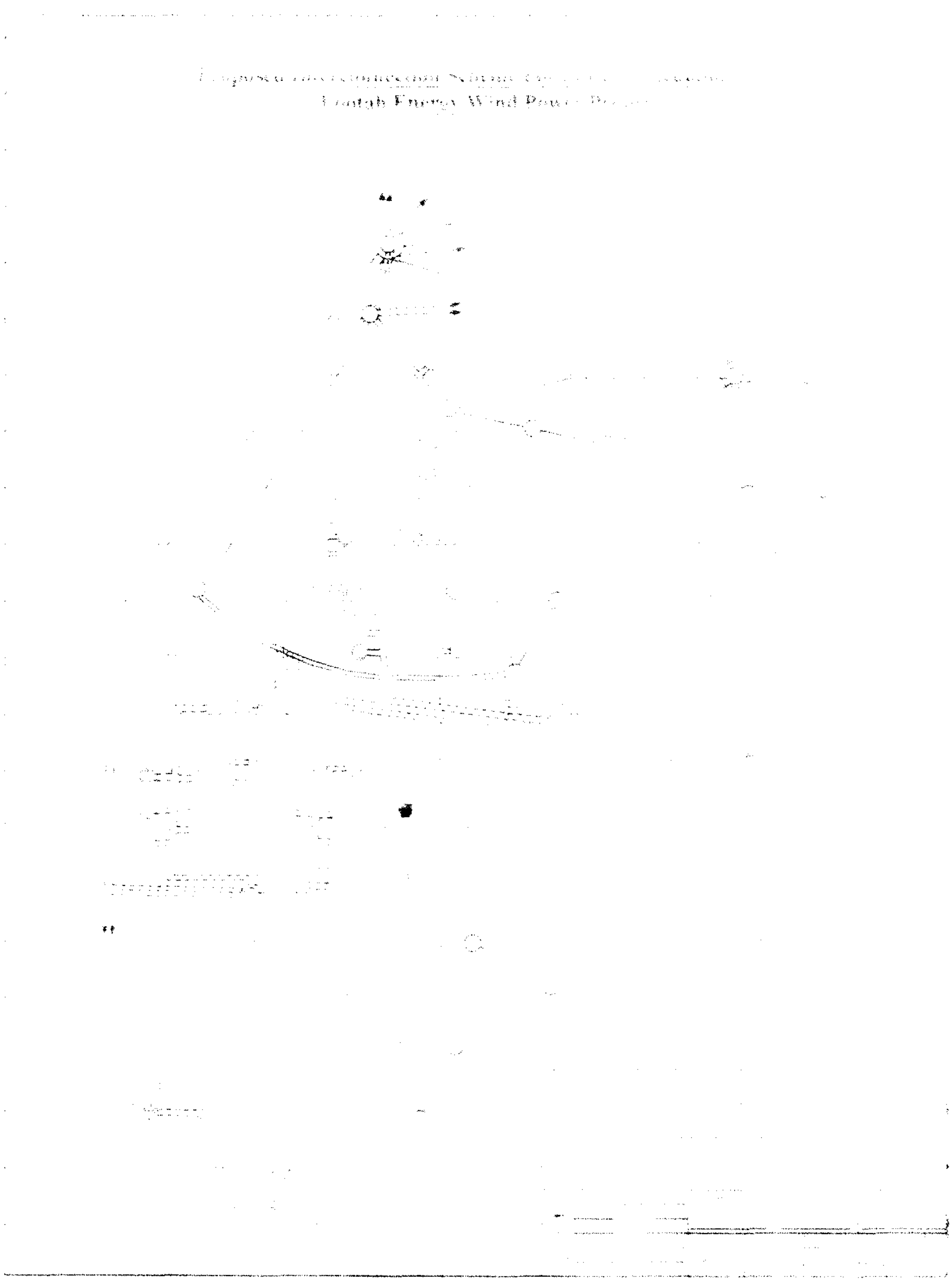
(b). Addition of two 132/500 kV step up transformers at Jhimpir-2 500/220/132kV Substation

(c). 500 kV double circuit (D/C) Transmission Line approx. 100 km long from Jhimpir-2 to Matiari grid station

(d). 132 kV double circuit (D/C) transmission line, approx. 184 km long, on twin-bundled Greeley conductor for connecting all the five WPPs including Wuwei-I, Wuwei-II, Lootah Energy, Shafi Energy and Cacho-II WPP to Jhimpir-2 500/220/132 kV newly proposed substation

(2). Any change in the above mentioned interconnection arrangement /transmission facilities duly agreed by Lootah Energy Limited, NTDC and HESCO shall be communicated to the Authority in due course of time.

Schematic Diagram for Interconnection Arrangement for Dispersal of Power from the Generation Facility/Wind Power of Lootah Energy Limited



Detail of
Generation Facility/Wind Power Plant/
Wind Farm of Lootah Energy Limited

(A). General Information

(i).	Name of the Company/Licensee	Lootah Energy Limited
(ii).	Registered/Business Office	
(iii).	Plant Location	
(iv).	Type of Generation Facility	Wind Farm/Wind Power Plant

(B). Wind Farm Capacity & Configuration

(i).	Wind Turbine Type, Make & Model	Gamesa G114-2.0 MW
(ii).	Installed Capacity of Wind Farm (MW)	50.00 MW
(iii).	Number of Wind Turbine Units/Size of each Unit (KW)	25x2.00 MW

(C). Wind Turbine Details

(a).	**Rotor**	
(i).	Number of blades	3
(ii).	Rotor diameter	114 m
(iii).	Swept area	10207 m^2
(iv).	Power regulation	Combination of blade pitches angle adjustment, and generator/converter torque control.
(v).	Cut-in wind speed	3 m/s
(vi).	Rated wind speed	13.07 m/s
(vii)	Cut-out wind speed	25 m/s
(viii)	Survival wind speed	59.5 m/s (Maximum 3 sec)

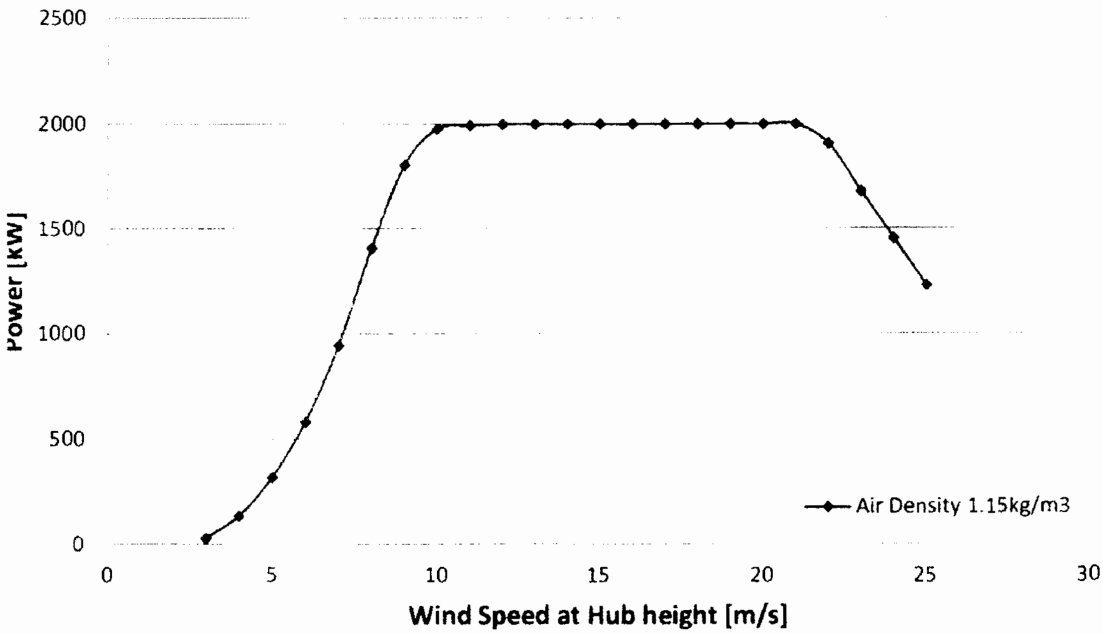
(ix	Pitch regulation	Pitch Control Hydraulic System consisting of Independent Hydraulic Actuators for each blade
(b).	**Gearbox**	
(i).	Type	3 combined stages: 1 stage planetary, 2 parallel shift gears
(ii).	Gear ratio	1:128.5
(iii).	Main shaft	Cast Shaft
(c).	**Blades**	
(i).	Blade length	56 m
(ii).	Material	Composite material reinforced with fiberglass through resin infusion technology.
(d).	**Generator**	
(i).	Nominal Power	2040 (kVA)
(ii).	Voltage	690 V
(iii).	Type	Double-Fed Induction Generator with a Coil Rotor and Slip Rings
(iv).	Degree of Protection	IP54 Turbine-IP21 Ring Body
(v).	Coupling	Main Shaft: Cone Collar High Speed Shaft: Flexible Coupling
(vi).	Power factor	0.95 Inductive – 0.95 Capacitive
(e).	**Control System**	
(i).	Type	PLC based Control System
(ii).	Scope of monitoring	Remote monitoring of different parameters, e.g. temperature sensors, pitch parameters, speed, generator torque, wind speed and direction, etc.
(iii).	Recording	Production data, event list, long and short-term trends
(f).	**Brake**	
(i).	Design	Mechanical brakes
(ii).	Operational brake	Aerodynamic brake achieved by feathering blades
(iii).	Secondary brake	Mechanical brakes on high speed shaft of gearbox

(g).	**Tower**	
(i).	Type	Conical barrel tube
(ii).	Hub height	80 m
(h).	**Yaw System**	
(i).	Yaw bearing	PETP
(ii).	Brake	Active Yaw
(iii).	Yaw drive	Motor Drive
(iv).	Speed	0.42/s controlling speed
(i).	**Other Details**	
(i).	Project Commissioning Date (Anticipated)	2018-2019
(ii).	Expected Life of the Project from Commercial Operation Date (COD)	25 Years

Power Curve of Wind Turbine Generator of Gamesa G114/2.0 (Tabular)

Wind Speed (m/s)	Power (kW)
3	29
4	135
5	319
6	581
7	943
8	1408
9	1804
10	1977
11	1993
12	1999
13	2000
14	2000
15	2000
16	2000
17	2000
18	2000
19	2000
20	2000
21	2000
22	1906
23	1681
24	1455
25	1230

Power Curve of Wind Turbine Generator of Gamesa G114/2.0 (Graphical)



SCHEDULE-II

The Total Installed/Gross ISO Capacity (MW), Total Annual Full Load Hours, Average Wind Turbine Generator (WTG) Availability, Total Gross Generation of the Generation Facility/Wind Farm (in GWh), Array & Miscellaneous Losses (GWh), Availability Losses (GWh), Balance of Plant Losses (GWh) Annual Energy Generation (GWh) and Net Capacity Factor of the Generation Facility /Wind Farm of Licensee are given in this Schedule

SCHEDULE-II

(1).	Total Installed Gross ISO Capacity of the Generation Facility /Wind Farm (MW/GWh)	50.00 MW
(2).	Total Annual Full Load Hours	3465 Hrs
(3).	Average Wind Turbine Generator (WTG) Availability	97.0 %
(4).	Total Gross Generation of the Generation Facility/Wind Farm (in GWh)	173.7 GWh
(5).	Array & Miscellaneous Losses GWh	10.419 GWh
(6).	Availability Losses GWh	5.07 GWh
(7).	Balance of Plant Losses GWh	5.211 GWh
(8).	Annual Energy Generation (20 years equivalent Net AEP) GWh	153 GWh
(9).	Net Capacity Factor	35.00 %

Note

All the above figures are indicative as provided by the Licensee. The net energy available to power purchaser for dispatch will be determined through procedures contained in the energy purchase agreement.

Ph: 021-99206449

NO. DAE/Wind/107-1/2016
GOVERNMENT OF SINDH
Directorate of Alternative Energy
ENERGY DEPARTMENT
Karachi, dated March 07, 2016
SAY NO TO CORRUPTION

Mr. Khalid Masood
Chief Executive Officer (CEO),
Lootah Energy (Pvt.) Limited,
Naseer Abdulla Lootah Group
P.O. Box 520, Dubai, UAE,
Ph: +971 4 2231520, Fax: +971 4 2232348.

Subject: **LETTER OF INTENT (LOI) FOR 50MW WIND POWER PROJECT-I AT WIND CORRIDOR THATTA.**

Reference: Your Proposal dated 15th October 2015.

In pursuance of the Policy for Development of Renewable Energy for Power Generation 2006 ("Policy"), implemented by Govt. of Sindh under clause 32 of Schedule II, Sindh Govt. Rules of Business 1986, the Directorate of Alternative Energy, Energy Department Govt. of Sindh, (DAE, GoS) hereby confirm its interest in your proposal for establishing an approximately 50 MW Wind Power Generation Project in wind corridor Thatta. The sponsors may approach the Land Utilization (LU) Department, through Energy Department Government of Sindh for acquisition of land. DAE GoS shall facilitate the sponsors for acquisition of land for project development. DAE GoS acknowledges receipt of Bank Guarantee NO. 174GTEN160610002 dated March 1, 2016 for the issuance of Letter of Intent ("LOI") **NO. DAE/Wind/107-1/2016/61** in the sum of USD 25,000/- (US dollars Twenty Five thousand only) from Dubai Islamic Bank Pakistan Limited (having registered office at Hassan Chambers, DC-7, Block 7, Kehkashan, Clifton) and Branch office at 7/FL6 Gulshan-e-Iqbal, Karachi. Bank Guarantee has been verified from concerned bank.

2. The Sponsor(s) is required to complete the feasibility study and achieve the milestones listed at the Annex-I to this LOI ("LOI Milestones") for the subject project, at no risk and at no cost to, and without any obligation on the part of the DAE Energy Department Government of Sindh or any other Provincial (Sindh) agency, within a period of 18 Months from the date of issuance of this LOI.

3. The Sponsor(s) is required to carry out and complete the feasibility study in accordance with internationally acceptable standards and in accordance with the terms and conditions stipulated in the Policy and this LOI. The feasibility study must include, inter alia, micro-siting details, detailed power production estimates based on wind speed benchmarks set by DAE GoS/GoP, soil tests reports, technical details pertaining to wind turbines to be used in the wind farm, electrical studies (including but not limited to short-circuit study, power quality study, load flow study and stability study), environmental study, project costing, financing plan, carbon credits, financing terms, tariff calculations and assumptions for financial calculations including economic/financial analysis. The Sponsor is also advised to liaise with Panel of Expert (POE), constituted by DAE, GoS and the power purchaser while determining the site, project layout, sub-station design and layout, the transmission line, interconnection arrangements and other related matters.

ATTESTED TRUE COPY
AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.

AIJAZ ALI ADVOCATE M.A. L.L.B NOTARY PUBLIC KARACHI

05 JAN 2018

8. (A) Pending the nomination of the Main Sponsor per sub-clause (B), the **M/S Naseer Abdulla Lootah Group** *(being the individual or group holding at least 20% equity or participatory interest in the IPP project)* is liable for all obligations and liabilities of and on behalf of all other shareholders/ Sponsor(s) (without relieving the other shareholders/Sponsor(s) of their obligations and liabilities under this LOI). It is emphasized that the financial and other relevant credentials of **M/S Naseer Abdulla Lootah Group** were a fundamental consideration for exercise of its shareholding (or other participatory interest, if the project company is not formed by the date of issue of the LOI) in the project or the project company without the prior written approval of DAE, Energy Department GoS, which approval may be declined by DAE, Energy Department GoS in its discretion if the proposed transferee's financial and other relevant credentials are found unsatisfactory.

(B) The Sponsor(s) is advised to nominate the Main Sponsor (being the individual or group holding at least 20% equity or participatory interest in the IPP project) no later than the Expiry Date of the LOI. In default of nomination as aforesaid, the **M/S Naseer Abdulla Lootah Group** will be deemed the Main Sponsor for all intents and purposes. The Main Sponsor together with other initial project shareholders/Sponsor(s) (which shall, subject in each case to sub-clause (A) above, by firmly settled and announced to DAE GoS by the Expiry Date of the LOI), must hold 51% of the project equity for a period up to the project's Commercial Operations Date (COD).

(C) Any actual or purported transfer or assignment of the shares or other participatory interests by the Sponsor(s) / shareholders in contravention of the foregoing restrictions without prior written consent of the DAE GoS shall render this LOI void and the bank guarantee will be encashed in such case by DAE GoS.

9. This LOI is not assignable and non-transferable. This LOI shall be void upon any actual or purported assignment or transfer hereof without the prior written consent of DAE GoS.

10. This LOI is issued in duplicate on the date hereof, and it shall come into effect when one copy is received by DAE, Energy Department GoS after being duly countersigned by you. Nevertheless, this LOI shall lapse if the countersigned copy is not received at DAE, GoS within 15 days of its issuance.

Agreed & Accepted for and on behalf
M/S Lootah Energy (Pvt.) Limited
Naseer Abdulla Lootah Group.

Khalid Masood

Name: KHALID MASOOD

Designation: CEO

07.03.2016

Engr. Mehfooz Ahmed Qazi
Director Alternative Energy
DAE, Energy Department
Government of Sindh
Karachi

AIJAZ ALI ADVOCATE M.A. L.L.B NOTARY PUBLIC KARACHI

ATTESTED TRUE COPY
AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.

05 JAN 2018

Annex-I

Milestones for the Letter of Intent (LOI)

Sr. No.	Milestones	Time Frame (in Months)
1.	Issuance of Letter of Intent (LOI)	T0
2.	Completion of Feasibility Study	No later than 120 days prior to the expiry date of the LOI
	i) Technical study along with project description.	
	ii) Wind data analysis	
	iii) Verification /constent of wind turbine generator (WTGs)	
3.	Approval of IEE / EIA from SEPA	No later than completion of the feasibility study
4.	Approval of Electrical and Grid Studies by NTDC	45 days after submission of the Electrical and Grid Studies
5.	Verification fee	To be submitted within 07 days of written request by DAE, GoS after preliminary approval
6.	Final approval of feasibility study by Panel of Experts	Within 30 days after preliminary approval, provided any requisite modifications are timely made by the Sponsor(s) and the modified feasibility study is resubmitted within 15 days of a letter by DAE, GoS requiring the modifications. (If necessary).
7.	Submission of application to NEPRA for tariff determination and Generation License	Within 15 days of final approval of the feasibility study by DAE, GoS
8.	Award of Tariff and Generation License by NEPRA	Within the validity of the LOI (as may be extended under clause 6)
9.	Posting of Performance Guarantee for Issuance of Letter of Support (LOS)	At least 15 days before expiry of LOI
10.	Issuance of Letter of Support (LOS) .	at least 7 days before expiry of LOI

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AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.

AIJAZ ALI ADVOCATE M.A. L.L.B NOTARY PUBLIC KARACHI

05 JAN 2018

NO. DAE/Wind/107-1/2016
GOVERNMENT OF SINDH
Directorate of Alternative Energy
ENERGY DEPARTMENT
Karachi, dated: November 28, 2017

Ph: 021- 99206448

Say No to Corruption

Mr. Khalid Masood
Chief Executive Officer (CEO),
Lootah Energy,
Naseer Abdulla Lootah Group
P.O. Box 520, Dubai, UAE,
Ph: +971 4 2231520, Fax: +971 4 2232348

SUBJECT: EXTENSION IN THE VALIDITY PERIOD OF LETTER OF INTENT (LOI) ISSUED TO M/S LOOTAH ENERGY (PVT.) LIMITED FOR THE DEVELOPMENT OF 50MW WIND POWER PROJECT-I

Reference is made to your request dated September 17, 2017 regarding subject matter.

2. Directorate of Alternative Energy, Energy Department, Govt. of Sindh is pleased to convey that the Panel of Experts (PoE) has considered your request for the extension in the validity period of LOI No.DAE/Wind/107-1/2016/61 dated 7th March, 2016 upto January 29, 2019 for the development of 50MW Wind Power Project-I in Jhimpir wind corridor, Thatta Sindh, subject to the submission of extended Bank Guarantee for a period of six (6) months beyond the extended date of LOI.

3. You are requested to submit the extended Bank Guarantee valid upto **July 29, 2019** within 15 days of the issuance of this letter for further processing of your request.

(Shahnawaz Farhan Khahro)
Deputy Director (Wind)
for Director Alternative Energy

Copy for information to:

- PS to Secretary, Energy Department, Govt. of Sindh
- PA to Special Secretary, Energy Department, Govt. of Sindh

ATTESTED TRUE COPY
AIJAZ ALI ADVOCATE M.A. L.L.B
Advocate & Notary
Public Karachi.
05 JAN 2018

FEASIBILITY APPROVAL SHEET

Title:

Feasibility Study Report of a 50MW Wind Power Project at Jhimpir-Sindh Pakistan For Lootah energy Pvt Ltd

Document No:

FS-WP-LE-10-2017

Prepared By:

Local Associate in Pakistan Mr. Najam Ul Hassan Farooqi

Reviewed By:

Rizwan Ahmed : Project Director- UK

Syed Salman Ahsan –Electrical Manager-UK

Final Approval :

Najam Ul Hassan Farooqi- Project Consultant

ACKNOWLEDGMENTS

The management of Lootah Energy Pvt Limited, is thankful to Ministry Of Water & Power, Alternate Energy Board, Central Power Purchase Agency, NTDC, HESCO, Department of Energy Government Of Sindh, NEPRA, for providing support, at each point, and level, to enable Lootah Energy develop this Feasibility Study, and enabled us to develop the project, where we are ready to proceed towards getting a Generation License, and Tariff, the pre-requisit for moving forward towards Implementation of this Project.

We continue to look forward for support from all the agencies and Govt. of Sindh, to enable us successfully instal and commission the Project as per required schedule.

We also acknowledge thanks to various individuals, departments, organisations, companies, whose publications or printed data, & data available on Internet, was used for development of this report.

DISCLAIMERS

This report is primarily prepared for use and benefit of Lootah Energy Pvt Limited (the Sponsors), and may not be used by any one else, or for any other purpose except for development of 50MW Wind Power Plant by Lootah Energy. The information thus provided is solely for development and implementation of the said project only.

SPONSORS CONTACT INFORMATION

M/S Lootah Energy (Pvt) Limited.

Address:	Office No: 201-202, Fareed Chamber, Abdullah Haroon Road Karachi,
Contact Person:	Mr. Khalid Masood- Chief Executive
Contact No:	Tel: 021-35662096 Fax: 021-35211243
E-Mail:	qbl@cyber.net.pk

CONSULTANTS CONTACT INFORMATION

	Najam Ul Hassan Farooqi- Project Consultant
Contact:	Tel: +92300 8222452
	E-Mail: najamfarooqi@gmail.com

1. EXECUTIVE SUMMARY

Pakistan is located on the North Western part of South Asian Sub Continent, with Arabian Sea being its Southern border, on the East its border is with India, The western border is with Iran and Afghanistan, the Northern Border with China.

Pakistan, geographically a very diverse country, with high altitude mountain ranges in the north, central of Pakistan is plan, the southern and south western part a desert, and a mountain range dividing whole of Pakistan near the western border, with, Hindukush, Sulaiman and Kirthir range.

The south eastern Pakistan on west of river Indus delta, has a wind corridor, which has the wind resources to produce nearly 50,000 MW of electricity through Wind Mills.

This alternate source of energy was investigated in 80's and an Alternate Energy Board was established to utilise this resource. , Considerable work was carried out in the 90's and in early 2000, which resulted in development of wind farms in the area. Investors showed, keen interest in the wind farm projects, which resulted in nearly 10 farms already installed, another 15 in process of installation and nearly 60, issued with LOI. Unfortunately, the pace of installation of Power evacuation infrastructure could not match with the interest in Power plants, so only about 750MW has been installed till date

Few year back, Sind Energy Board and Sindh Alternate Energy Board were formed and given the task to develop these Projects, however the Regulatory regime is still centralised, and SAEDB, only limits to issuance of LOI.

Issues in future development are still Evacuation of Power, and determination of Tariff, as well as allocation and lease of land for project. Upfront Tariff, now has been shifted to Bidding. However, the process of bidding has not been finalised, till writing of this report. The current development on Evacuation is basically for another 500MW, and now Lease of Land is restricted, and sponsors with own lands getting priority.

Lootah Group, a UAE based sponsor, got interested in Wind Project, and applied for 2x50MW Letter of Interest, which was granted to them under name of Lootah Energy a private limited company registered in Pakistan. Lootah, which had 5000 Acres of Land available with them, will now utilise part of it for this 100MW(2x50) project.

The consultant was hired to prepare a feasibility study, and develop the project for Lootah Energy.

1.1 PROJECT OVERVIEW AND SITE CONDITIONS

The Project is of 100MW , in two phases of 50MW each, and is going to be located at Jhimpir, near ZORLU & THREE GORGE existing Wind Farms. This part of Wind Corridor is already developed,and roads to site are paved, and majority of early projects are based in this area, as the Wind in Jhimpir area is slightly better, as Jhimpir plateau has an inclination of about 50=150 meters above sea level, and because of its hard ground, the cost of installation is lower. Plus there is hardly any populated area, so Environmental impact is also limited. Lootah Site is nearly flat and have mostly small shrubs. Geo study and Borehole Data of the whole plot of 5000 Acres of Lootah site was done, and found suitable for installation of WTG.
Currently NTDC is working in this area to further develop the Transmission system, so it's the most preferred site for sponsors
Three WTG manufacturers of repute have been selected for this project and final selection will be based on Energy yield, & Price of Project.

1.2. PROJECT STATUS WITH VARIOUS MILESTONES

Status, of first phase of 50MW Project is as follows;

- LOI Received for 2x50MW
- Initial feasibility study submitted to DAE ED GOS
- Preparation of Bankable Feasibility in Hand expected to be completed in 3rd week of October 2017
- Land arrangement made, lease of land to Project in Hand, with approval for usage for Wind Power, under documentation

- Geo Study and Borehole study carried out-See Attachment
- Grid Connectivity (GIS) study completed –See annexure
- Topographic Study completed – see annexure
- IEE study completed by Consultant , submitted for approval from SEPA in hand,-See annexure
- Transport & Access study carried out- see annexure

- Micro Sitting Studies of WTG, at various locations of Site carried out for best options.- Final site selected,
- Wind Resource Assessment carried out, based on Mast Data from FF & Masters
- Energy Yield Estimates of the three WTG, suppliers made
- Design of Civil Work in Hand, by OEM supplier, as part of Turnkey EPC
- Design of Electrical Work carried out.- Basic design done by OEM approved by NTDC, under GIS report
- Construction Management under review
- O&M management already under discussion with O&M/EPC suppliers, will be finalized with selected OEM
- Environmental Management, Health & Safety under discussion with OEM/EPC contractors
- Approval of Feasibility Study, -In month of October
- Generation Licence Application- End of October
- Tariff Application – In second Week of November
- Signing of EPC contract – By first week October
- LOS End December 2017
- Financial Close – By March 2018
- Construction to Start end Second Quarter 2018.

1.3. TARIFF STATUS:

After the expiry of Upfront Tariff in December 2016, a Bench Mark Tariff was Issued, on which bidding process was to be initiated, for selected Sponsors who were in priority List, based on NOC from NTDC for

Evacuation of Power and NOC from HESCO for purchase of power and approval of GIS.
Current status is that no RFP has been issued for the mechanism of Bidding process, and most of the sponsors are planning to apply tariff based on Cost Plus basis. Our indications are that it will not be allowed by NEPRA, and only other possibility is that for next lot of 15 projects, the Bench mark tariff could be declared as UPFRONT tariff. However situation is not clear , and Lootah Energy is ready for all three options.

1.4. FINANCIAL STATUS

Lootah Energy sponsors have the capacity and ability to raise Equity for this project, and for Debt part, negotiations are in hand with OEM/EPC contractors to raise country loan. Alternately we are talking to various banks including Dubai Islamic Bank, in which sponsor have ownership stake.
Once the status on type of Tariff modality is clear, after which we get the Tariff, and after commitment from the lenders, , the financial part of the Feasibility will be completed.

PART A- TECHNICAL FEASIBILITY

2. INTRODUCTION

2.1 Power Scenario In Pakistan

2.1.1 Pakistan is facing acute electricity shortage. The gap between the estimated peak demand and the recorded peak supply of electricity in 2013 was around 5,000 MW, which continue to exist even today. This shortage of electricity supply is not only adversely affecting the daily life of the people but also hampering the economic activities in Pakistan. Electricity in Pakistan is generated mainly on furnace oil, substantial quantity of which is imported. The oil prices in the international market vary frequently thus resulting in corresponding variation in fuel prices in the country. This situation along with the rapid depleting reserves of natural gas has raised very serious issues with respect to reliable supply of electricity posing threats to energy security in the country.

2.2. Overview Of Energy Situation In Pakistan

As per the Integrated energy plan developed by Economic Advisory Counsel in year 2009 for period upto 2022, Pakistan's total energy need during 2007-08 was 62.9 Million TOE. The total energy mix is also graphically presented in figure 2.3. Based on an expected GDP growth rate of 3.5% - 5%, the total energy demand outlook (if the current energy mix continues 'AS IS') is expected to be 122 MMTOE by 2022 as shown in figure 2.4.

During 2007-08 the total import bill for 17 MMTOE was approximately US$ 12 billion, Should the energy mix continue as it is today the total import bill for 79 MMTOE with a constant value of US$ 70 BBL could lead to imports of US$ 41 billion in 2022. The objective of this proposed policy is to reduce the import bill to $ 16 billion by the year 2022.

According to a recent study Pakistan's **prognosticated** reserves for gas and oil are noted below. We have at present only discovered about a third of the natural gas and considerably less of oil.

Gas (CF)	**150 Trillion**	Oil (bbls) **27.5 billion**
Coal (Mtons)	**185 billion**	Hydel (MW) **55,000**
Wind (MW)Gharo	**55,000**	Solar (MW) **2.9 million**

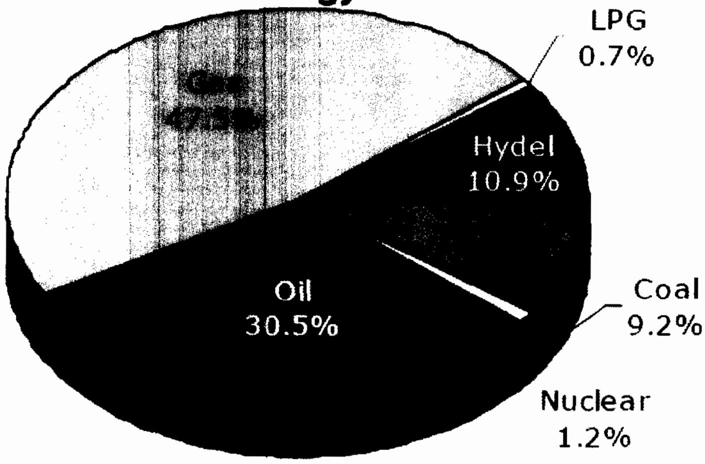
The potential power generation potential from hydro, coal and alternative and renewable resources is immense. The desire of the Energy Expert Group was to focus on these potentials so to create greater self reliance, energy diversity and security.

During the provision and generation of final energy, significant volumes of energy are lost during processing, generation, transmission, and as feedstock. This gross energy consumption i.e. final energy demand plus energy consumed/lost for generating final energy is termed as primary energy demand.

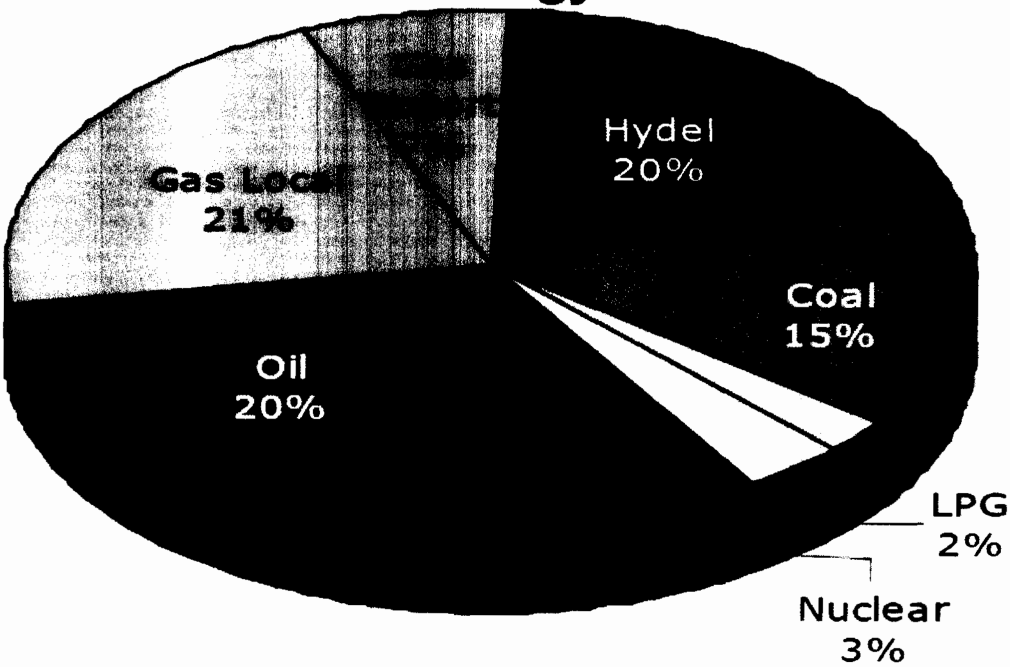
Pakistan's historical and current energy mix if allowed to grow as Business as Usual will lead to unprecedented dependency on imported energy feedstock. The net result would be that the country will lack in Energy Security, Energy Diversity and the import bill for hydrocarbon imports assuming crude prices remain at US$ 50-70 per BBL on average would result in an import bill of over US$ 41 billion. This energy mix is shown in Figure below

The country's primary energy demand is presented in Figure . In 2007, the country's primary energy demand was estimated to be around 60.20 million TOEs as compared to 29.94 million TOEs in 1992. The primary energy demand during 1992-2007 as such increased at an annual growth rate of 4.8%. The Energy Expert Group believes that Pakistan's total primary demand will grow to 122.46 MTOE in 2022 which is the middle case scenario predicted by the Petroleum Institute of Pakistan. Where this model is very different is in its diversity and indigenizing of resources.

2008 Energy Mix



2022 Energy Mix



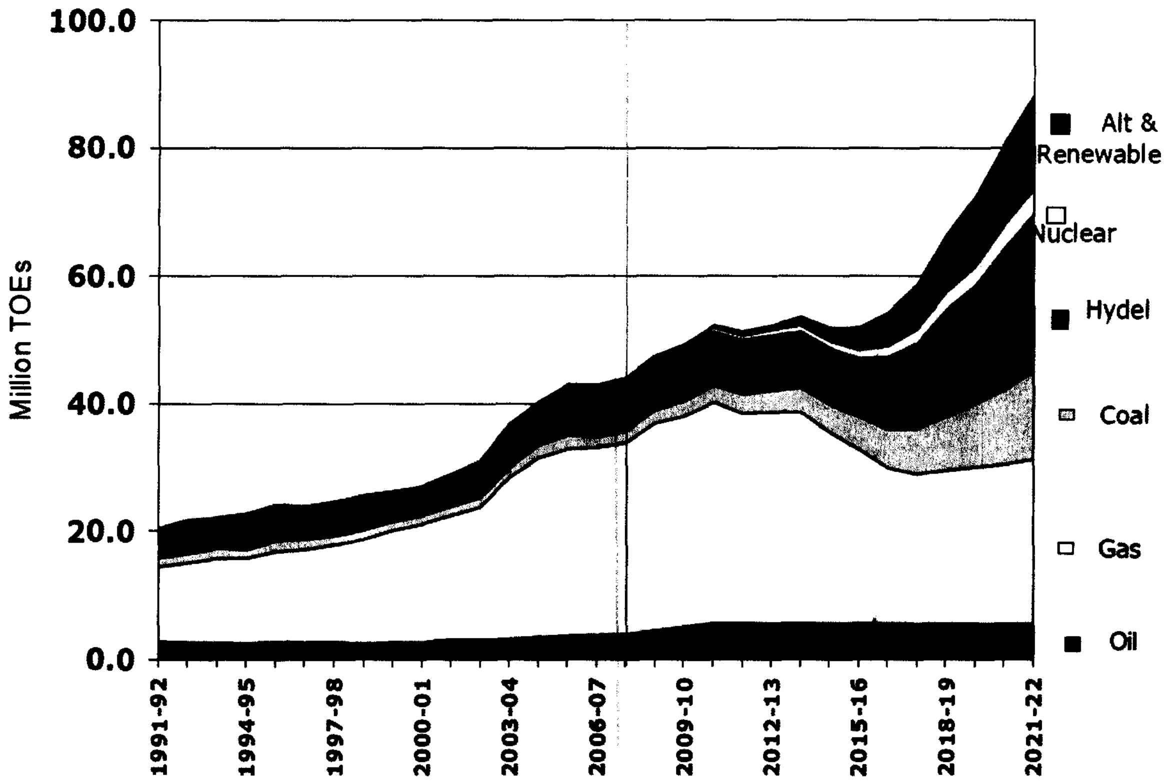
The above figures also indicate the direction in which the energy Expert Group would like to see the market grow in order to create greater self reliance.

2.3. Domestic Energy Supply Forecast

Presently the supply of natural gas (barring recent imports of LNG of upto 1.5million tons), hydel and nuclear are sourced locally.

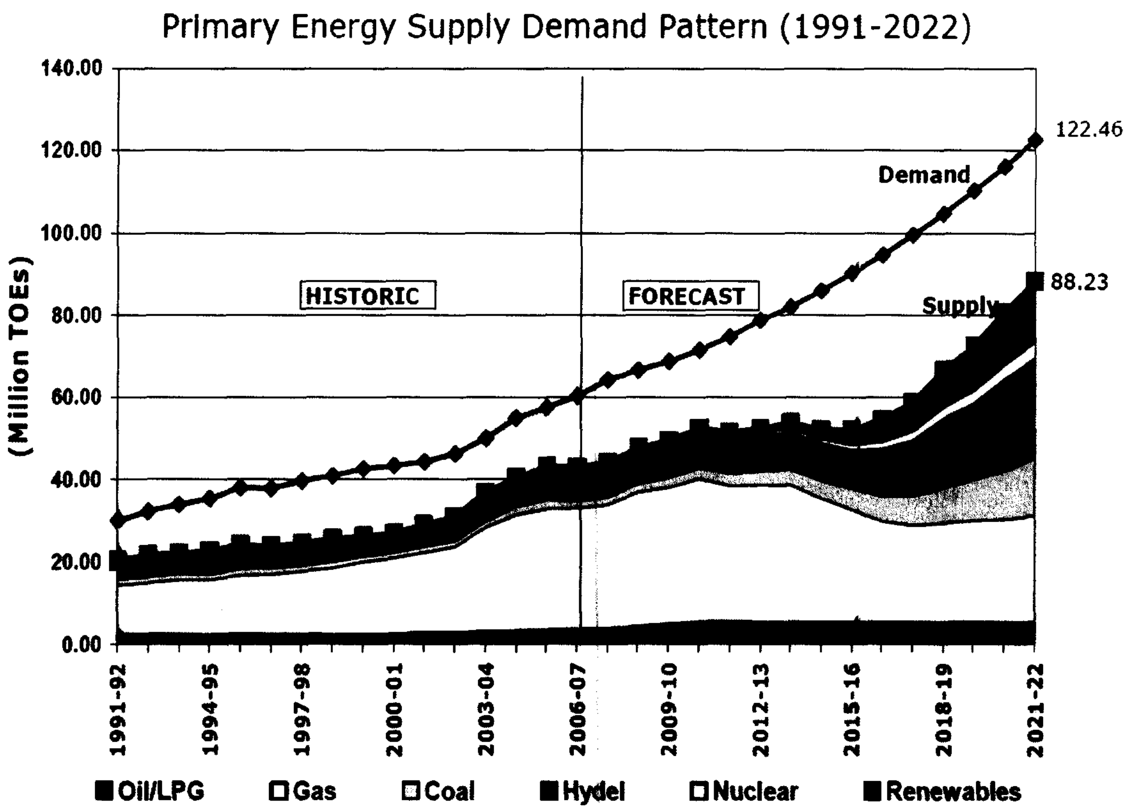
While a relatively small proportion of crude oil, petroleum products and coal is produced locally as against imports. Alternative & Renewable energy supplies have a very small contribution in the country's total energy mix.

Pakistan Domestic Energy Supply Pattern (1991-2022)



2.3.1 Energy Deficit and import Projection

In order to bridge the energy deficit Pakistan will need to import increasing quantities of gas and liquid hydrocarbons and diversify its energy supplies to include Coal, Alternate & Renewable and a greater proportion of Nuclear Energy. As such Pakistan will need to import around 34MMTOE of Primary energy, or 28% of its Primary Energy requirements, to meets its demand by the year 2022.



2.4 Power Supply and Demand

Pakistan Power Sector historically suffers from large demand-supply gap.Currently it has enlarged to 4,000-5,000 MW. More than one-fourth of the demand remains unmet round the year. Generation capacity was not added to match the growing demand resulting in extended load shedding of 6-8 hrs daily, in cities and upto 12 hours in rural areas.

In fact, Government made a Policy on Induction of Private Sector in Power Generation in late 80s and built it in to the Power Policy of 1994. This Policy enunciated that no more thermal power was to be inducted through the Public Sector; capacity additions were to be made exclusively by the private sector. After the installation of IPPs under the 1994 Power Policy, the supply-demand gap disappeared. However since 2000 not a single power plant was added in the private sector. Thus, the gap between the supply and the growing demand started to appear and continued to widen with every passing year. The power shortage has now turned into 'power crisis'. With its immense socio economic ramifications, the prevalent power crisis has become one of the most critical issues for the Government. For socio economic good of the people and the Government, it is essential that the crises be brought to an end.

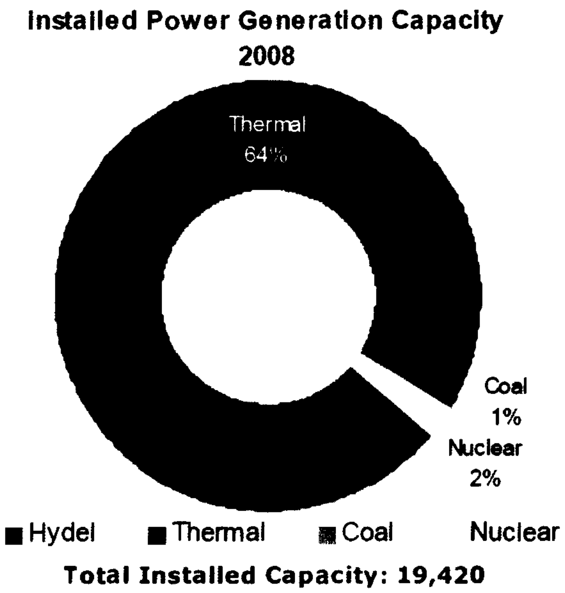
2.5 Demand & Demand Forecast

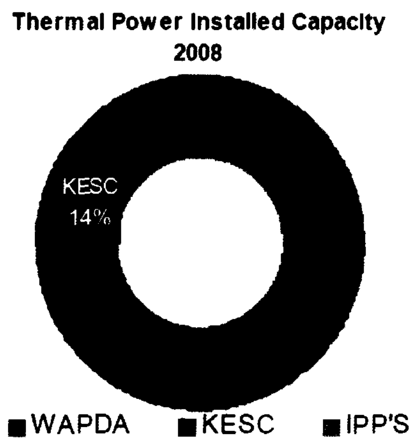
Electricity demand which was growing by 3 to 4 % up to 2003-04, jumped to 6,8,9 & 13% in the past four years and it was 10% in 2007-08. This jump was mainly due to a massive influx of large number of air conditioners and other home appliances in the system. This non productive demand was more residential in nature and overburdened the power system. In 2007, the computed peak demand was 18,883 MW which included not only unmet demand (load-shedding) but also self generation by industry (1556 MW). This demand is, expected to grow, at an average rate of about 8.1% to 54,000 MW by 2020 and to 113,695 MW by 2030.

This forecast has been reckoned through a regression process using a statistical model with not only the historic data but also economic factors such as GDP, CPI, tariff etc.

2.6 Existing Generation Capacity and Supply Position

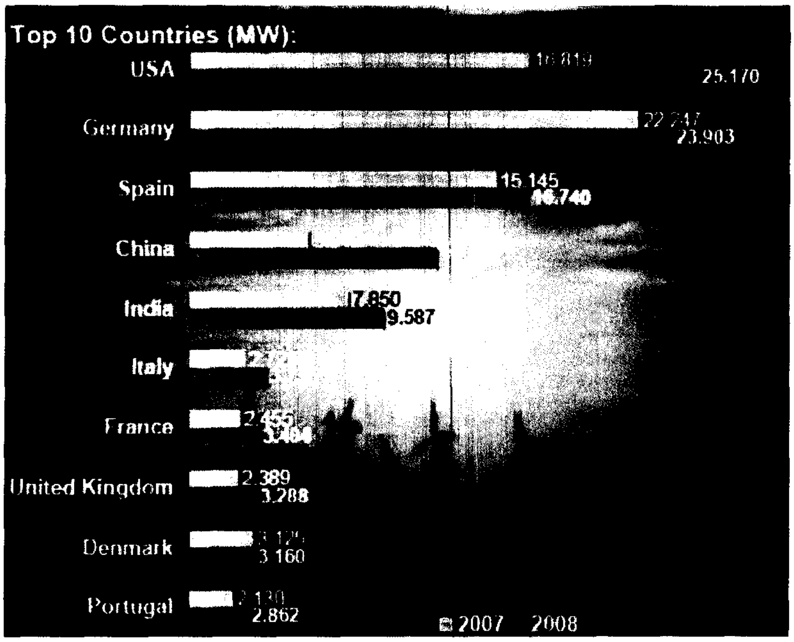
Total installed generating capacity is about 19,420 MW: One third is hydro, whereas two third is thermal see figures below. This lop sided structure has pushed the tariff upwards creating financial difficulties for the public and the Government. Title wise, 40% of thermal power production is from the private sector and 25% production comes from the public sector. Supply side, the maximum availability in summer is about 15,700 MW. Against this, the maximum computed demand in summer of 2007-08 was about 19,100 MW leaving a gap of over 4,000 MW. This balance is often aggravated by poor hydrological conditions, low rolling reserves, reduced supply of gas & break down in fuel oil supplies etc. Due to non availability of gas, more and more generation is being done through expensive imported fuel oil which has correspondingly eroded both the viability and the affordability of the sector. The extra burden on the exchequer of the country is obvious from the fact that in 2007-08, 32% of power generation was through oil out of which 58% of thermal power generation was through imported fuel oil where as only 29% was from hydro, 34% through natural gas and 2% was from nuclear. These figures do not include generation in the KESC area. Main issue is that very heavy dependence is on oil for generation and is going to increase with new generation.





2.7 Alternative and Renewable Energy (ARE) Sector

Pakistan is blessed with abundantly available and inexhaustible Renewable Energy (RE) resources, which if tapped effectively can play a considerable role in contributing towards energy security and energy independence of the country. Sporadic efforts and initiatives have been undertaken by the Government in the past leading to lacklustre results due to non-commitment, improper and disjointed planning and lack of focused, integrated efforts on part of the stakeholders involved. This is evident from the current installed capacity of RE sources in the country, which is limited to 340 MW only all of which have been added during the last one year. Given the current global energy scenario in general and Pakistan's energy scenario in particular, the adoption and deployment of ARE technologies makes perfect sense as it inherently favours indigenous, inexhaustible energy resources which also happen to be the most energy efficient by default. This is also in line with the objective of this document. However a major shift in



Government's policy and planning is required to favour deployment of Alternate Energy technologies.

2.8 Potential of Renewable Energy in Pakistan

Potential for various ARE technologies1 in the country vary from significant to phenomenal, which is as follows:

1. Wind: 346,000 MW
2. Solar: 2.9 Million MW
3. Small Hydel: 2,000 MW
4. Biogas / Waste to Power / Cogeneration : 2.000 MW

Pakistan's internal oil production meets approximately one sixth of the country's current oil requirements. Almost one third of the country's total energy requirement is met through import of oil.

Availability of energy in any country has a strong relationship with its economic and social stability. The per capita energy consumption is an index used to measure the prosperity of any society. Pakistan is basically an energy deficient country. Pakistan's per capita energy consumption, 3,894 kWh as against the world average of 17,620 kWh, gives it a ranking of 100 amongst the nations of the world.

3.Wind power capacity in the world

Wind power is present today in more than 80 countries, with 24 countries having more than 1,000 MW installed.

Wind energy is one of the fastest growing technologies in the world. Total worldwide wind capacity doubles every three years . In 2009 wind power showed a growth rate of 31.7%, the highest rate since 2001 . Worldwide wind capacity reached 159,213 MW, out of which 38,312 MW were added in 2009 . A total wind capacity of 200,000 Megawatt will be exceeded within the year 2010.

Pakistan also made a small contribution to worldwide wind energy capacity in 2009 by establishing a 6 MW wind power project in Jhimpir, Sindh. This was the first phase of a 50MW project which was expected to achieve COD by the end of 2010. Three (03) more projects of 50MW each are expected to achieve COD in the following year, 2011.

Until recently, wind energy did not manage to make significant inroads in Pakistan. This was due to several factors, the most significant of which was the non-availability of reliable long term surface wind speed data.

All the international agencies and investors require bankable long term wind data to develop feasibility studies.

AEDB shared the wind data collected by Pakistan Meteorological Department (PMD) with private investors/ project developers, but they raised reservations that the data had not been collected according to standard international procedures for collecting wind data. Until recently, wind energy did not manage to make significant inroads in Pakistan. This was due to several factors, the most significant of which was the non-availability of reliable long term surface wind speed data.

All the international agencies and investors require bankable long term wind data to develop feasibility studies.

GLOBAL INSTALLED WIND POWER CAPACITY (MW) - REGIONAL DISTRIBUTION

		End 2012	New 2013	Total (End of 2013)
AFRICA & MIDDLE EAST	Ethiopia	81	90	171
	Egypt	550	-	550
	Morocco	291	-	291
	Tunisia	104	-	104
	Iran	91	-	91
	Cape Verde	24	-	24
	Other [1]	24	-	24
	Total	**1,165**	**90**	**1,255**
ASIA	PR China	75,324	16,088	91,412
	India	18,421	1,729	20,150
	Japan	2,614	50	2,661
	Taiwan	571	43	614
	South Korea	483	79	561
	Thailand	112	111	223
	Pakistan	56	50	106
	Sri Lanka	63	-	63
	Mongolia	-	50	50
	Other [2]	71	16	87
	Total	**97,715**	**18,216**	**115,927**
EUROPE	Germany	31,270	3,238	34,250
	Spain	22,784	175	22,959
	UK	8,649	1,883	10,531
	Italy	8,118	444	8,552
	France	7,623	631	8,254
	Denmark	4,162	657	4,772
	Portugal	4,529	196	4,724
	Sweden	3,746	724	4,470
	Poland	2,496	894	3,390
	Turkey	2,312	646	2,959
	Netherlands	2,391	303	2,693
	Romania	1,905	695	2,600
	Ireland	1,749	288	2,037
	Greece	1,749	116	1,865
	Austria	1,378	308	1,684
	Rest of Europe [3]	4,956	832	5,737
	Total Europe	**109,817**	**12,031**	**121,474**
	of which EU-28 [4]	106,454	11,159	117,289
LATIN AMERICA & CARIBBEAN	*Brazil	2,508	953	3,461
	Chile	205	130	335
	Argentina	142	76	219
	Costa Rica	148	-	148
	Nicaragua	146	-	146
	Honduras	102	-	102
	Dominican Republic	33	52	85
	Uruguay	56	4	59
	Carribean [5]	136	-	136
	Others [6]	54	20	74
	Total	**3,530**	**1,235**	**4,764**
NORTH AMERICA	USA	60,007	1,084	61,091
	Canada	6,204	1,599	7,803
	Mexico	1,537	380	1,917
	Total	**67,748**	**3,063**	**70,811**
PACIFIC REGION	Australia	2,584	655	3,239
	New Zealand	623	-	623
	Pacific Islands	12	-	12
	Total	**3,219**	**655**	**3,874**
	World total	**283,194**	**35,289**	**318,105**

Source: GWEC

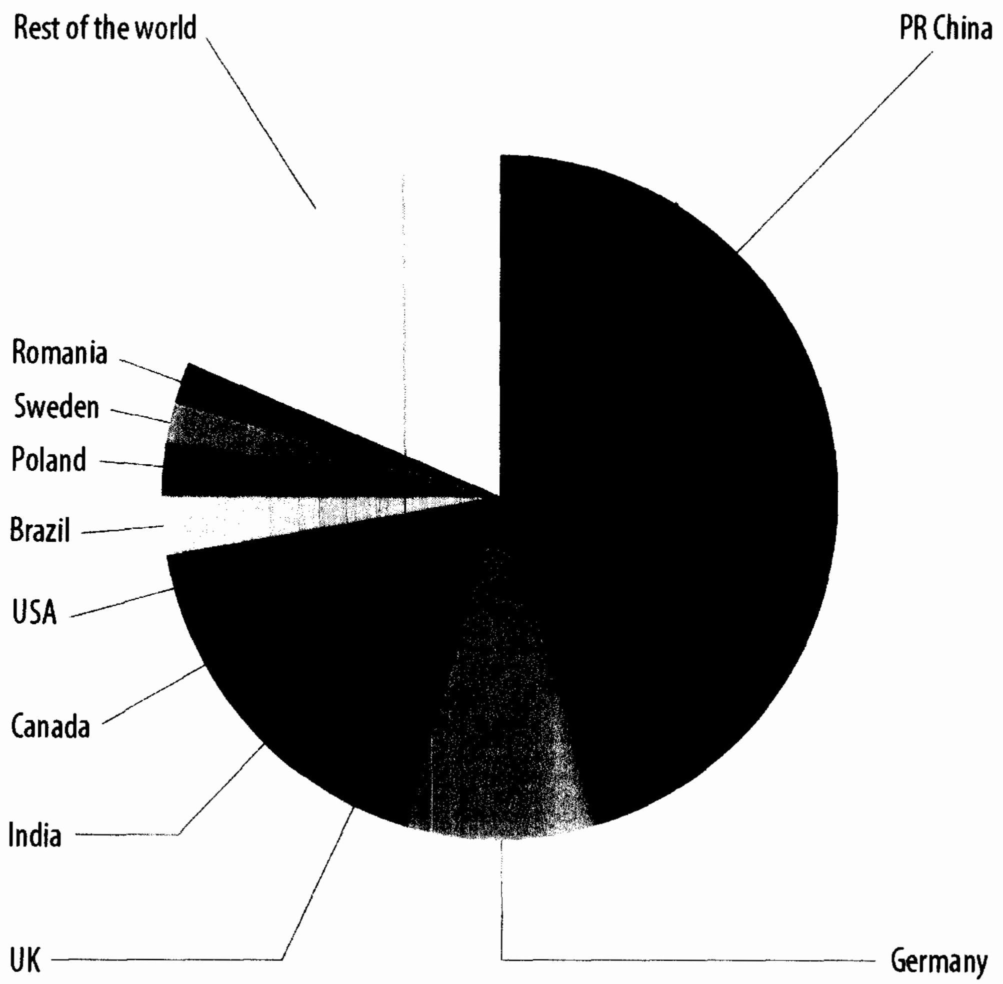
1 *Israel, Jordan, Kenya, Libya, Nigeria, South Africa*
2 *Bangladesh, Philippines, Vietnam*
3 *Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Faroe Islands, FYROM, Hungary, Iceland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Romania, Russia, Switzerland, Slovakia, Slovenia, Ukraine.*
4 *Austria, Belgium, Bulgaria, Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK*
5 *Caribbean: Aruba, Bonaire, Curacao, Cuba, Dominica, Guadalupe, Jamaica, Martinique, Granada*
6 *Bolivia, Colombia, Ecuador, Peru, Venezuela*

Note:

* **Projects fully commissioned, grid connections pending in some cases**

Project decommissioning of approximately 374 MW and rounding affect the final sums

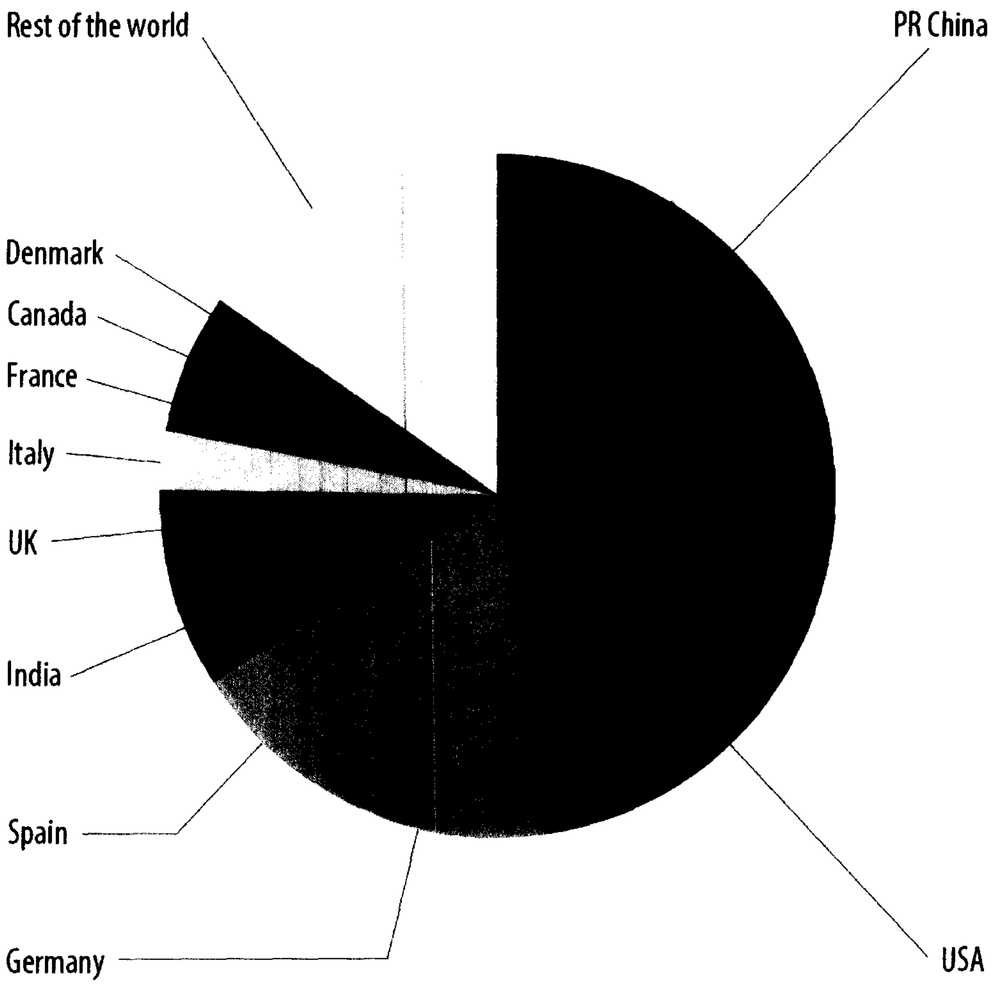
TOP 10 NEW INSTALLED CAPACITY JAN-DEC 2013



Country	MW	% SHARE
PR China	16,088	45.6
Germany	3,238	9.2
UK	1,883	5.3
India	1,729	4.9
Canada	1,599	4.5
USA	1,084	3.1
Brazil	953	2.7
Poland	894	2.5
Sweden	724	2.1
Romania	695	2.0
Rest of the world	6,402	18.1
Total TOP 10	**28,887**	**82**
World Total	**35,289**	**100.0**

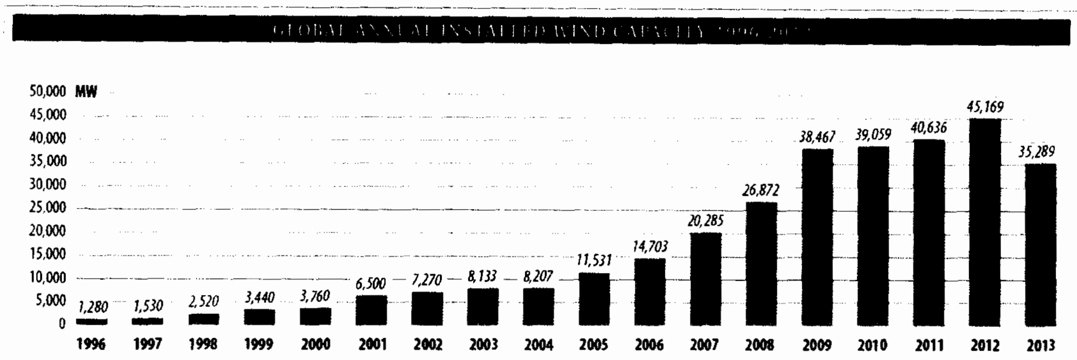
Source: GWEC

TOP 10 CUMULATIVE CAPACITY DEC 2013



Country	MW	% SHARE
PR China	91,412	28.7
USA	61,091	19.2
Germany	34,250	10.8
Spain	22,959	7.2
India	20,150	6.3
UK	10,531	3.3
Italy	8,552	2.7
France	8,254	2.6
Canada	7,803	2.5
Denmark	4,772	1.5
Rest of the world	48,332	15.2
Total TOP 10	**269,773**	**84.8**
World Total	**318,105**	**100.0**

Source: GWEC


GLOBAL ANNUAL INSTALLED WIND CAPACITY
50,000 MW
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1,280
1,530
2,520
3,440
3,760
6,500
7,270
8,133
8,207
11,531
14,703
20,285
26,872
38,467
39,059
40,636
45,169
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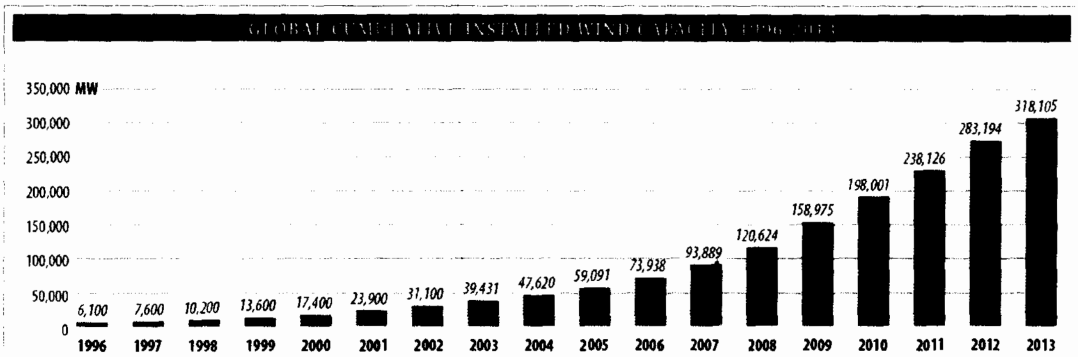
GLOBAL CUMULATIVE INSTALLED WIND CAPACITY
350,000 MW
300,000
250,000
200,000
150,000
100,000
50,000
0
6,100
7,600
10,200
13,600
17,400
23,900
31,100
39,431
47,620
59,091
73,938
93,889
120,624
158,975
198,001
238,126
283,194
318,105
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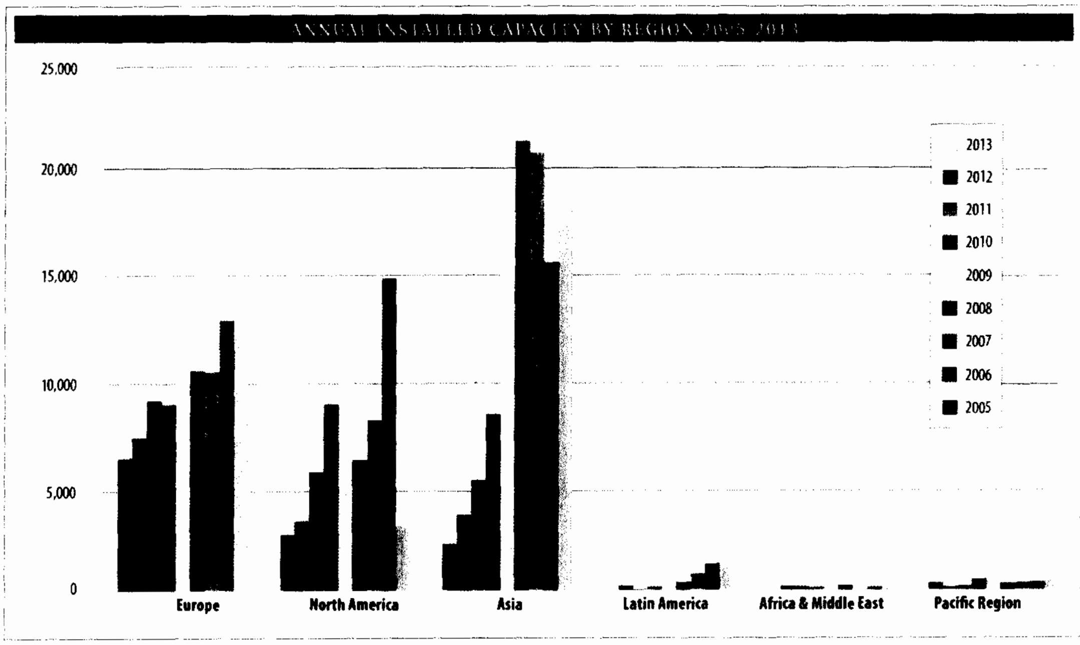

ANNUAL INSTALLED CAPACITY BY REGION
25,000
20,000
15,000
10,000
5,000
0
Europe
North America
Asia
Latin America
Africa & Middle East
Pacific Region
2013
2012
2011
2010
2009
2008
2007
2006
2005

3.1 Annual market down; Return to Growth in 2014

The Global Wind Energy Council (GWEC) released its 2013 market statistics , with cumulative global capacity reaching a total of 318,137 MW, an increase of nearly 200,000 MW in the past five years. However, the annual market dropped by almost 10 GW to 35,467 MW, attributable to the precipitous drop in US installations due to the policy gap created by the US Congress in 2012. While 2013 marked another difficult year for the industry with 'only' 12.5% cumulative growth, the prospects for 2014 and beyond look much brighter.

"Outside of Europe and the US, the global market grew modestly last year, led by China and an exceptionally strong year in Canada. While the policy hiatus in the US hit our 2013 figures hard, the good news is that projects under construction in the US totalled more than 12,000 MW at year end, a new record. European installations were off by a modest 8%, but with an unhealthy concentration of the market in just two countries - Germany and the UK", said GWEC Secretary General Steve Sawyer.

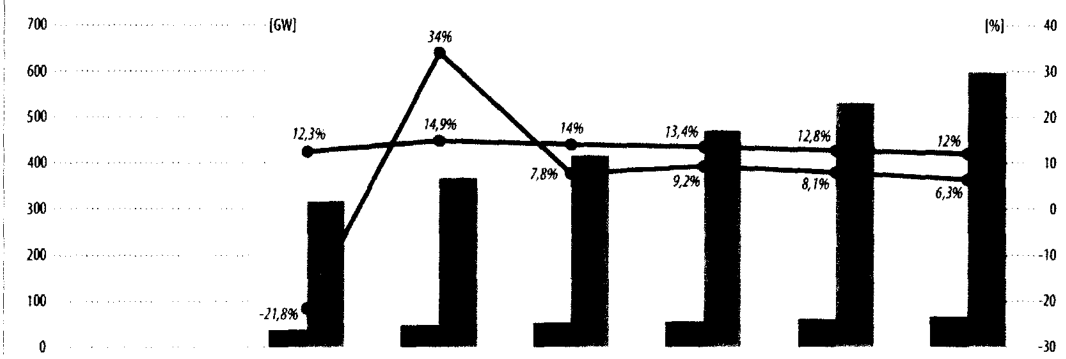
GWEC welcomed the strong installation figures from China, noting that the consolidation phase for the Chinese industry which began after the peak year of 2010 seems to be over, and the market is growing again.

"China is a growth market again, which is good news for the industry. The government's commitment to wind power has been reinforced once again by raising the official target for 2020 to 200 GW, and the industry has responded", continued Sawyer.

India has a new national 'Wind Mission', Brazil booked 4.7 GW of new projects in 2013, and Mexico's electricity sector reform is set to ignite the market in the coming years. While only chalking up 90 MW in installations in 2013, Africa is set to boom with new installations in 2014 led by South Africa, Egypt, Morocco, Ethiopia, Kenya and Tanzania.

Non-OECD markets are pretty healthy on the whole, and there is a steady stream of new markets emerging in Africa, Asia, and Latin America. With the US apparently back on track, at least for the next two years, the main challenge is stabilising the European markets, both onshore and offshore, which have been rocked by political dithering over the past few years.

MARKET FORECAST FOR 2014 – 2018



	2013	2014	2015	2016	2017	2018
Cumulative [GW]	318,1	365,4	416,4	472,1	532,3	596,3
Cumulative capacity growth rate [%]	12,3%	14,9%	14,0%	13,4%	12,8%	12,0%
Annual installed capacity ([GW]	35,3	47,3	51,0	55,7	60,2	64,0
Annual installed capacity growth rate [%]	-21,8%	34,0%	7,8%	9,2%	8,1%	6,3%

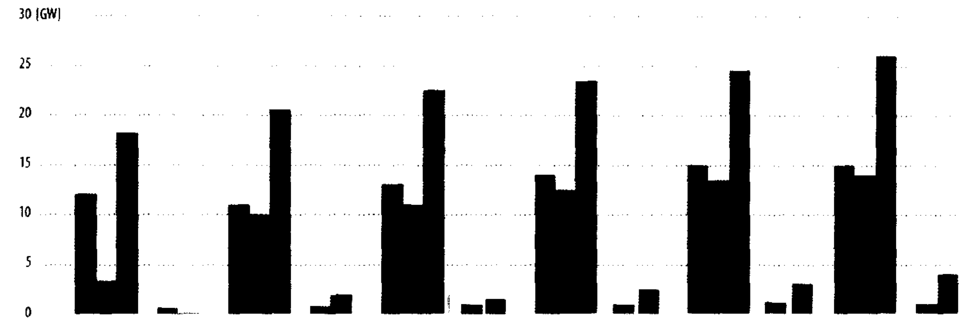
Source: GWEC

GWEC expects the market diversification trend which has emerged over the past several years and intensified during 2013 to continue to do so over the next several years. New markets outside the OECD continue to appear, and some of them will begin to make a significant difference to overall market figures. Inside the OECD, as wind power approaches double digit penetration levels in an increasing number of markets, and as demand growth either stalls or goes backwards, incumbents feel increasingly threatened. The fight for market share and policy support in these markets is becoming more and more intense. As a result, most of the growth in the coming years will be in markets outside the OECD.

The competition with incumbent fossil generation will continue until and unless there is a global price on carbon, a prospect which few look for any time soon. However, regional and national carbon markets are starting to show some promise, although it will take some time to see if they begin to have a systemic effect on the market. The shine is starting to come off of the notion of the 'Golden Age of Gas', much touted in recent years, as the environmental and climate impacts of the fracking revolution in the US begin to emerge, and as artificially low prices begin to rise. That, combined with political unrest in the hydrocarbon-rich parts of the world, has given wind and other renewables a competitive boost in terms of price.

Today, in the absence of a concerted effort to combat climate change, it is wind's cost competitiveness that is its greatest advantage in the market place. In Brazil, South Africa, Turkey, Mexico and elsewhere, wind is competing directly and

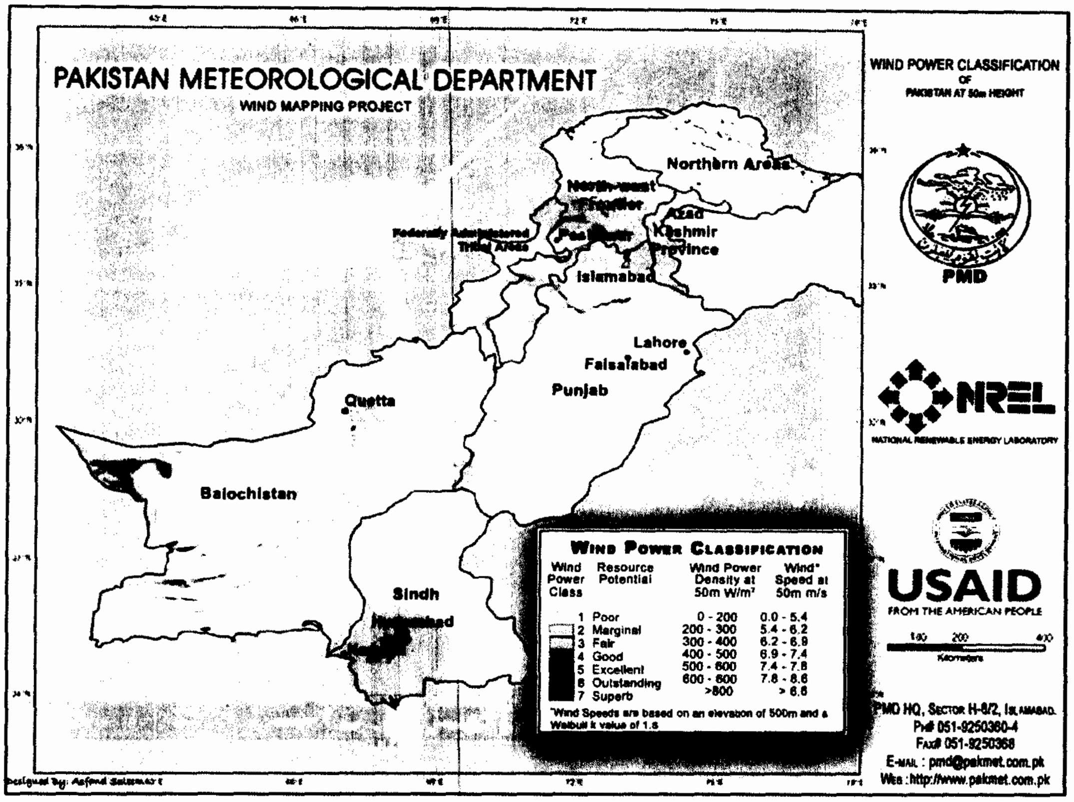
ANNUAL MARKET FORECAST BY REGION [illegible]



	2013	2014	2015	2016	2017	2018
Europe	12.03	11	13	14	15	15
North America	3.06	10	11	12.5	13.5	14
Asia	18.22	20.5	22.5	23.5	24.5	26
Latin America	1.24	3	2	2.2	3	4
Pacific	0.66	0.8	1	1	1.2	1
Middle East and Africa	0.09	2	1.5	2.5	3	4

Source: GWEC

4.WIND POWER POTENTIAL IN PAKISTAN



USAID & Pakistan Meteorological Department has conducted a detailed Wind Power Potential Survey of Coastal Areas of Pakistan and Ministry of Science and Technology has provided the required funding for this purpose. This study has enabled to identify the potential areas where economically feasible wind farm can be established. One interesting aspect of this study is that contrary to the general impression, Sindh coastal areas have greater wind power potential than Baluchistan coastal areas. Potential areas cover 9700 sq.km in Sindh. The gross wind power potential of this area is 43000 MW and keeping in view the area utilization constrains etc. the exploitable electric power generation potential of this area is estimated to be about 11000MW.

The demand for energy has increased in tremendous proportions in the last few decades in Pakistan; the same is expected to increase further in the coming years. The primary sources of energy available in Pakistan are oil, natural gas, hydro and nuclear Power. At present oil accounts for approximately 45% of total commercial energy supply. The share of natural gas is 34% while that of hydel power remains roughly at 15%. The increase in cost of fossil fuel and the various environmental problems of large scale power generation have lead to increased appreciation of the potential of electricity generation from non-conventional sources. This has provided the planners and economists to find out other low cost energy resources.

Wind and Solar energies are the possible clean and low cost renewable resources available in the country. The potential, for the use of alternative technologies, has never been fully explored in Pakistan. Wind power provides opportunity to reduce dependence on imported fossil fuel and at the same time expands the power supply capacity to remote locations where grid expansion is not practical.

Recently conducted survey of Wind Power Potential along coastal areas of the country by Pakistan Meteorological Department (PMD), indicates that a potential exists for harvesting wind energy using currently available technologies, especially along Sindh coast.

As Pakistan moves toward rapid economic development, energy scarcity is becoming a critical barrier that could threaten the development process. The existing power deficit is 5000 MW which is expected to reach 8,500 MW by 2015.

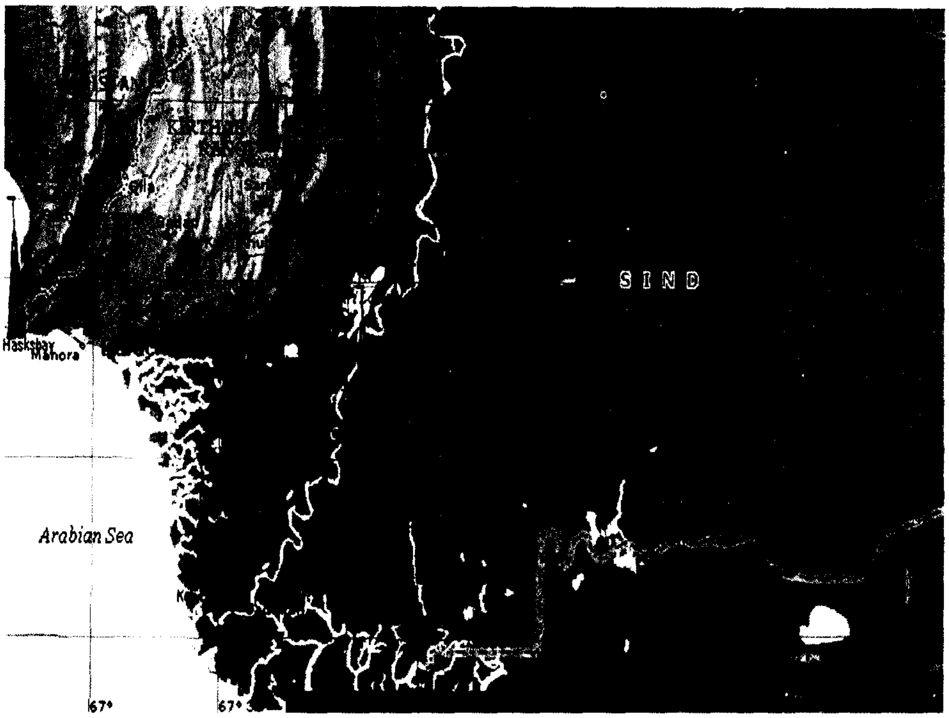
Power, the backbone of any development activity in the country, is provided by conventional and non-conventional sources. The continuous use of fossil fuels is not only depleting reserves but also causing serious environmental concerns and creating alarming circumstances for the future. To avoid such situation, more power from non-conventional sources is required. Wind is one non-conventional energy source that provides one of the most promising alternatives for generation of grid quality power.

4.1 Wind Power In Pakistan

4.1.1 Wind Mapping Project 1

The wind power program in Pakistan was initiated around ten years back installation of Wind Measuring Stations in the costal areas of

Sindh, Pakistan and was called Wind Mapping Project I.

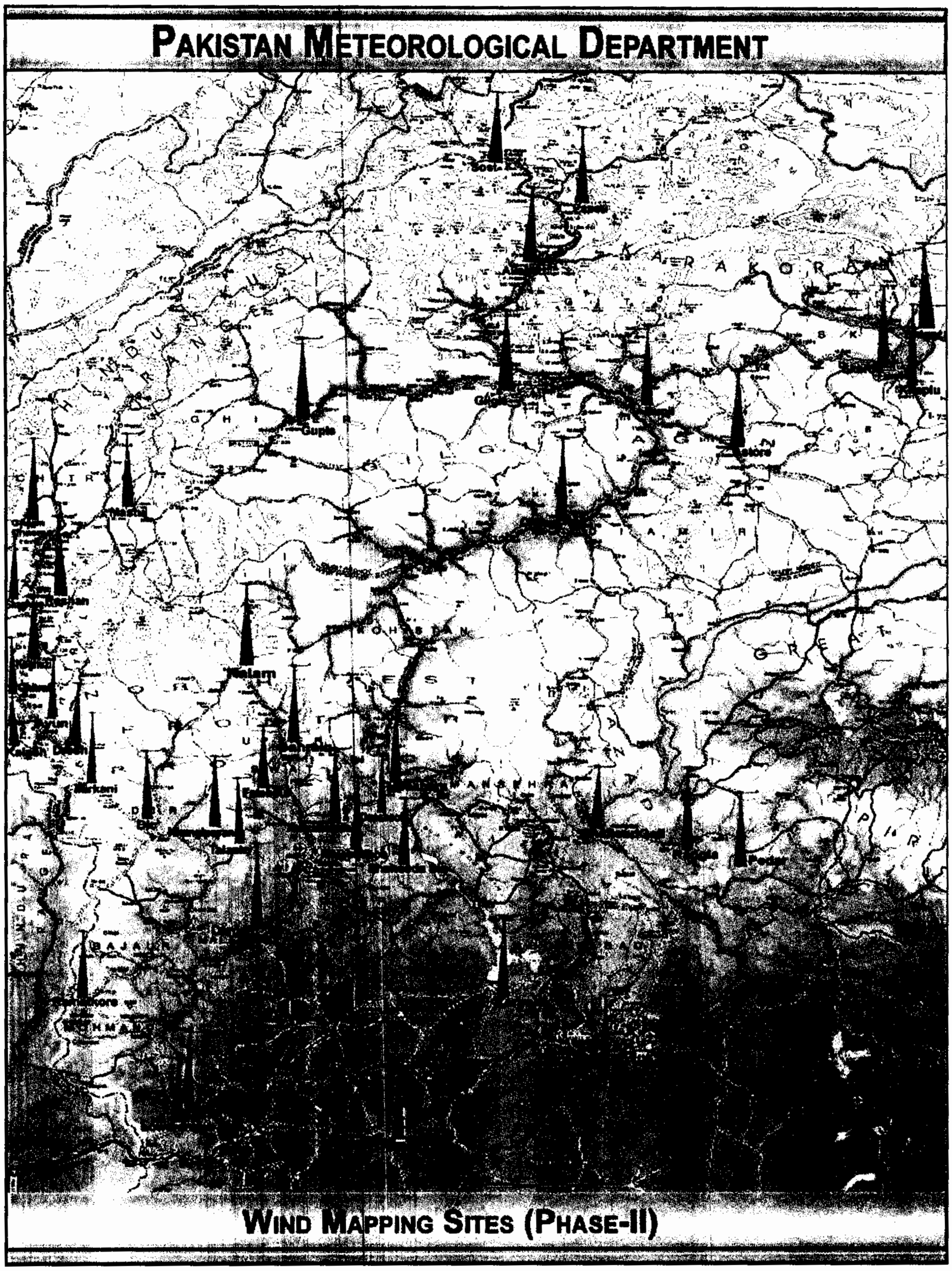


Phase-I of project is completed successfully and based on this survey, potential areas for installing wind power farms have been indicated. These areas having coverage of 9700 sq. km in Sindh have a gross wind power potential of 43000 MW. Keeping in view the area utilization constrains etc.

the exploitable electric power potential of this area in Sindh is about 11000

4.1.2 Wind Mapping Project Phase II.

Wind Mapping of Northern Areas of Pakistan was called Wind Mapping Project II. It catered for identifying areas in the North of Pakistan, which had wind Power potential


PAKISTAN METEOROLOGICAL DEPARTMENT
WIND MAPPING SITES (PHASE-II)

Wind Mapping Project (Phase-II) Northern Areas of Pakistan					
Sr. No.	**Station**	**District**	**Power Density (W/m^2) 50m.**	**Mean Wind Speed (m/s) (Based on available period)**	**Capacity Factor for a Bonus 600/44M K IV Turbine**
1	Sheedgali	Muzafferabad, AJK	208.19	5.39	18%
2	Fatehpur	District Swat	164.53	4.91	14%
3	Dargai	Malakand Agency	153.03	4.51	13%
4	Shahida Sir	District Buneer	148.00	4.60	13%
5	Besham Qila	District Shangla	131.48	4.69	13%
6	Moorti Pahari	Motorway M2, Rwp	207.00	4.26	11%
7	Tarbella	District Haripur	150.00	3.81	10%
8	Ayune	District Chitral	168.28	3.93	9%
9	Chitral City	District Chitral	126.40	3.02	8%
10	Lorramiana	Khyber Agency FATA	86.65	3.34	6%
11	Rangla, Dhirkot	District Bagh, AJK	65.73	3.61	6%
12	Danakool Chakesir	District Shangla	63.30	3.59	6%
13	Kalam	District Swat	155.66	2.13	5%
14	Drosh	District Chitral	63.24	2.82	5%
15	Khudabad, Sost	Northern Area	37.89	3.51	5%
16	Warsak	District Peshawar	56.29	2.61	4%
17	Gilgit	Northern Area	55.48	2.36	4%
18	Bahrain	District Swat	61.90	2.88	3%
19	Malamjabba	District Swat	50.48	2.15	3%
20	Khungi payan	District Lower Dir	42.94	2.32	3%
21	Khawazakhaila	District Swat	37.38	2.31	3%
22	Pedar, Bagh	District Bagh, AJK	26.29	2.21	2%
23	Nizampur	District Nowshera	14.92	1.75	1%
24	Talash	District Lower Dir	21.21	1.60	1%

25	Ramatkoore	Mohmand Agency FATA	14.37	1.70	1%
26	Passu Hunza	Northern Area	179.78	4.28	In progress
27	Barapayan, Khaplu	Northern Area	139.52	3.27	In progress
28	Kaghozi	District Chitral	93.20	3.43	In progress
29	Gupis	Northern Area	71.13	5.05	In progress
30	Bunji	Northern Area	66.58	2.86	In progress
31	Astore	Northern Area	62.00	4.07	In progress
32	Mirkani	District Chitral	60.30	4.09	In progress
33	Chillas	Northern Area	57.36	4.40	In progress
34	Shigar	Northern Area	56.51	4.21	In progress
35	Shaghore	District Chitral	41.37	4.08	In progress
36	Sermik, Skardu	Northern Area	39.02	3.31	In progress
37	Reshan	District Chitral	33.74	4.76	In progress
38	Aliabad Hunza	Northern Area	32.85	2.85	In progress
39	Garam Chasma	District Chitral	20.72	3.04	In progress
40	Bomboriat, Kalash	District Chitral	18.00	2.28	In progress
41	Met.Obsy Dir	District Upper Dir	15.08	1.88	In progress
42	Mastuj	District Chitral	10.18	1.66	In progress

The energy potential of 346,000 MW in the country is estimated by NREL, USA and only the Gharo – Ketibander Wind Corridor has a potential of 43,000 MW of Wind energy.The primary sources of energy available in Pakistan are oil, natural gas, hydro and nuclear Power. At present oil accounts for approximately 45% of total commercial energy supply. The share of natural gas is 34% while that of hydel power remains roughly at 15%. The increase in cost of fossil fuel and the various environmental problems of large scale power generation have lead to increased appreciation of the potential of electricity generation from non-conventional sources. This has provided the planners and economists to find out other low cost energy resources.

Wind and Solar energies are the possible clean and low cost renewable resources available in the country. The potential, for the use of alternative technologies, has never been fully explored in Pakistan. Wind power provides opportunity to reduce dependence on imported fossil fuel and at the same time expands the power supply capacity to remote locations where grid expansion is not practical.

4.1.3 Wind Potential Area of Sindh

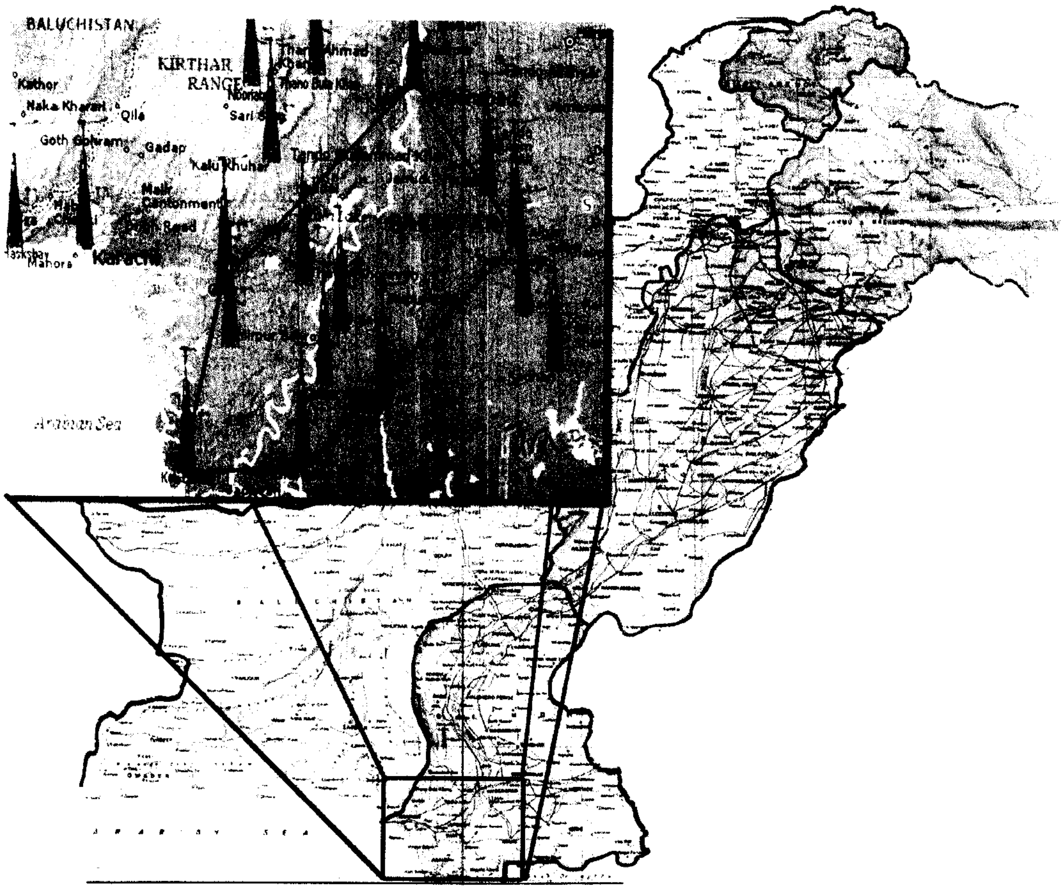
Total Area of Sindh suitable for wind farms = 9749 km2

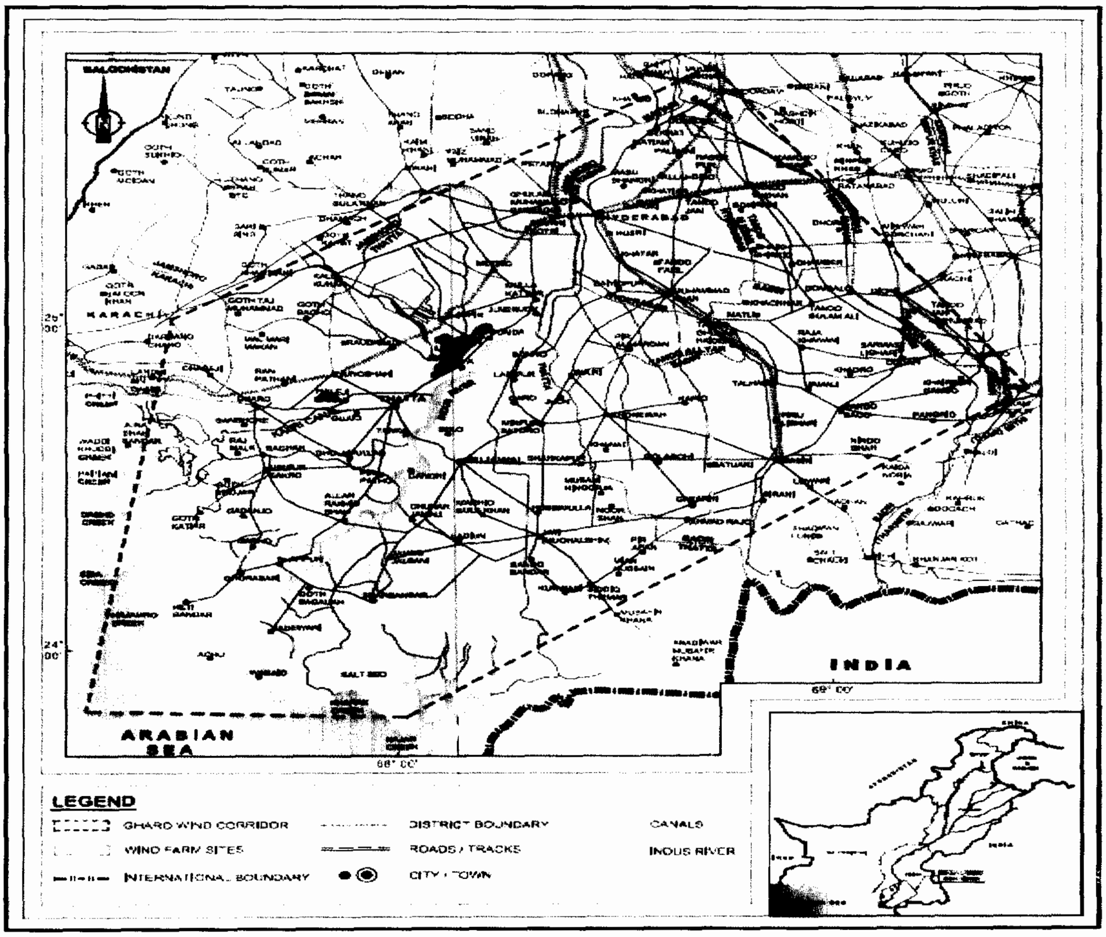
Average Capacity Factor of this area in Sindh = 25%

Exploitable Potential (25% of the area) ≈ 11000 MW

However with new machines coming into the market with capability to produce electricity at lower wind speed increases the capacity potential.

Gross Potential of the area corresponding to 25%Capacity Factor=9749x 4.5=43871 MW


BALUCHISTAN
KIRTHAR RANGE
Kathor
Naka Kharari
Qila
Sari
Goth Gohram
Gadap
Kalu Khuhar
Malir Cantonment
Mahora
Karachi
Arabian Sea



WIND CORRIDOR OF SINDH

4.1.4 INCENTIVES By Government Of Pakistan for Investment in Wind Energy:

Originally Some of the incentives provided for investors in the Renewable Energy Policy 2006 were as listed below:

• Specific purpose land available for the list of the project to eligible investors an extremely attractive annual rentals US$ 1 per sq yard/annum for direct impact area(foot prints)

• Upfront tariff of 14.67 cents / KWH for all those investors who are ready to complete projects in 18 month time (CoD)

- Long term (20 year) throughput agreements with the Power Purchaser i.e. WAPDA backed by GOP through, Implementation Agreement & Sovereign Guarantee
- Guaranteed purchase of all electricity produced by the project for the entire concession period (20 years).
- Comprehensive coverage to investors against political risk and risk of change of Law through Force Majeure provisions
- Guarantee of buy back of the facility in case of termination of the project
- Wind data available from various sources accounts for 5 years, enabling a great degree of accuracy for the purpose of calculation of wind speed, direction, density, frequency, etc
- Coverage of Wind Speed Risk (for those who does not opt for upfront tariff)
- Comprehensive tariff regime on a cost plus basis
- Fiscal incentives through a zero tax/duty regime. Only contribution to national exchequer would be through a 7.5% withholding tax on dividends declared across the life of the project.
- Guaranteed Attractive Return on Equity ("ROE") – 17% to 18% - offered under the NEPRA tariff guidelines
- Certified Emission Reductions (CERs) available on a shared basis with the Government of Pakistan
- Environmental issues facilitation by AEDB to investors including EIA and relevant Government permissions.

However, over the period, when a great interest was shown b y Local & International Investors,andapplications for over 3000MW were received, Government and regulators, started revising these incentives, and kept reducing the upfront tariff. Recently a Benchmark tariff for bidding has been issued which is nearly 40% of the upfront tariff introduced in 2006 policy.

The other ,unfortunate policy change was that Evacuation of electricity from the Wind Power cluster, was not given priority and did not match the pending applications for installing wind power. This resulted in very slow growth of Wind Power plants, and induction of green energy in the country.

5.Wind Power Production

There are three terms to describe basic electricity production.

A. Efficiency,

B. Capacity

C. Capacity factor.

A. Efficiency refers to how much useful energy (electricity, in this case) we can get from an energy source. A 100 percent energy efficient machine would change all the energy put into it into useful energy. It would not waste any energy. There is no such thing as a 100 percent energy efficient machine. Some energy is always lost or wasted when one form of energy is converted to another. The lost energy is usually in the form of heat, which dissipates into the air and cannot be used again economically. How efficient are wind machines? Wind machines are just as efficient as most other plants, such as coal plants. Wind machines convert 30-40 percent of the wind's kinetic energy into electricity. A coal-fired power plant converts about 30-35 percent of the chemical energy in coal into usable electricity.

B. Capacity refers to the capability of a power plant to produce electricity. A power plant with a 100 percent capacity rating would run all day, every day at full power.

There would be no down time for repairs or refuelling, an impossible goal for any plant.

Coal plants typically have a 75 percent capacity rating since they can run day or night, during any season of the year.

Wind power plants are different from power plants that burn fuel. Wind plants depend on the availability of wind, as well as the speed of the wind. Therefore, wind machines cannot operate 24 hours a day, 365 days a year. A wind turbine at a typical wind farm operates 65-80 percent of the time, but usually at less than full capacity, because the wind speed is not at optimum levels. Therefore, its capacity factor is 30-35 percent. Economics also plays a large part in the capacity of wind machines. Winds machines can be built that have much higher capacity factors, but it is not economical to do so. The decision is based on electricity output per dollar of investment.

C. Capacity Factor

The annual energy output from a wind turbine is to look at the capacity factor for the turbine in its particular location. By capacity factor we mean its actual annual energy output divided by the theoretical maximum output, if the machine were running at its rated (maximum) power during all of the 8766 hours of the year.

Example: If a 600 kW turbine produces 1.5 million kWh in a year, its capacity factor is= 1500000: (365.25 * 24 * 600) = 1500000: 5259600 = 0.285 = 28.5 per cent.

Capacity factors may theoretically vary from 0 to 100 per cent, but in practice they will usually range from 20 to 70 per cent, and mostly be around 25-30 per cent.

5.1 The Benefits of Wind Energy

Wind energy is an ideal renewable energy because:

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5.1 The Benefits of Wind Energy

Wind energy is an ideal renewable energy because:

- it is a pollution-free, infinitely sustainable form of energy
- it doesn't require fuel
- it doesn't create greenhouse gasses
- it doesn't produce toxic or radioactive waste.
- Wind energy is quiet and does not present any significant hazard to birds or other wildlife.
- When large arrays of wind turbines are installed on farmland, only about 2% of the land area is required for the wind turbines. The rest is available for farming, livestock, and other uses.
- Landowners often receive payment for the use of their land, which enhances their income and increases the value of the land.
- Ownership of wind turbine generators by individuals and the community allows people to participate directly in the preservation of our environment.
- Each megawatt-hour of electricity that is generated by wind energy helps to reduce 0.8 to 0.9 tones of greenhouse gas emissions that are produced by coal or diesel fuel generation each year.

6. SITE SELECTION & WIND ASSESSMENT

Wind farms require large areas. Depending on the rotor diameter the required mutual separation is 300 to 500 metres with a further similar separation distance from dwellings and commercial buildings to limit noise nuisance and to provide a safety zone. Even for a medium size wind farm, such as the 50MW farm being proposed , wind turbines of 2 to 2.5 MW considered here, a substantial land area is required.

Generally speaking, potential wind farm sites are preferably open areas of flat land or on top of hilly areas.

Obviously, the sites should be known to be windy, with high and recurrent wind resources. Having selected the site, the next step is to assess the local long-term wind climate by reference to existing data or by long term monitoring. The objective in this phase is to eliminate all sites that may be unsuitable (in other words, unprofitable) in the long term.

6.1 SELECTED SITE FOR WIND FARM (JHIMPIR)

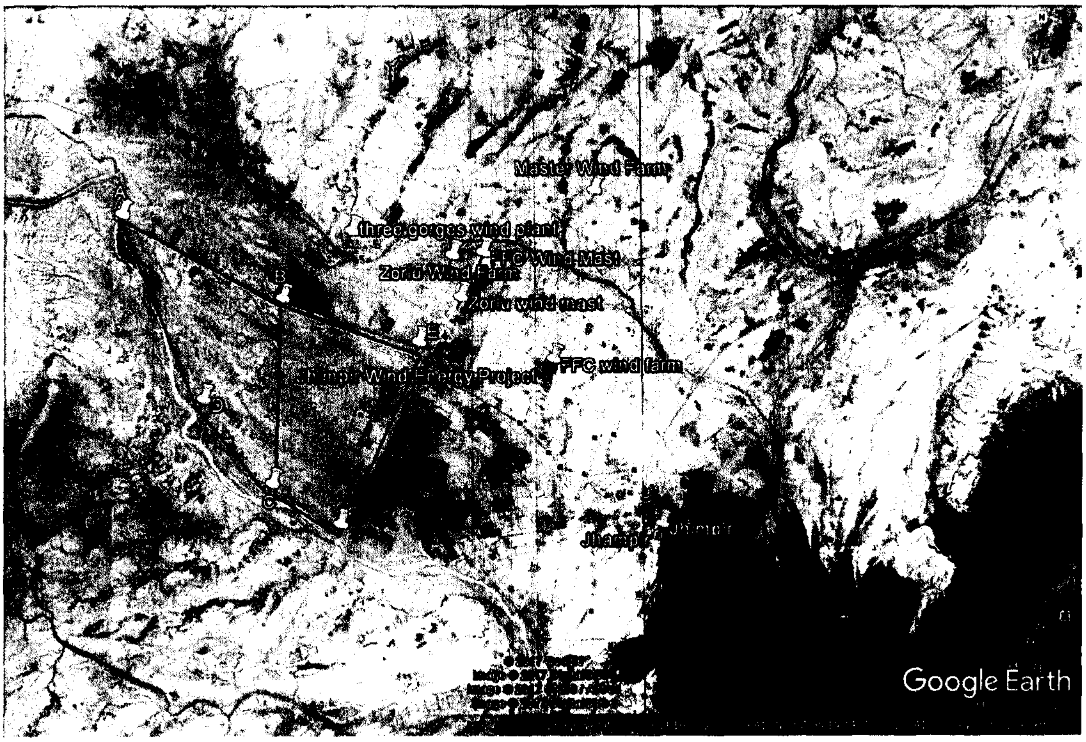
The site selected by sponsors for this project is at Jhimpir, near FF & Three Gorges wind farm. The site is owned by sponsor, and is adjacent to Three Gorgue Wind Farm, as wind study has been carried out of the area and enough data is available to make it suitable hence, it was considered to use it for the Wind Farm. Further its mostly inhabited area and space was available for further development. Three of the operational Wind Farms are located in this area , and allocation to many more has be given under the AEDB scheme of providing land on lease by Government of Sindh for Wind Farms. The current status of land allocation in Jhimpir area is defined by following two pictures. However sponsors avoided allocation of land under this scheme as currently no unallocated land for Wind Farm is available in Jhimpir area and such allocation takes long time, and would delay the project by at least 18 months, and thus opted to use its own land in that area , which is covered under wind corridor.

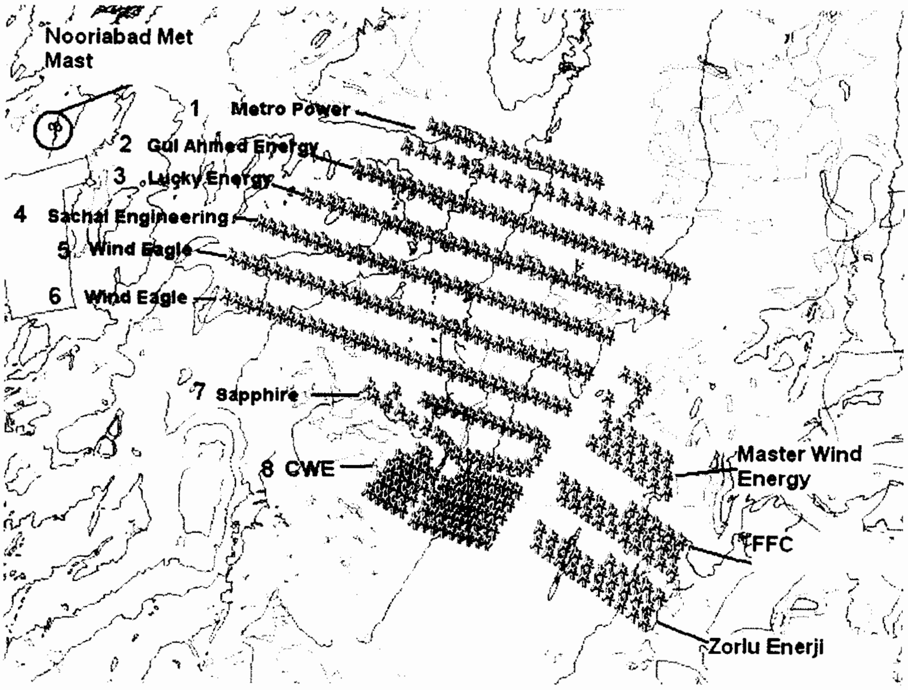
6.2 PROPOSED WIND FARM SITE LOOTAH ENERGY

The proposed wind farm site is located in the south-eastern part of Pakistan between Hyderabad and Karachi, approximately 100 km inland from the coast in a semi-desert area with rare vegetation. The nearest settlements are Jhimpir (2.5 km southeast) and Nooriabad (22 km north-west).

Site is owned by the sponsors and they will utilise part of it to establish First phase of wind Farm of 50MW capacity.

6.2 Wind Farm Site Lootah





6.2 MICRO SITING OF WIND FARMS IN JHIMPIR BY AEDB EXPERTS

6.2.1 The Environmental & General Conditions of Site

The environmental aspects of the project site at Jhimpir are taken into consideration as Impact Study Reports of Three Wind Farms in the area has already taken place & approved.. The investigations show that there will be **No impact** on the flora & fauna of the area since there is no established grazing land, national parks, protected wild life zones or bird sanctuary present near the wind farm.

The site has also been examined from Noise, Shadow Flickering and Visualisation impact angle. Detailed calculations were performed by consultants, working in this area on other projects, which were performed according to guidelines of ISO 9612-2 and stringent German Standards. The results showed that there would be **no adverse impact** of Noise, Shadow Flickering and visualization on the Jhimpir dwellings.

The Land is also free from any resettlement issue as its the property of sponsors.Initial IEE has been carried out by the Consultants, a draft has been forwarded to us and also submitted to SEPA, for NOC, which we expect to get by end of September, if not earlier.

7. Project Development Activities:

Sponsors are working on the plan to complete the initial project development studies By End Of September,2017. The planned studies are briefly described below:

7.1 Wind Resource Assessment System:

Sponsor will be using the existing data from FF & Masters mast, which are located adjacent to Lootah Si. Since over 7 years data is available from these masts, it gives fairly accurate status of wind over Lootah Farm. Since now Wind Risk is of the Sponsors, its appropriate that long term existing data is preferred over a new Wind Mast data to be installed by Lootah.However, two wind masts will be installed at site with the power plant, to verify yearly production based on wind availability.

Additionally temperature, pressure & humidity data from existing FF & MASTER masts was used for working out the Energy yield.

7.2. Topographical Survey:

A detailed topographical survey of the site is being carried out, by the same consultants, M/S Soil Testing Services, who had originally carried out the Geotechnical Investigation & Bore Hole study of the proposed site. and it is expected to be completed by Middle of October. The suppliers of Equipment were fairly satisfied with the site allocated, as its fairly flat land, and google mapping was initially used for Contour map, Copy of report attached as Enclosure.

7.3 Preliminary Geo-Technical Survey:

Preliminary Geotechnical investigation of the area has en be carried out and detailed report is attached along with borehole data, as bore holes were made by drilling four bore holes to 30 meter depth. Initial work has been carried out and It is covered under separate heading in the Feasibility Study. Copy of report attached as annexure.

7.4 Transportation Study:

A transportation study from port to site has been carried out by the consultant. Situated 100 Km from Karachi, the land is approachable by Super Highway. 20 km long access road links the Super highway to the site.No site road has to be made at this stage to receive the plant as the Plant Site is adjacent to the Nooriabad /Jhimpir road. Copy of the Transport study is also attached for reference as enclosure. However details of reports will be supplied under separate heading, and also attached as annexure

7.5 Electrical Grid Study:

The wind farm will be connected to the main electrical network of Pakistan through a local grid. The responsibility to evacuate power from the wind farm is the responsibility of Power Purchaser i.e. Transmission Line from Grid to Wind Farm will be on part of Power Purchaser. Jhimpir's 132KV grid station is within three Km from the site. Another 132 KV grid station in Nooriabad is at a distance of only 20 km from the site. The new Jhimpir Grid Station II, is also just few Km from our plant site.

Up gradation of existing network at Jhimpir by National Transmission & Dispatch Company is in progress. Sponsors has conduct a detailed Electrical Grid Studies like load flow, short circuit and stability analysis through a experienced consultant. These studies were submitted to NTDC, via CPPA for approval, and approval has been received. The study has now been submitted to HESCO for their approval as well. Copy of GIS report is attached as Enclosure.

7.6 Initial Environmental Examination

EMC Pakistan Pvt Ltd were awarded the contract to carry out Initial Environmental Examination of the site allocated by Lootah Energy for its power plant from its existing land in Jhimpir. The original allocation was for agriculture and cattle farmining business, and was in their possession and control. This eliminated any possible encroachment, and subsequent removal or shifting of people, thus avoiding major impact.

The draft report was approved and application for has been submitted to SEP for issuance of an NOC which is expected to be received in 3rd week of October, copy of the IEE report is attached as Enclosure. Further details of Environmental report are discussed under separate heading and attached as annexture.

8. Geology of Macro environment: JHIMPIR(Deh Kohistan)

Topographically Deh Kohistan comprises the macro environment of Jhimpir Wind Corridor. It can be characterized as the piedmont colluvial fans. In regimen of fluvial erosion, the colluvial fringe has developed by merging of alluvial fans of individual streams depositing the erosional load of coarse sediments at the foot of each hillside. The deposits combined with material brought by sheet wash from hillsides has remained mostly unconsolidated, and under the process of weathering it has developed into good fertile soil where water is available. In dry or semi-arid conditions this shelving deposit of unconsolidated material has created badland topography of deeply scarred earth, unsuitable both for cultivation and habitation. Covered by sparse thorny shrubs, these however, serve as grazing grounds for goat and sheep.

The prevailing geologic conditions in the barren forefront of the Kirthar Range are the results of extensive inundation, depositions, coastal movements, and erosions over a long period of time in the geological ages. The geology of Deh Kohistan is closely related to the Himalayan orogeny that gave rise to intense deformation with complex folding, high angle strike-slip faults and crust thickening expressed in a series of thrust faults. The important tectonic changes which have had their influence in the region are not visible in the microenvironment but the macro environment has history of seismic activity in the past.

Topographic undulation of the microenvironment of Deh Kohistan 7/1 is substantially large with the relative height varying between 65 meters and 105 meters with the differential being 20 to 25 meters. The hilly areas are in the north and west while the low-lying and flat farm fields are located on the east. Absolute elevation of the ground is 15 to 37 meters. The highest point is located at an altitude of 37 meters on the hill, north of the boundary of initial wind farm area. The lowest point is located on the east near the Indus River at an altitude of 10 meters.

8.1. Geological Setting

The region belongs structurally to Lyari embayment zone

Geological investigations of the area, suggest the presence of (Shallow marine Early to Middle Eocene Laki limestone and Late Eocene Tyon Formation) only Middle and Tertiary rock formations comprising fresh and slightly weathered recent and sub-recent shoreline deposits. Principal constituents of these deposits are the inter bedded sandstone and shale together with subordinate amounts of large size gravels or conglomerate.

8.2 Geomorphology

Pediments and fluvial terraces at various levels in the landscape of Deh Kohistan 7/1 indicate that uplift is intermittent, because these surfaces only form during periods of vertical stability. In general the landscape of Kirthar Range is dominated by erosion while the stony plains are dominated by deposition4.8.

The mountains of the Kirthar region have been cut by deep gorges that have passed onto a piedmont that is characterized by the following units: bedrock-cut pediments that are now dissected by alluvial fans which terminate in a plain, and finally a floodplain.

The piedmont plain is subdivided into plains cut in bedrock (pediments) and plains formed of alluvium (alluvial plains). Deh Kohistan is located in the Dissected Plain Unit.

The dissected plain geomorphological land unit is bounded by bedrock outcrops. The main difference between this land unit and the 'Plain' land unit is the degree of fluvial incision into this surface. Streams like Layari and Harolo Nai are deeply entrenched. The 'Dissected plain' surface is higher in the landscape than the 'Plain' surfaces, and the streams have therefore incised it more deeply in an attempt to maintain regular stream long profiles.

This indicates that even in the current arid conditions, the available discharge is sufficient to maintain a graded long profile. Another difference between this land unit and the 'Plain' land unit is the higher concentration of gravel lag on the surface. This is due to Higher concentration of gravel in the underlying material, The surface being older, has experienced a longer deflation history, The surface is less likely to be inundated by water which may replace some of the deflated material on the 'Plain' land unit.

The Project site in Deh Kohistan can be more appropriately described as Plain with Stone Lag for which the local map term is 'Stony waste'. It is possible that the broader plains of the 'Plain' land unit originated as plains with a stone lag, that is, this unit is a less well developed form of the 'Plain' land unit. As the name suggests, these plains are covered with coarse pebbles and boulders, predominantly of limestone.

8.3 Evidence for deflation by wind

There are clear evidences of deflation by wind as a common natural process in the GAWPL Project macro-environment. Evidence for this process is the ubiquitous gravel covered surfaces occurring throughout Deh-Kohistan (e.g. the stony wastes). However, there is also evidence of high contemporary rates of wind erosion. This is shown by the elevated mounds of fine sand that occur around shrubs on the Plains Unit (Fig.). These mounds provide evidence of wind blown sand, but they also demonstrate that the surface has been deflated by tens of centimetres during the life of the plants.

Excavating the mounds shows that there is a distinct sedimentary change in the mounds. The upper sediments are unconsolidated, with distinct aeolian bedding planes. The lower sands are consolidated, with indistinct bedding. The upper sediments are interpreted as recently deposited wind blown sands. The lower sediments are fluvial sediments deposited as distal units of alluvial fans. Fabel and Rutherfurd's interpretation of this stratigraphy is that the original surface of t

he plain has been deflated to a depth of about 15 cm to 20 cm during the life of the trees ,the age estimates for *Prosopis cineraria* and other species growing on these mounds would be between 50 and 100 years. This suggests a deflation rate of between two and four mm per year on the Plains Unit between the trees. This is a minimum estimate, because it takes a maximum age for the trees, and assumes that the erosion has occurred progressively over the life of the tree. It is more likely that the erosion rate has increased over the last decades as grazing pressures have increased and more surface has been exposed.

Assuming that half of the Stony Plains Unit has been eroded to half of the estimated depth, this represents a volume of 30 x 106 m3 of sediment removed. This rate of erosion has more likely been increased owing to acute aridity in the macro environment of Deh Kohistan by wind erosion of the surface of its plains unit, estimated to be 2-4 mm per year.

8.4 Land Form Types at Microenvironment

A variety of landforms can be identified and mapped within the length and breadth of Deh Kohistan These fall into two broad groups:

- Mountain Landforms which occur in the mountainous area in the north
- Low Lands comprising river valleys, their flood plains, alluvial plains, piedmont and exposed bedrock plains

The spurs of Kohistan plateaus running from the Kirthar Ranges, and the undulating land enclosed by Harolo Nai and Layari Nai as its boundary on the east and northeast, and the Keenjhar Lake form the boundary on the south. The stony waste sloping on the east towards Harolo Nai, on the west towards Layari Nai is almost entirely piedmont deposit on exposed bedrock or weathered bedrock surface, with:

- Denuded synclines as low hilly divides that are only an extension of the Sindh Kohistan Ranges of the Kirthar Mountainous region;
- Shallow synclines of the Harolo Nai and Layari Nai synclines and their flood plains.

The structural foundations of the stony waste or plain of the microenvironment are furnished by two synclines occupied by the valleys of Harolo Nai and Layari Nai. The mountainous area in the north of the site is not much emphatic while folding is not visible with the result that elevations and dips of the strata are not identified.

8.5 General Geology and Stratigraphy

A sequence of lateritic clay and shale with beds of arenaceous sandstone of Laki Formation, named as Sonhari Member of Eocene age is found in Deh Kohistan, the microenvironment of proposed GAWPL-WPGC. The generalized stratigraphic sequence is as follows:

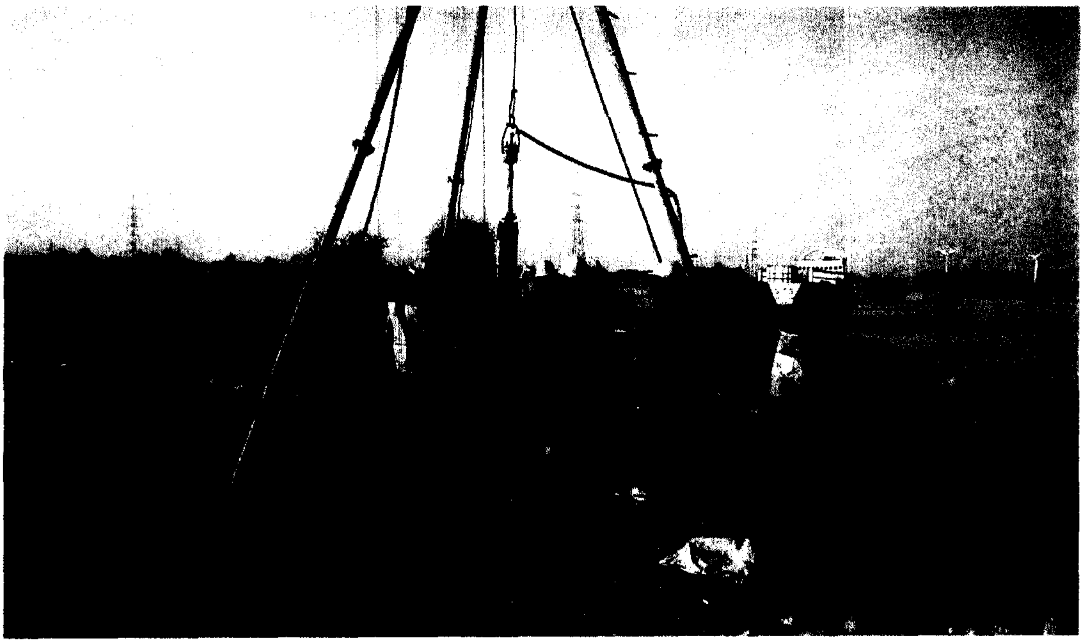
Laki Formation: This formation comprises cream colored to grey limestone, finely crystalline limestone with subordinate marl, lateritic claystone, siltstone and shale. It contains a rich fossil assemblage of foraminifera, gastropods, bivalves, echinoderms and algae. This Formation appears well developed in the Meting area of Deh Kohista that constitutes the Project microenvironment. Geo-technical investigations during this IEE study show that the formation achieves thicknesses of 30 m and over. The lower contact of the formation is uncomformable with Lakhra formation and is marked by Sonhari member. This is divided into members viz. Sonhari bed member, Meting limestone and shale member, and Laki Limestone member.

Sonhari Bed Member: This member is composed of limestone, sandstone, lateritic clays, and gypsiferous shales deposited in restricted marine environment. Limestone contains a large of marine fossils and re-crystallized into fine-crystal limestone etc. The soil has yellow color due to long-term weathering and has a lot of burrows. Sandstones are yellowish brown to light brown and dark grey in color and gritty at places with rounded and sub-rounded grains. Friable bands of silica sand occur in sandstone with variable thickness that passes gradually into buff, reddish ferruginous sand. Shales in this member are of different colors like dirty brown, grey and grayish black. Small bands of laterite occur in the middle part of the beds. There is a ferriferous quartzose sandstone or limonite bed in the bottom. The thickness of the member is about 10m. Clays are of different colors ranging from violet to reddish brown, yellowish brown, bluish grey, off-white, grey brown, and buff. They are silty, sandy and highly ferruginous with local patches of fireclay and lenticular lignite beds towards the coal fields of Jhimpir-Meting and Sonda.

Meting Limestone Member: The member consists mainly of creamy white nodular limestone, with subordinate sandstone in the upper part. The shale is grey, weathering dark rusty brown white kaolin clay or chalk, deposited in extensive marine environment. It contains foraminifera fossils, and plant debris.

Laki Limestone **Member**: This member consists of limestone which deposited in vast marine environment. The limestone has re-crystallized into crystalline limestone. It contains large numbers of foraminifer that has eroded off at the site. The limestone of this member has 25m thickness and is light yellowish grey, white and light grey, stained yellow to brown, and light grey at places. It is nodular hard, resistant and massive, and is characterized by steep scarps. There is a pseudo-conformity contact relation between Laki formation and underlying Lakhra formation.

8.6 Bore Hole Analysis



Geotechnical Investigation for Lootah Wind Power Project in Jhimpir area district Jamshoro, Sindh was carried out in order to determine geotechnical parameters of subsurface deposits. Four (04) boreholes were drilled as a part of the field investigation. Soil and rock samples were collected during field investigation. Laboratory testing of these samples has been carried out in the 'Soil Testing Services' laboratory, Karachi.

The deposition of the area mainly consists of *'extremely weak to very weak'* mudstone,highly weathered and fractured limestone, highly weathered and fractured sandstone and *very dense* coarse grained sand with traces of silt. Groundwater table was not

encountered in the boreholes up to the explored depth of 30 meters.

Keeping these conditions under consideration:

Keeping these conditions under consideration:

• Allowable bearing pressures have been given for shallow foundations at a depthof 1.5 m below existing ground level.

• Seismic soil profile has been taken as *'SC'* for shallow foundations in accordance with UBC-97.

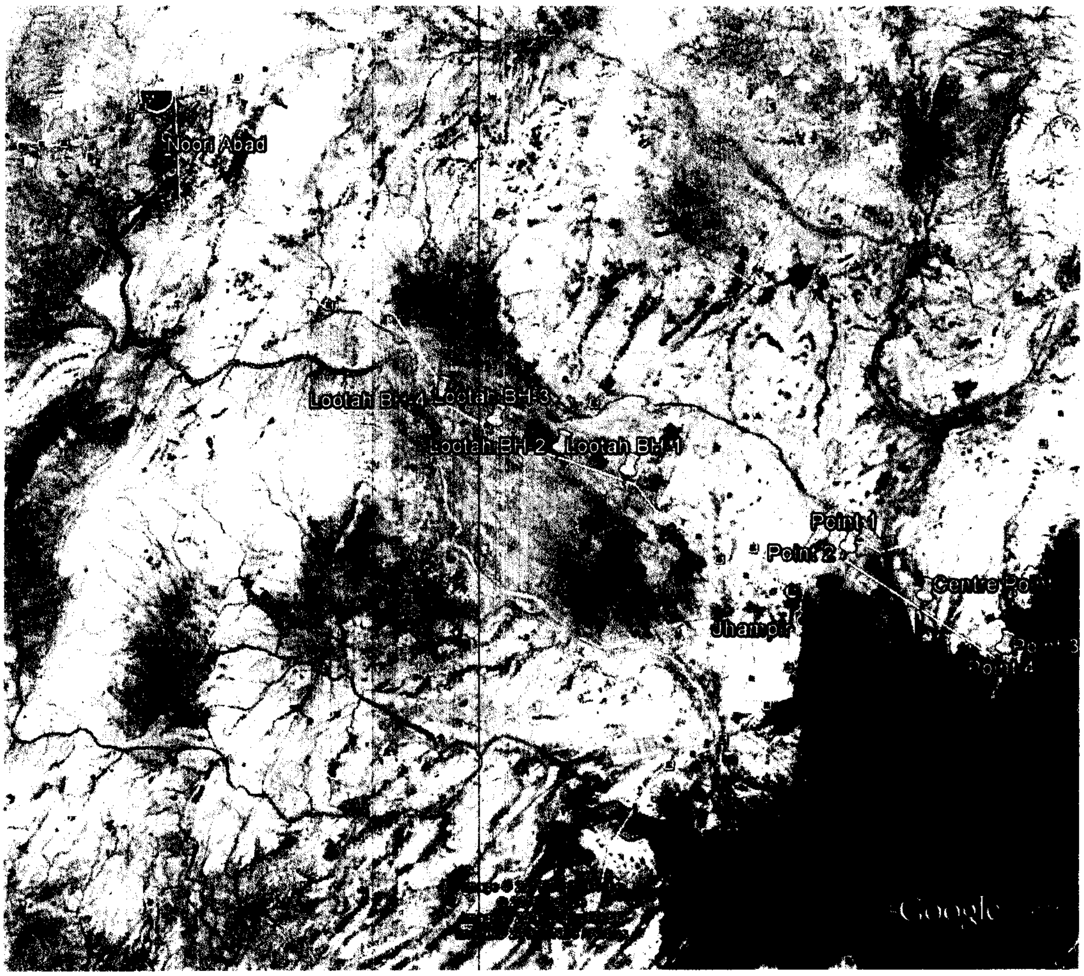
The exposure of underground concrete to aggressive chemicals is found to be *'negligible'* for soil samples, for sulphates and chlorides which have influenced the selection of cement for underground concreting and it is recommended to use *Ordinary Portland Cement(OPC).*

The area of the project site is large and this investigation is only for the preliminary feasibility stage study. Detailed geotechnical investigation should be carried out after the location for WTG are finalized.

EPC has been advised to carry out its own study, as this study is only for guideline, for him to prepare a EPC pricing.

8.6.1 Bore Site: The site is located around 13 kilometres from the Nooriabad city towards south and 8 kms from Kalri Lake towards east. Nearby landmarks include Three Gorges Wind farm, Tapal Wind Power project, Brohi hotel and Palari village.

The site comprises partly of plain land with no major variations in elevation, and partly of uneven land due to presence of sand dunes. Bushes and different types of wild plants were also found across the site. Figure 2.1 shows google image of the site, and location of the Bore holes.



8.7 GROUND CONDITIONS AT BORE HOLE SITE

The subsurface deposits up to the explored depth consist of the following units.

- Sand
- Limestone
- Mudstone
- Sandstone

Following sub-sections describe the strength characteristics of the geological units and
the groundwater conditions.

Rock samples have been classified in accordance with BS-5930. Unconfined compressive
strength, moisture content, density etc. of these deposits was carried out in the laboratory.

8.7.1 SAND

Deposits of coarse grained sand with silt and gravel were found in all of the boreholes drilled at the site. The grain size analysis of these deposits was carried out in the laboratory. Unified Soil Classification System (USCS) classifies these deposits as *'SP', 'SM' and 'SP-SM'*. Table 3.1 summarizes the details of these deposits.

Table 8.7.1 Deposits of Sand

Borehole No.	Depth(meters)
BH-01	0.0 – 1.5
BH-02	0.0 – 1.5
BH-03	0.0 – 3.0

BH-01	3.0 – 16.5
	24.0 – 30.0
BH-02	3.0 – 6.0
	7.5 – 20.0
	21.0 – 24.0
BH-03	12.0 – 30.0

8.7.4 SANDSTONE

Deposits of *highly weathered and fractured sandstone* were found in all of the boreholes drilled at the site. Rock core samples were collected from these deposits. Table 3.4 summarizes the details of these deposits.

Table 8.7.4 Deposits of Sandstone

Marking	Depth(m)
BH-01	16.5 – 20.0
BH-02	6.0 – 7.5
	24.0 – 30.0
BH-03	3.0 – 7.5
	28.5 – 30.0
BH-04	3.0 – 12.0

8.7.5 GROUNDWATER CONDITIONS

Groundwater table was not encountered up to the explored depth of 30 meters below the existing ground level in any of the boreholes drilled at site, during the time of this investigation.

8.7.6 ENGINEERING DESIGN CONSIDERATIONS

Foundation type for a structure depends on the expected loads taken by the foundation and the type of soil underlying it. The characteristics of subsurface soil deposits have been discussed in the previous section. Keeping in view the subsoil conditions prevailing at the site and the loads expected to be transferred to the foundations, shallow foundations i.e. mat foundations are recommended as the foundation system. It should be noted that the

area of the project site is large and this investigation is only for the preliminary feasibility stage study. Detailed geotechnical investigation should be carried out after the location for WTG are finalized. This study is recommended to be carried by EPC, for final design of the Mast Base.

The following section gives the allowable bearing pressures for the shallow foundations at each borehole location.

8.7.7 ALLOWABLE BEARING PRESSURES

The allowable bearing pressure has been calculated following shear strength determination through unconfined compressive strength, and elastic settlement. *Table 8.7.7* gives the net allowable bearing pressures for shallow foundations at given depth.

Table 8.7.7 Net Allowable Bearing Pressures

Borehole location Foundation	Minimum Embedment below existing ground level(meters)	Mat (kPa)
BH-01	1.5	180
BH-02	1.5	200
BH-03	1.5	230
BH-04	1.5	280

It should be noted that the bearing capacity values are only valid for the respective borehole locations. The settlement of shallow foundations due to net allowable pressure has been estimated within allowable limit of 50mm for mat footings. Cohesive material shall not be used for backfilling purposes. Check for tension must be carried out before finalising the dimensions of the footing in order to ensure adequate safety against uplift forces. Due to the horizontal seismic forces, and wind forces, uplift can occur at one end of the foundation. This uplift can be balanced by increasing the dimensions of the foundation and the weight of the soil above the foundation. The angle of internal friction for limestone can be taken as 40 degrees.

8.7.8 MODULUS OF SUBGRADE REACTION

Designing of floor slab system requires the modulus of subgrade reaction at the depth at which it is to be placed. Table 4.2 shows the values of modulus of subgrade reaction for given pressure.

Table 8.7.8 Modulus of subgrade reaction based on allowable bearing pressure

Borehole location	Minimum embedment	ks for Shallow

	(meters)	Foundation(MN/m3)
BH-01	1.5	10.8
BH-02	1.5	12.0
BH-03	1.5	13.8
BH-04	1.5	16.8

8.7.9 SOIL PROFILE TYPE (ACCORDING TO UBC-97)

Chapter 16, Division V, Section 1636 of UBC-97 deals with the determination of Soil Profile Types. Design practice involves using seismic parameters of zone 2A for the area under consideration.

8.7.10 SEISMIC ZONE FACTOR

Table 16-I of UBC-97 defines the seismic zone factor to be used in choosing seismic coefficients for a location. The seismic zone factor "Z" will be taken as 0.15.

8.7.11 SEISMIC COEFFICIENTS

Seismic coefficients are as under:For SC; Ca = 0.18 & CV = 0.25

The subsurface strata encountered during the investigation are not found to be susceptible to liquefaction for the ground motion parameters mentioned above.

8.7.12 TYPE OF CEMENT

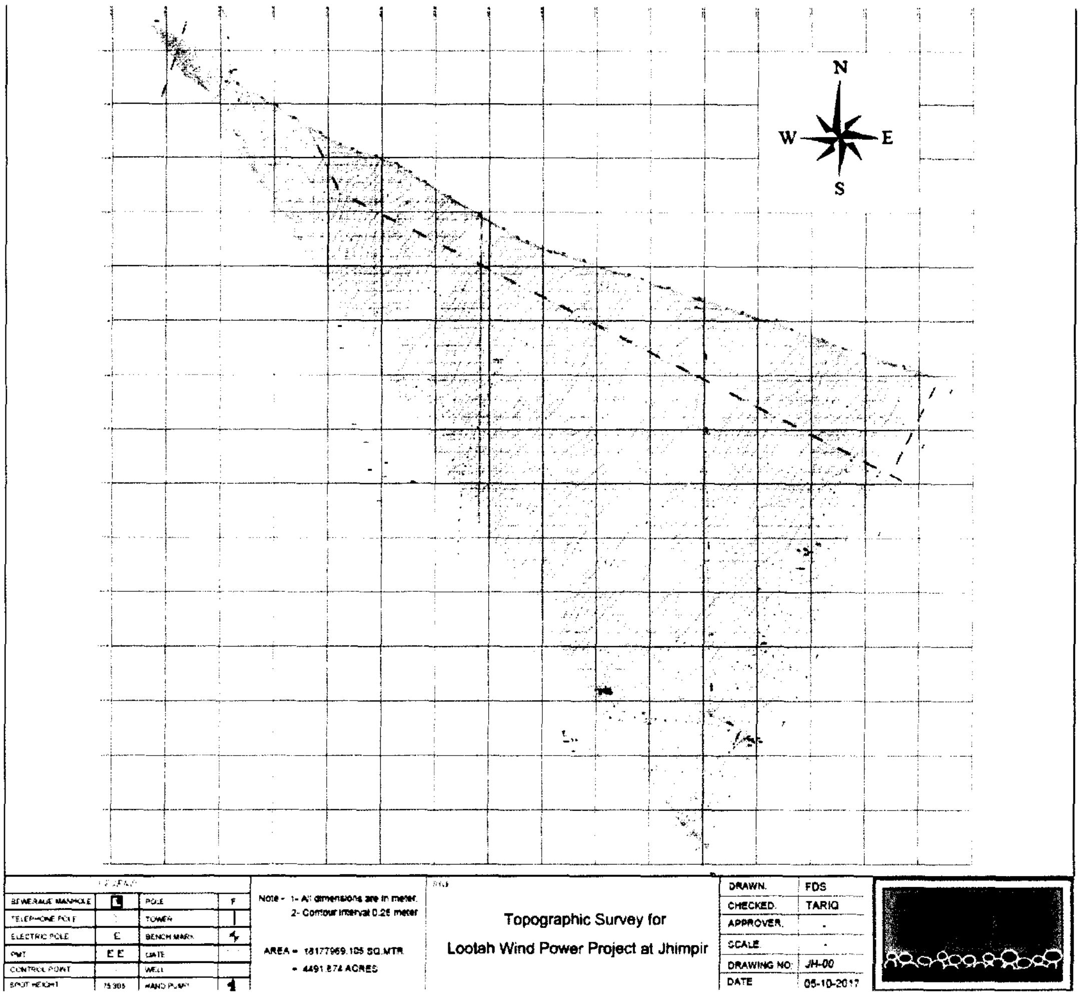
Tests on soil samples obtained from the boreholes indicate *'negligible'* exposure for rock,for sulphate and chloride. Under these conditions it is recommended to use *Ordinary Portland Cement (OPC)* for all underground concrete works.

8.7.13 CONCLUSION OF INITIAL GEO STUDY

Keeping in view, the results from field, and laboratory tests and the expected loads being transferred to the founding stratum, allowable bearing pressures for shallow foundations at depth of 1.5 meters is recommended. Exposure to chloride and sulphate salts Is 'negligible' for rock; therefore, Ordinary Portland Cement (OPC) should be used for underground concreting. It should be noted that the area of the project site is large and this investigation is only for the preliminary feasibility stage study. Detailed geotechnical investigation should be carried out after the location for WTG are finalized.

8.8 Topographic map of site

The topographic survey was completed and detailed report is attached as enclosure, which clearly indicate Site is nearly flat, with very little mounds, and a gentle slpe from West to East exist, which allows the rain water to flow with out restriction to the perennial rivers which are on the southern border of site.


N
W
E
S
SEWERAGE MANHOLE
POLE
TELEPHONE POLE
TOWER
ELECTRIC POLE
BENCH MARK
PMT
GATE
CONTROL POINT
WELL
SPOT HEIGHT
HAND PUMP
Note - 1- All dimensions are in meter.
2- Contour interval 0.25 meter
AREA = 18177969.105 SQ.MTR.
= 4491.874 ACRES
Topographic Survey for
Lootah Wind Power Project at Jhimpir
DRAWN. FDS
CHECKED. TARIQ
APPROVER. -
SCALE. -
DRAWING NO: JH-00
DATE 05-10-2017

9. Meteorological Data Of Jhimpir

9.1 Temperature

The yearly average temperature varies between minimum 16.4^{O}C and maximum 35.8^{O}C. The monthly average temperature ranges between 8.7^{O}C in January and 39.8 reaching a maximum of 43.8^{O}C in May. The temperatures start falling from October each year to January and dry and hot weather prevails from April to September

TEMPERATURE IN DEGREE C for year 2015

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Mean Hi	**27.2**	**28.6**	**31.8**	**36.3**	**36.2**	**37.5**	**33.9**	**33.3**	**35.0**	**35.0**	**32.9**	**28.5**
Mean Lo	**12.9**	**16.9**	**19.5**	**25.4**	**27.6**	**29.9**	**28.6**	**26.9**	**26.6**	**25.0**	**18.9**	**12.9**
Maximum	**30.0**	**34.0**	**40.0**	**41.0**	**43.0**	**45.0**	**36.0**	**34.0**	**43.0**	**41.0**	**35.0**	**32.0**
Minimum	**10.0**	**12.0**	**14.0**	**23.0**	**26.0**	**28.0**	**24.0**	**24.0**	**23.0**	**20.0**	**14.0**	**8.00**

Table 9.1: Meteorological Parameters for Jhimpir Area

Months	Temperature °C		Rainfall mm	Relative Humidity %
	Maximum	Minimum		
January	25.78	8.73	0.96	50.38
February	28.59	11.60	3.60	48.81
March	34.02	16.80	2.30	48.36
April	38.40	21.80	2.49	48.67
May	39.85	25.47	0.69	53.10
June	38.02	27.46	10.76	60.70
July	35.11	27.04	70.49	69.61
August	33.61	26.06	89.88	72.55
September	34.36	24.87	34.43	68.78
October	35.80	21.70	3.72	58.15
November	31.87	15.86	1.67	53.88
December	26.68	10.10	1.11	52.46

Annual	33.48	19.76	221.64	57.56

In Kohistan extreme temperatures of up to 38-45ºC in summer and 6-8ºC in winter prevail during the two seasons. Due to high temperatures in summer, the plant species with low vigor and shallow root system die away. Maximum temperature is high in these regions, specially in the dry season when there is little cloud or moisture in the atmosphere to absorb solar radiation. Under conditions of high temperatures life and work become difficult. Not only is lack of moisture in the form of rain, the chief factor causing arid conditions, but low air humidity in itself has an adverse effect upon plants and animals, because the rate of evaporation is very high at these temperatures.

Loss of moisture from the ground and from vegetation is an indicator of rate of "evapotranspirtion" which is very high in semi- arid and arid regions of Kohistan. The incidence of high temperature causes heat damage. Maximum temperatures are high in Kohistan especially in dry season when there is little

cloud or moisture to absorb solar radiation. Accordingly the rate of evapo-transpiration is very high.

9.2. Rainfall

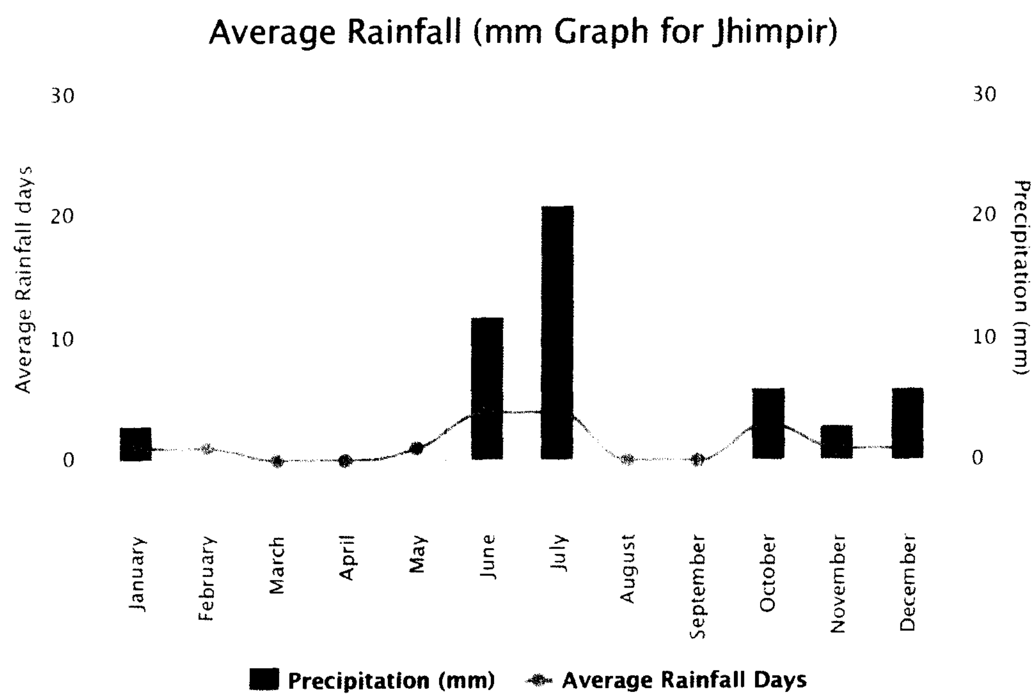
The southwest monsoon brings in humid air from the sea, but the precipitation is generally very low with nearly 80% of the 100 to 200 mm rain falling from June to September. Rainfall, when it does come, it is often torrential causing problems of drainage and erosion of the light and sparsely vegetated land of UA Jhimpir.

The winters are short and mild from late November to early February with the prevailing wind coming from the North East with very little rainfall. The most important characteristics of the prevailing meteorological conditions are the generally high dust conditions as a result of the aridity of the surrounding area; dust storms occur especially before the onset of monsoon. The higher winds during the southwest monsoon tend to carry air-borne dust inland during the summer months, while in winter they tend to be light to moderate in intensity and carry air borne particulate matter seaward.

Monsoon in the arid area of Kohistan is characterized by low and high variable rainfall both in time and space. The rainfall has a specific trend and pattern that is below medium rainfall, which may come once in three years, whereas drought once in 8- 10 years[4.16]. Annual rainfall increases from less than 100 mm in the north to 350 mm in the southeast. Nearly 14 per cent of the desert receives 350 mm rainfall, 25 per cent gets 250 mm, and 4.5 per cent receives less than 150 mm, and remaining 52.5 percent receives 150- 25 mm rainfall. Almost all the rain is received during monsoon from mid June to mid September, but July and August are the months of heavy rainfall. During remaining period of the year there are drought-like conditions for continuous period of six to nine months. Although, rainfall is in heavy showers yet there is generally little runoff. The rainwater is usually absorbed in the sandy grounds, however the village folks have constructed channels to divert the surface run-off into land area enclosed by dykes for storage in tanks or *bandats*, and also into fields for irrigation.

Removal of vegetation, by overgrazing, or drying up due to continuous drought conditions greatly reduces the effects of rain, because the water runs off the surface of the ground. Within a few minutes, the dry Nai (rain fed channel) such as Layari and Harolo become roaring torrents removing any sign of topsoil and eroding deep gullies into the ravaged landscape. The two nais are dry except after rain. During some years the persistent wind with high velocity the monsoon winds do not reach the region and no rain occurs during such periods. The desertified area is subject to heavy soil erosion.

During recent years the annual rainfall has ranged between a the minimum 4.6mm in 2002 and 800mm in 2006 with an annual average of 300mm. The rainy season is spread over the June-September period, with maximum rainfall occurring in September, and average rate of evapotranpiration 3218.2mm



9.3 Wind Direction and Speed

The wind direction at the area is predominantly west-north westerly at 250°, which suggests that it has a direction almost perpendicular to the 11 km long site, which is oriented at the Project site at about 20° above the west-east axis. The wind direction in the area is generally west-north westerly during the summer monsoon and east-north easterly during the short winter monsoon season. The wind speed at ground level varies between 0 and 2 m/s during the calm months to 4 and 8m/s during the pre-monsoon season. The normal wind direction during 1961-1990 is given in the following Table.

Table 9.3 Wind Direction in Karachi (1961-1990)

Month	Direction in degrees	Velocity in Knots	Steadiness %
January	36	2.5 to 3.0	31
February	320	3.1 to 3.7	19
March	263	3.9 to 5.0	72

9.4 WIND SPEED IN JHIMPIR AREA

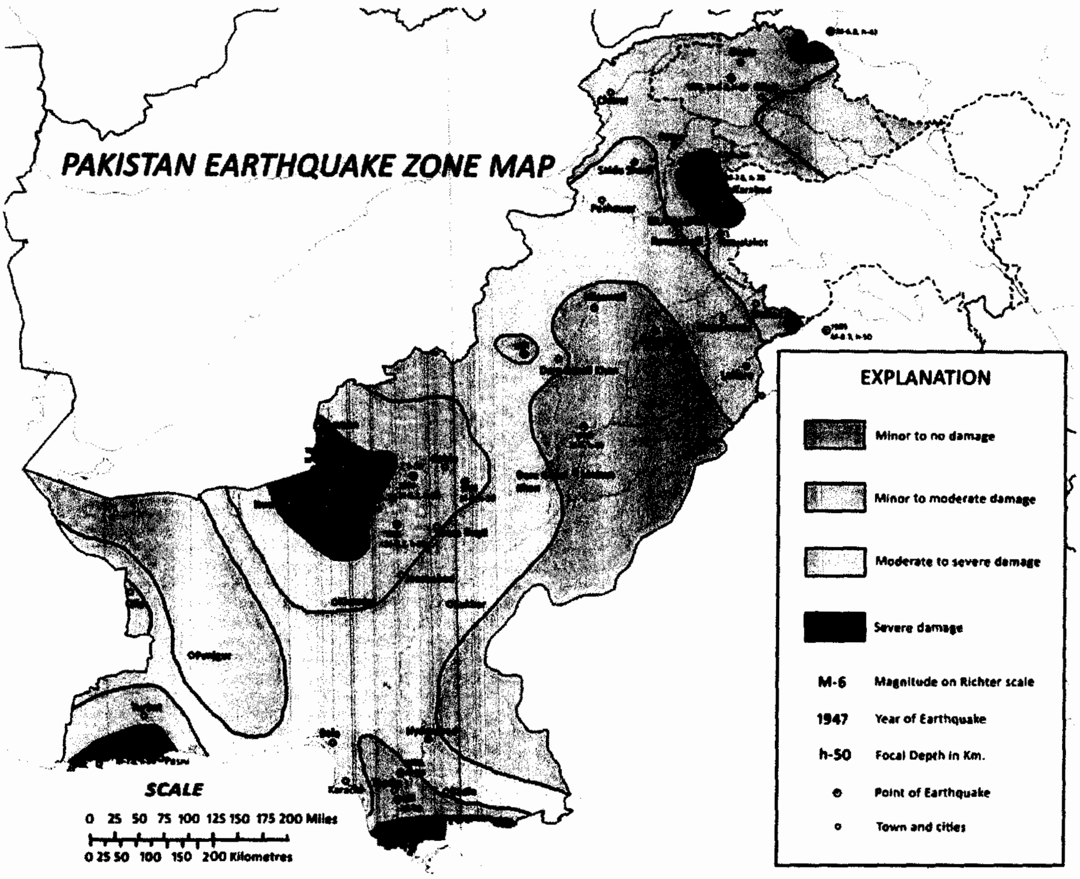
AEDB, has been able to establish a bench mark wind speed in Jhimpir, which gives a guidline to sponsors to initiate work n wind farm projects. Normaly a wind mast is installed at site, which records the data for a period. However, many companies have installed the wind mast in the area, and now generally data from these are used b y new sponsors for deciding on size and type of wind Turbines.

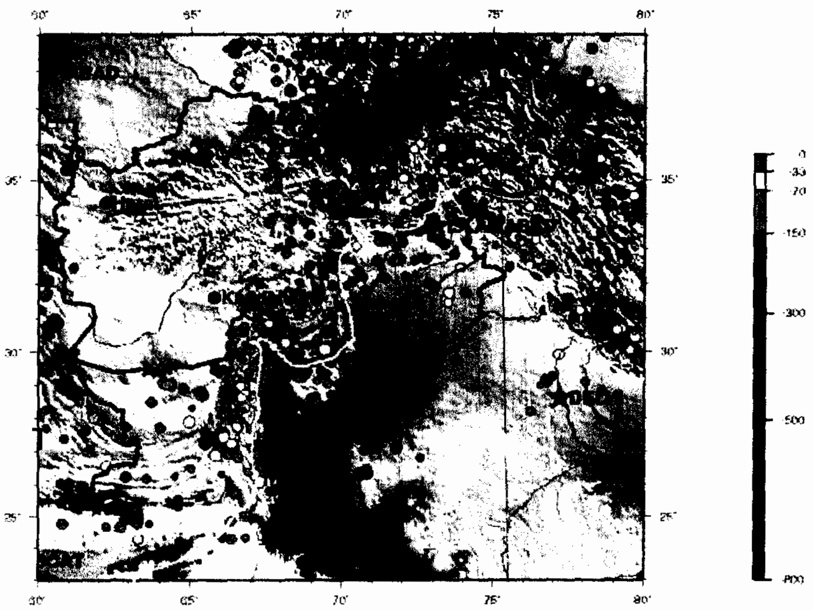
9.4.1Monthly Benchmark Wind Speeds for Jhimpir sites

Month	Monthly Mean Wind Speeds (m/s)					
	30m	50m	60m	67m	80m	85m
January	4.25	4.70	4.90	5.02	5.24	5.3
February	4.50	4.98	5.18	5.32	5.55	5.7
March	4.77	5.28	5.50	5.64	5.89	6.0
April	6.39	7.03	7.29	7.46	7.75	7.9
May	8.29	9.05	9.36	9.56	9.90	10.0
June	8.79	9.50	9.78	9.96	10.25	10.4
July	8.83	9.59	9.89	10.08	10.40	10.5
August	8.20	8.89	9.16	9.34	9.63	9.6
September	6.63	7.28	7.54	7.72	8.01	8.1
October	4.22	4.68	4.87	5.0	5.22	5.3
November	3.59	3.98	4.14	4.24	4.43	4.5
December	3.96	4.38	4.56	4.67	4.88	5.0
Annual Average	**6.0**	**6.6**	**6.8**	**7.0**	**7.3**	**7.4**

Year	Month	Mean WS 85m (a) (m/s)	Mean WS 85m (b) (m/s)	Mean WS 60 m (m/s)	Mean WS 30m (m/s)	Mean WS 10m (m/s)
2008	Nov	8.918	8.893	8.069	6.526	5.1125
2008	Dec	7.374	7.356	6.859	5.857	4.7326
2009	Jan	8.019	8.005	7.444	6.334	5.1507
2009	Feb	6.07	6.079	5.711	4.937	3.9816
2009	Mar	6.131	6.149	5.824	5.161	4.3107
2009	Apr	7.027	7.051	6.656	5.905	4.9913
2009	May	8.936	8.977	8.668	8.034	7.1246
2009	Jun	8.786	8.824	8.586	8.026	7.1841
2009	Jul	9.297	9.336	9.036	8.381	7.4504
2009	Aug	9.343	9.378	9.123	8.496	7.543
2009	Sep	8.446	8.487	8.105	7.343	6.3419
2009	Oct	5.685	5.691	5.331	4.585	3.6604
2009	Nov	6.853	6.84	6.353	5.233	3.9693
2009	Dec	7.11	7.084	6.552	5.297	4.0409
2010	Jan	6.477	6.458	6.082	5.07	3.9407
2010	Feb	6.17	6.169	5.775	4.966	3.98
2010	Mar	6.585	6.605	6.249	5.502	4.5774

10. SEISIMIC CONDITION OF JHIMPIR AREA





Seismicity of Pakistan, 1990 - 2000

The seismicity map of Pakistan show that the earthquake zones have been hit by earthquakes a number of times, but the depth of their epicentre is not usually lower than 33 km. The map also shows the yellow line, which marks the frequency zones as well as the fault lines. It also shows that the yellow line on entering the Arabian Sea bifurcates into a line that travels along the coastline while the other goes southwest. This indicates that there are quite a few other active faults in Lower Sindh, including a thrust-and-fold belt extending northward parallel to the transform fault separating India from Asia, and the Rann of Kuch fault system trending westward towards Jhimpir, Karachi city and Makran Coast bordering the Arabian Sea. The map does not show the presence of the unique Mud Volcanoes, which are still active on the Balochistan coast.

Seismic activity in the macro environment of the Project site is caused by the dynamics of slow but constant relative motion of the active Karachi Triple Junction (KTJ) of three major tectonic plates viz. the Indian Plate, the Arabian Plate, and the Eurasian Plate of the earth's crust. Their corresponding fault systems comprising a subduction zone, a transform boundary, and the ancient rift system, intersect in the general vicinity. Each produces a distinct type of ground motion and appears to have been reactivated, with an associated hazard risk that can be disastrous. Seismic activity in the region is the result of movement on one or more faults and mainly from intra-plate active faults, including the Karachi-Jati, Allah Bund-Rann of Kutch, Surjan-Jhimpir, and Pab.

The macro environment of Project is about 200 km on the NEE, while Karachi lies approximately 160 km east of the triple junction. The western and north-trending arms of the triple junction sustain convergent and trans-current rates of 28-33 mm/yr respectively

The presence of a recently discovered active Sonne fault indicates that the Arabian plate has been fragmented across the southwest corner of the triple junction defining a triangular plate: the Ormara plate whose velocity relative to the Arabian plate increases the subduction velocities by a few millimetres per year compared with the rate at the west. In addition to these clearly defined plate boundaries, other active structural zones have produced damaging earthquakes that have been felt in the macro environment of Project site in Deh Kohistan in the past 200 years. They include the following faults:

Karachi-Jati, (2) Surjan-Jhimpir, (3) Pab Fault (4) Hab Fault (5) Allah Bund-Rann of Kutch

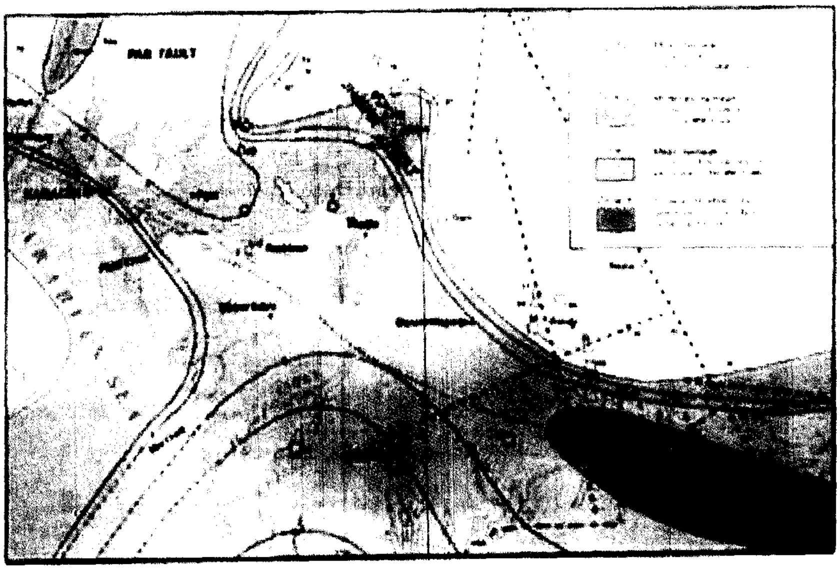
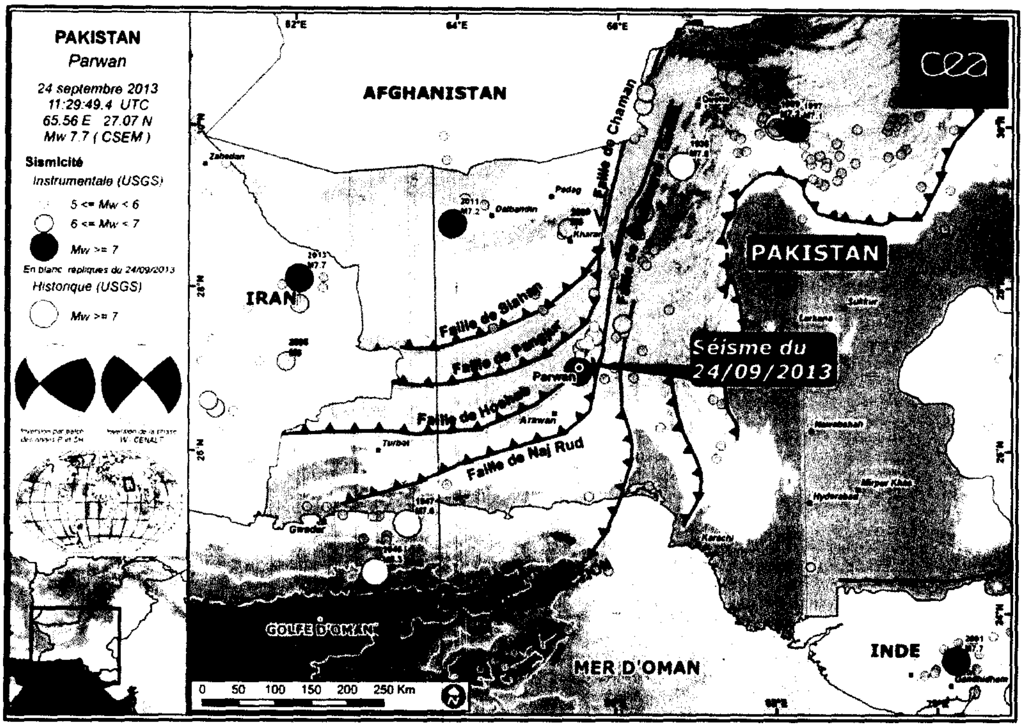


Fig. 7. Seismic risk map of Karachi-Hyderabad Divisions, showing major active faults around Karachi Metropolis (after Mirza et al., 1984)



Surjan Fault: These N-S trending dip-slip or bedding-plane faults are active along the Kirthar Range Front. This fault cuts across the Quaternary deposits on the north of Karachi and west of Lakhra. The southern end of this fault is intersected by the northwest trending Jhimpir Fault on the west of Jhimpir. The interaction of these two faults is characterized by at least four teleseismic events of shallow focal depth and magnitude 3-6. The maximum magnitude of the earthquake associated with the Surjan Fault is of the order of M ≈ 6-1. On Richter Scale

***Pab Fault*:** This NNW-SSE trending is 135 km in length and islocated in the eastern part of the Pab Range and has dislocated vertically the Quaternary alluvial fans.The maximum magnitude of the earthquake associated withthis fault is of the orderM ≈ 7.0 on Richter scale.

Hab Fault: The Hab valley is traversed by this fault.

Rann of Kutch Fault: This E-W trending fault has produced earthquake of the order of M ~ 7.6 on Richter scale. In 1819 and 1956, this fault was responsible for severe earthquakes in Gujrat, Tharparkar and Indus delta. This fault system also known as Allah Bund Fault passes in the proximity of the Steel Mills and Karachi Nuclear Power plant. It is 225 km in length and is responsible for the production of earthquake of considerably high magnitude of up to 7.6 M on Richter scale and of IX to X intensity on the Modified Mercali, MM scale on June 16, 1819.

Additionally a complex series of faults generally oriented easterly and slightly concave to the north have been identified through aerial photographs. They are roughly parallel to the inferred zone of rupture for the 1819 earthquake event.

Over the last sixty years, earthquakes of intensity lower than 5 on Richter Scale, including those in 1945 and 1985, have struck the region comprising the macroenvironment and thus far they have been of minor significance. This is mainly because the earthquakes here are not "Inter-Plate" or "Plate Boundary" earthquakes which occur commonly along narrow zones that follow the edges of tectonic plates.

The tectonic fault that produced the 2002-Bhuj earthquake, which registered a massive 7.7 on the Richter scale, was part of a complex system of geologic faults that run northwest in Gujrat through the marshy Rann of Kutch, where it produced a magnitude 7.6 quake in 1819, and also ran into Pakistan. While concealed under the loose sand of the Rajasthan and Thar deserts and sediments of the Indus delta, this system of faults appears to continue to the west, passing through Karachi and while extending into the Arabian Sea, it intersects another system of faults associated with a major tectonic boundary that has produced devastating earthquakes as far north as Quetta in the past. Together these fault systems have produced historically large earthquakes within Kohistan, notably in the Pab Range,Thatta taluka, and Jhimpir areas. It is the Intra-plate type of earthquakes (Mid-Plate Earthquakes) that occur far away from plate boundaries. The latter type earthquakes are less frequent but are capable of releasing just as much energy in a single event as one of similar intensity along a plate boundary. These arise due to localized systems of forces in the crust sometimes associated with ancient geological structures such as in the Rann of Kutch. Thus while the October 8, 2005 megathrust earthquake was the direct result of the interaction between Indian Plate and the Eurasian plate, the earthquakes of July, August and October 11 in the macroenvironment are intra-plate or Mid-Plate events. It is interesting to note that no earthquake, including the 1945 Makran and 2001 Bhuj events, as well as the occasional shaking from M 4-5 earthquakes on faults in the Deh Kohistan, has ever produced documented damage anywhere. Although the 1819 earthquake was apparently similar or larger in magnitude than the 2001 Bhuj event, little damage occurred in Thatta and Hyderabad in 1819 compared to 2001 even though the former event was closer to these towns/cities. The following Table shows the earthquake occurrences over the last forty years. The Table does not include the numerous events of magnitude less than 4.0 on Richter scale. Earthquakes of recent occurrence were recorded on July 16, 2005, followed by one on August 6, another on August 13, yet another on October 9 and then again on October 11, 2005. They were all of magnitude between 4 and 5.1 on Richter scale. The epicenter of these earthquakes was away from those listed in table. The epicenter of the most recent tremor of January 2, 2009 was 100 kilometers in the coastal region of Thatta district. It had a shallow depth of 10 kilometers and magnitude of 2.2 M on Richter scale.

Table 10.1: Epicenter, Depth, Magnitude & Intensity of Earthquakes Near Jhimpir

Year	Coordinates	Depth	Magnitude Richter Scale	Intensity MM	Location
1962	24°70'N66°00E	0	4.50	-	Karachi
1965	25° 03N67°76'E	40	4.50	-	Karachi
1966	25° 0N68°00' E	-	5.0	VI-VII	Jhimpir
1968	24° 61N66°42' E	19	4.10	-	Karachi
1970	25° 28N66°65' E	33	4.90	V	Karachi
1971	25° 00N68°00' E	-	4.50	V	Jhimpir
1972	25° 35N66°71' E	33	4.50	V	Karachi
1973	25° 00N68°00' E	-	5.00	VI	Jhimpir
1973	25° 48N66°33' E	57	4.90	V	Karachi
1975	25° 50N66°80' E	-	4.50	V	Gadani
1975	25° 22N66°59' E	33	4.90	V	Karachi
1976	24° 96N70°38' E	14	4.70	V	Karachi
1984	25° 86N66°41' E	33	4.70	VI	Karachi
1985	24° 90N67°39' E	33	5.00	VI	Karachi
1986	25° 34N66°60' E	33	4.50	V	Karachi
1992	25° 25N67°76' E	33	3.60	IV	Karachi
1996	25° 06N66°76' E	33	-	-	Karachi
1998	25° 69N66°46' E	33	4.40	V	Karachi
1998	24° 85N66°35' E	33	4.50	V	Karachi
2009	24° 31N67°18'	10	2.2	IV	Thatta

According to a map created by the Pakistan Meteorological Department, the country is divided into 4 zones based on expected ground acceleration. The areas surrounding Quetta, those along the Makran coast and parts of the NWFP, and also along the Afghan border fall in Zone 4. The rest of the NWFP lies in Zone 3, with the exception of southern parts of this province, which lie in Zone 2. The remaining parts of the Pakistani coastline also lie in Zone3. The remaining parts of the country lie in Zone 2. According to this classification Deh Kohistan would be placed in Zone 2.

11. TRANSMISSION SYSTEM PLAN OF AREA

Plan of NTDC for Jhimpr area for Interconnectivity was laid in 2017, but till date very little work has been carried out, as such only 10 Windpower plants are commissioned, and the rest are waiting for laying of Transmission system

2.1 Interconnection Scheme

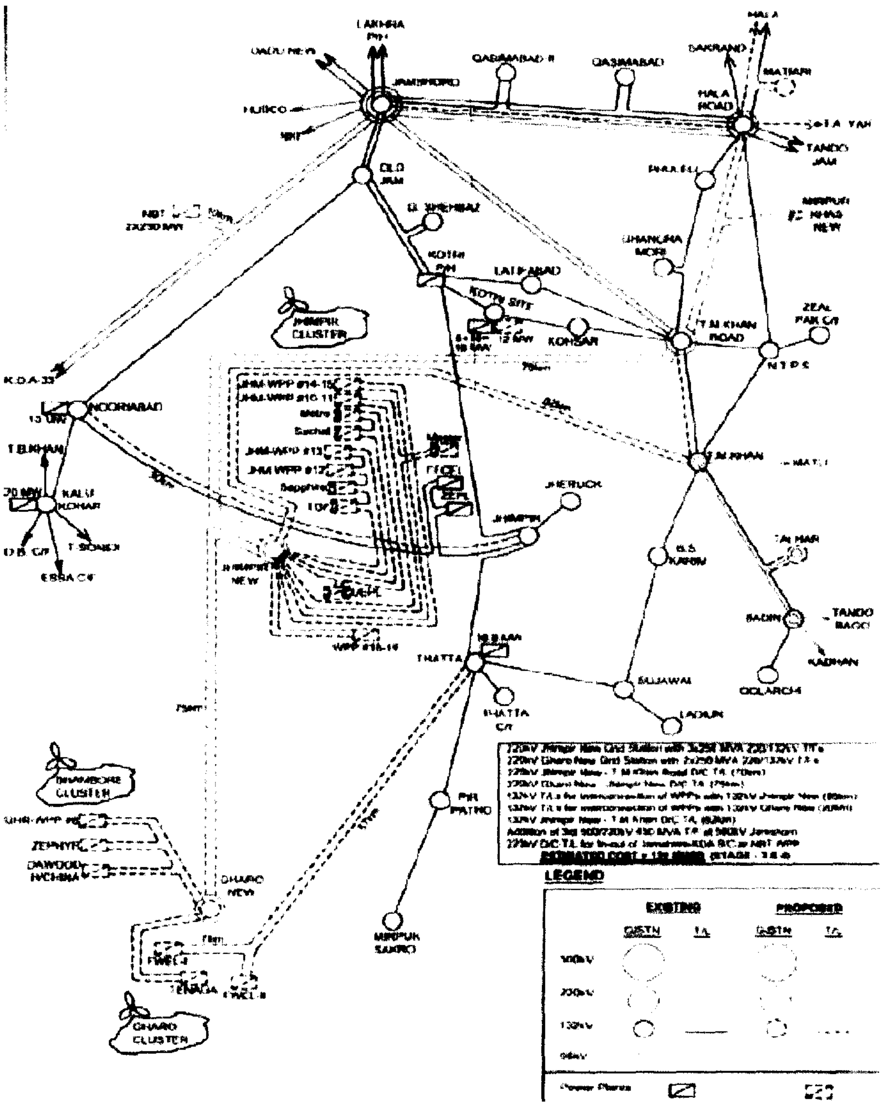


Figure 2: Interconnection Schematic Diagrams

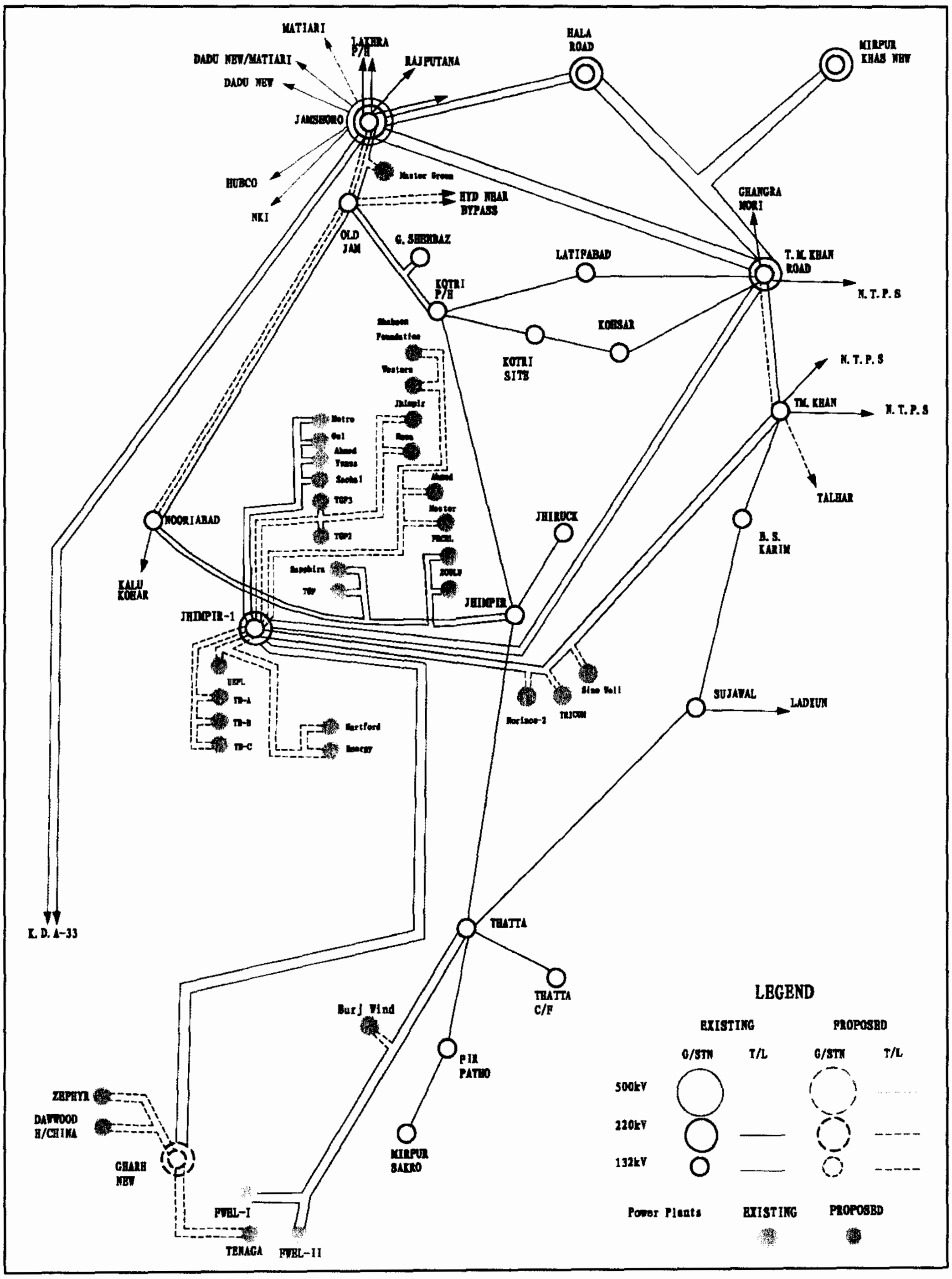


Figure 10-1 Status of grid in Jhimpir and its surrounding areas

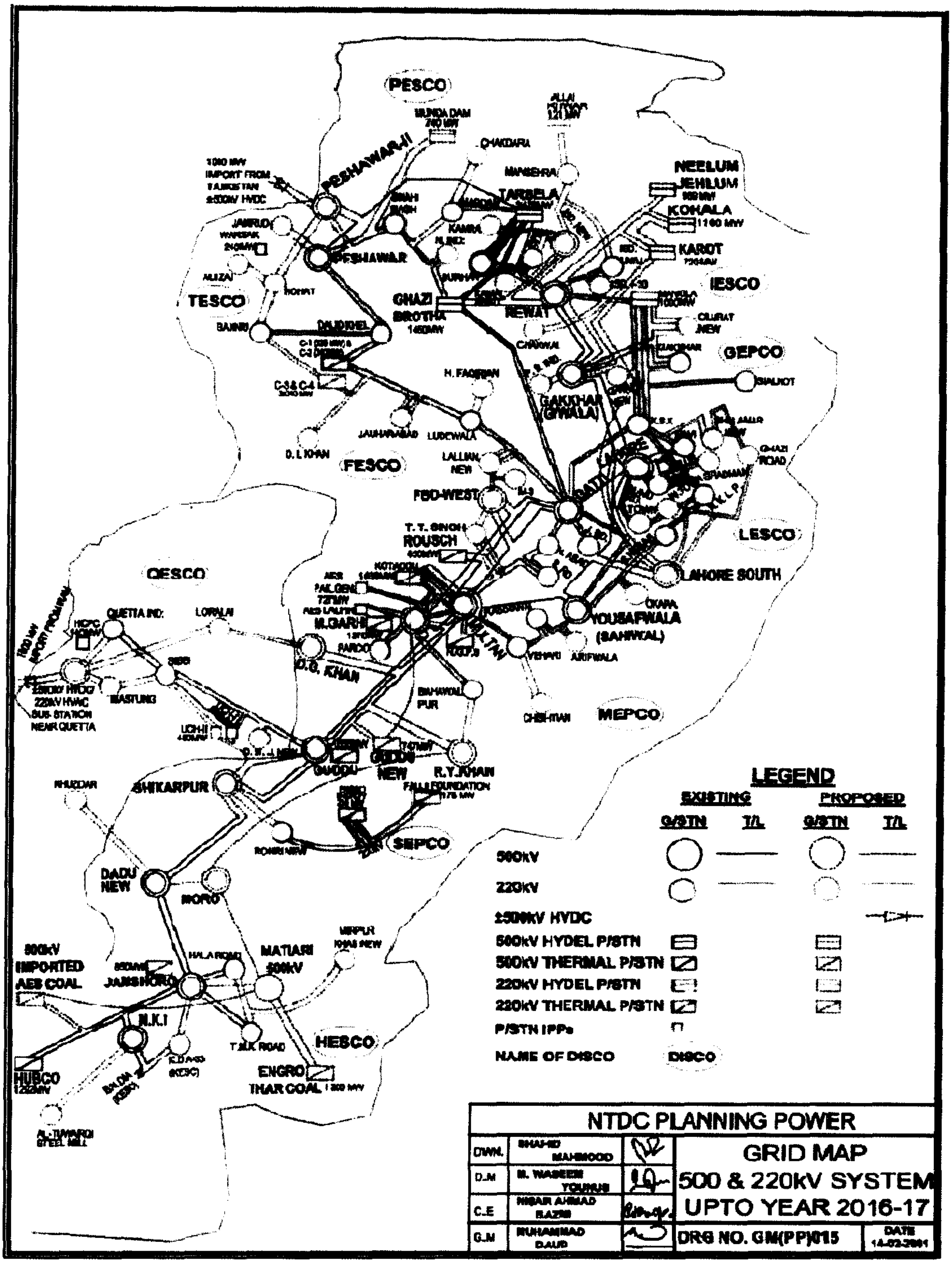


Figure 3-1 Existing/Committed 500/220 kV System

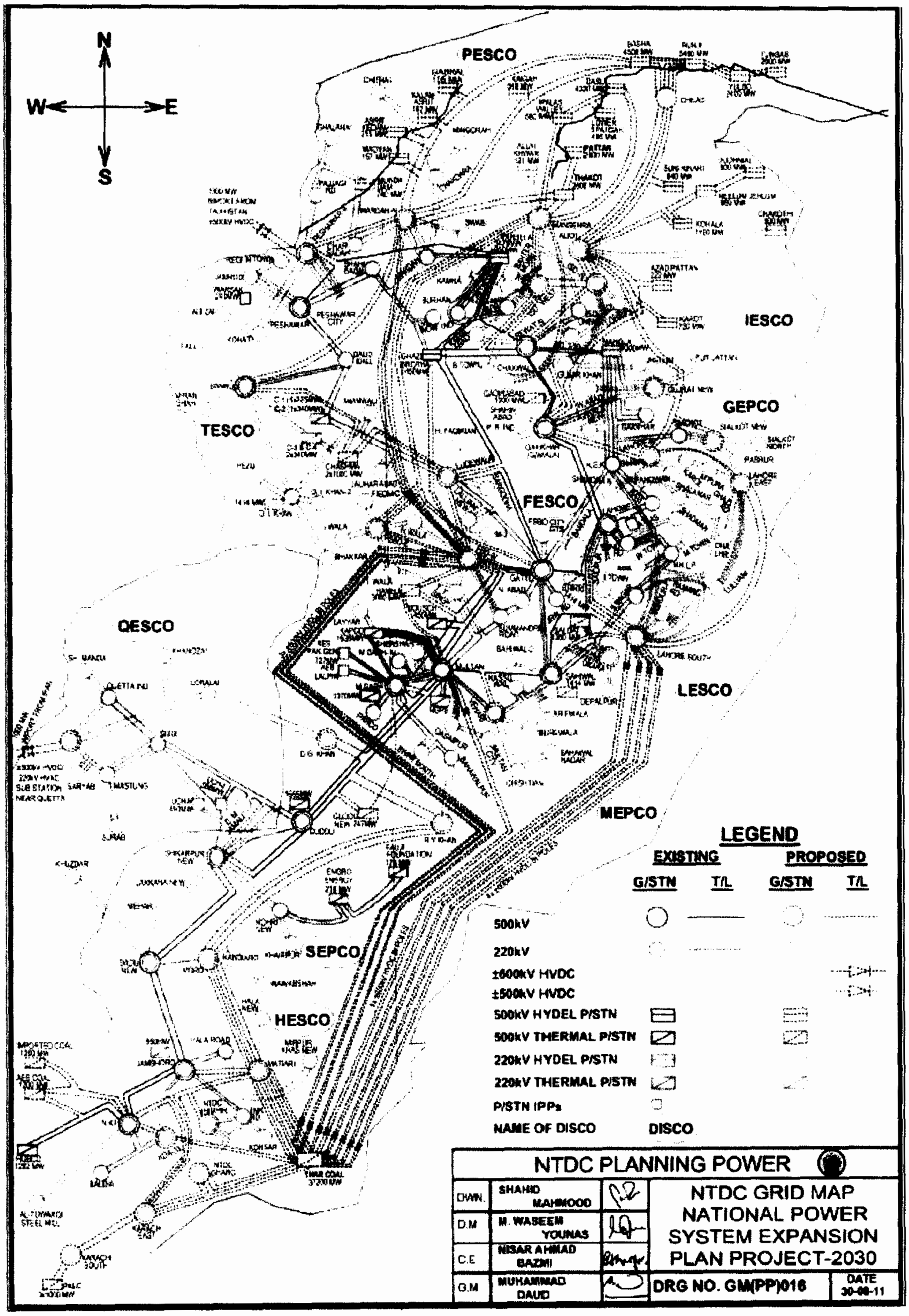


Figure 9-1 500/220 kV System in the Ultimate Year 2030

12. CURRENT STATUS OF WIND PROJECTS IN PAKISTAN

The status of various wind projects as published by AEDB is as follows;

12.1 List of Wind IPPs with Project Land:

S.No	Name of Company	Location of Land
1	Master Wind Energy Ltd,	Jhampir
2	Sachal Energy Development Pvt Ltd,	Jhampir
3	FFC Energy Limited.	Jhampir
4	Yunus Energy (Pvt.) Ltd	Jhampir
5	Metro Power Co.(Pvt.) Ltd.	Jhampir
6	Gul Ahmed Energy Ltd	Jhampir
7	Zorlu Enerji Pakistan Ltd	Jhampir
8	Wind Eagle Ltd.	Jhampir
9	Wind Eagle Ltd.	Jhampir
10	Sapphire Wind Power Company (Pvt) Ltd	Jhampir
11	Three Gorges First Wind Farm Pakistan P	Jhampir
12	UEPL Wind Power Pakistan (Pvt.) Ltd	Jhampir
13	Hawa Energy	Jhampir
14	Dewan Energy (Pvt.) Ltd	Jhampir
15	Tapal Wind Energy (Pvt.) Ltd	Jhampir
16	Titan Energy Pakistan (Pvt.) Ltd	Jhampir
17	Hartford Alternate Energy	Jhampir
18	Finerji (Pvt.) Ltd	Jhampir
19	China Sunec Energy (Pvt.) Ltd	Jhampir
20	Tricon Boston Corporation	Jhampir
21	Trident Energy (Pvt.) Ltd	Jhampir
22	Tenaga Generasi Ltd.	Kuttikun
23	Foundation Wind Energy – II Pvt Ltd. (Gre Pvt Ltd)	Kuttikun
24	Foundation Wind Energy – I Ltd. (Beacon	Kuttikun
25	HydroChina Dawood Power Ltd.	Bhambore
26	Zephyr Power Ltd	Bhambore

12.2 List of Companies acquired Generation License from NEPRA:

S.No	Name of Company	Date of Issuance
1	Fauji Fertilizer Company Ltd.	27th August 2010
2	Zorlu Enerji	6th May 2011
3	Foundation wind Energy-II (Pvt.) Ltd	22nd December 2011
4	Foundation wind Energy-I (Pvt.) Ltd	22nd December 2011
5	Three Gorges First Wind Farm Pakistan (Pvt	12th October 2011
6	Tenaga Generasi Ltd.	23rd February 2012
7	Hydro China Dawood Power Pvt. Ltd.	27th June 2013
8	Master Wind Energy Ltd,	26th December 2011
9	Zephyr Power (Pvt.) Ltd.	27th July 2012
10	Sachal Energy Development Pvt Ltd	30th August 2012
11	Yunus Energy Ltd	26th December 2011
12	Metro Power Co. (Pvt) Ltd,	26th December 2011
13	Sapphire Wind Power Company (Pvt) Ltd	27th July 2012
14	Gul Ahmed Energy Ltd	26th December 2011
18	United Energy Pakistan Ltd.	4th November 2013
21	Finerji (Pvt.) Ltd	22nd August 2013
23	Tapal Wind Energy (Pvt.) Ltd	27th November 2013
24	Hawa Holding Limited	1st January 2014
26	China Sunec Energy (Pvt.) Ltd	Application submitted at

12.3 List of Companies Obtained Tariff from NEPRA:

NEPRA announced tariff determinations for following IPPs.

	Name of IPP	Tariff (US$ Cents per kWh)	Date of Announced
Companies Opted Cost Plus Regime			
1	Zorlu Enerji	13.3456	13 Dec, 2011
2	FFC Energy Ltd	16.109	10 Aug, 2010
3	Three Gorges First Wind Farm Pakistan	13.9399	15 Dec, 2011
4	Metro Power Company Ltd	14.5236	15 May, 2012
5	Foundation Wind Energy-I (Pvt.) Ltd	14.1359	16 March, 2012
6	Foundation Wind Energy-II Ltd	14.1164	16 March, 2012
7	Sachal Energy Development (Pvt.) Ltd	14.8618	13 January, 2014
8	Zephyr Power (Pvt.) ltd	15.9135	24 May, 2012
Companies opted Upfront Tariff Regime:			
9	Yunus Energy Ltd	Upfront Tariff 2013	21 November 2013
10	Sapphire Wind Power Company Ltd	Upfront Tariff 2013	21 November 2013
11	Tapal Wind Power Energy (Pvt.) Ltd	Upfront Tariff 2013	21 November 2013

12	UEP Wind Power (Pvt.) Ltd	Upfront Tariff 2013	13 December 2013
13	Master Wind Energy Ltd	Upfront Tariff 2013	Upfront Tariff awaite(
14	Gul Ahmed Wind Power Ltd	Upfront Tariff 2013	Upfront Tariff awaited
15	Finerji (pvt.) Ltd	Upfront Tariff 2013	Upfront Tariff awaited
16	Hawa Energy Ltd	Upfront Tariff 2013	Upfront Tariff awaited
17	Dewan Energy (Pvt.) Ltd	Upfront Tariff 2013	Upfront Tariff awaited
18	China Sunec Energy (Pvt.) Ltd	Upfront Tariff 2013	Upfront Tariff awaited
19	Titan Energy Pakistan (Pvt.) Ltd	Upfront Tariff 2013	Upfront Tariff awaited
20	Tenaga Generasi Ltd	Upfront Tariff 2013	Upfront Tariff awaited
21	Hydro China Dawood Power (Pvt.) Ltd	Upfront Tariff 2013	Upfront Tariff awaited

NEPRA announced Upfront Tariff of US cents 13.5244 per kWh for wind power projects on 24th April, 2013. The Upfront Tariff is being offered for projects based on take-and-pay arrangement without the wind risk coverage. The companies opting for this Upfront Tariff will have to achieve the financial close by 30th September 2014.

12.4 List of Wind Power Project Companies obtained Letter of Support (LOS) from AEDB:

The following five IPPs have acquired LOS from AEDB upon submission of Performance Guarantees;

Sr. #	Company Name	Date of Issuance of LOS	Project Capacity (MW)
1	FFC Energy Ltd.	2nd December 2010	50
2	Zorlu Enerji Pakistan Ltd	9th February 2009	56.4
3	Foundation Wind Energy -I Ltd. (formerly: Beacon Energy Ltd.)	2nd May 2012	50
4	Foundation Winnd Energy -II Pvt. Ltd (Formerly: Green Power (Pvt) Ltd)	2nd May 2012	50
5	China Three Gorges First Wind Farm Pakistan Ltd (Formerly : CWE)	30th December 2011	50
6	Sapphire Wind Power Company (Pvt) Ltd	27th September 2012	50
10	Metro Power Co. (Pvt) Ltd,	9th August 2012	50
11	Gul Ahmed Wind Power Ltd	9th August 2012	50
12	Sachal Energy Development Pvt Ltd	20th March 2013	50

13	Yunus Energy Ltd (Formerly: Lucky Energy Ltd)	24th October 2012	50
14	Tenaga Generasi Ltd.	4th September 2012	50
15	Master Wind Energy (Pvt.) Ltd	8th August 2012	50
16	Zephyr Power (Pvt.) Ltd	17th January 2013	50
17	Hydrochina Dawood Power Ltd. (Formerly: WIN Power Ltd)	1st June 2011	50
18	UEP Wind Power Pakistan (Pvt.) Ltd		100

12.5 List of Wind Power Project Companies signed Energy Purchase Agreement (EPA) with CPPA:

The following IPPs have signed EPA with CPPA;

Sr. #	Company Name	Date of Signing of EPA	Project Capacity (MW)
1	FFC Energy Ltd.	5th April 2011	50
2	Zorlu Enerji Pakistan Ltd	12 January 2012	56.4
3	Foundation Wind Energy -I Ltd. (formerly: Beacon Energy Ltd.)	20th December 2012	50
4	Foundation Wind Energy -II Pvt. Ltd (Formerly: Green Power (Pvt.) Ltd)	20th December 2012	50
5	China Three Gorges First Wind Farm Pakistan Ltd (Formerly : CWE)	4th January 2013	50
6	Sapphire Wind Power Company (Pvt) Ltd	20th February 2014	50
7	Metro Power Co. Ltd,	26th February 2014	50
8	Sachal Energy Development Pvt Ltd	27th February 2014	50
9	Yunus Energy Ltd (Formerly: Lucky Energy Ltd)	26th March 2014	50

12.6 List of Wind Power Project Companies who have signed Implementation Agreement (IA) with AEDB:

The following IPPs have signed IA with AEDB.

Sr. #	Company Name	Date of Signing of IA	Project Capacity (MW)

1	FFC Energy Ltd.	18th February 2011	50
2	Zorlu Enerji Pakistan Ltd	11th April 2012	56.4
3	Foundation Wind Energy -I Ltd. (formerly: Beacon Energy Ltd.)	18th December 2012	50
4	Foundation Winnd Energy -II Pvt. Ltd (Formerly: Green Power (Pvt) Ltd)	18th December 2012	50
5	China Three Gorges First Wind Farm Pakistan Ltd (Formerly : CWE)	30th October 2012	50
6	Sapphire Wind Power Company Ltd	24th February 2014	50

12.7 List of Wind Power Project Companies who have obtained Financial Close:

Following companies have achieved financial close for their respective wind power projects:

Sr. #	Company Name	Date of Financial Close	Project Capacity (MW)
1	FFC Energy Ltd.	28th June 2011	50
2	Zorlu Enerji Pakistan Ltd	25th May 2012	56.4
3	Foundation Wind Energy -I Ltd. (formerly: Beacon Energy Ltd.)	18th July 2013	50
4	Foundation Wind Energy -II Pvt. Ltd (Formerly: Green Power (Pvt.) Ltd)	3rd April 2013	50
5	China Three Gorges First Wind Farm Pakistan Ltd (Formerly : CWE)	17th July 2013	50

12.8 List of Wind Power Project Companies who have obtained Commercial Operation:

Following companies have achieved commercial operation for their respective wind power projects:

Sr. #	Company Name	Date of achievement of COD	Project Capacity (MW)
1	FFC Energy Ltd.	24th December 2012	50
2	Zorlu Enerji Pakistan Ltd	26th July 2013	56.4

13. REGULATORY REGIME

Ministry Of Power controls the Power Sector in Pakistan, and operates through various departments, organisations, corporations, and Regulatory Authorities , which are supposed to be Independent in decision making. Following Stake Holders are involved , to control ,regulate, assist , approve ,a power project. For Wind, Solar, and other Renewable Projects, an Alternate Energy Board has been formed, which operates in Parallel to PPIB, (Private Power Infrastructure Board), which take care of all other Thermal projects. For Wind Power Project in Sindh, following stake holders are involved.

- Ministry Of Water & Power (Energy)
- National Electricity Power Regulatory Authority(NEPRA)
- National Transmission & Dispatch Company (NTDC)
- Central Power Purchase Agency Guarantee Ltd (CPPA-GL)
- Directorate of Alternate Energy,Energy Department Government Of Sindh

13.1MINISTRY OF WATER AND POWER

The Federal Minister Of Water and Power is responsible for this ministry, and exclusive source for settlement of all issues relating to Power Generation, Transmission and Distribution, Pricing regulation and consumption. All powers to fulfil these functions are exercised by him through various agencies reporting to him, including autonomous regulatory bodies. He is responsible for formulating a Power policy, including incentives, coordinating in implementation,with Provinces and other ministries.

13.2NATIONAL ELECTRICITY POWER REGULATORY AUTHORITY (NEPRA)

NEPRA, was created to regulate power policy, tariff suggestions and control, and regulate both Power Generation, Transmission and Distribution, to take care of consumer interest, and set terms and conditions of operations, Transmission, Distribution of Electricity. It also issue the Power Generation and Transmission Licenses, Control the Grid Code, and Liaise with Provinces on Power matters.

13.3NATIONAL TRANSMISSION AND DISTRIBUTION COMPANY (NTDC)

NTDC, was formed in 1998, as the Body ,to purchase power from Generation Companies, Transmit it to Distribution Companies. It was carved out of WAPDA, when it was decided to deregulate various functions under WAPDA.It was to take over the 220Kv and 500Kv Grid Stations and Transmission line Network from WAPDA ,including all such assets, obligations, & Liabilities. It currently maintain all Transmission lines and Grid Stations, in Pakistan of 220Kv and 500Kv ratings.

Smaller 132Kv and 11Kv networks are maintained and under control of Distribution Companies, called DISCO's.Its also responsibility of NTDC , to design , install new transmission systems, and Grid station , for evacuation of power, from new Power Stations.Under the Tariff regulatory scheme it charges certain rates for such transmission of power on per Kwh/Km. basis which is added to the consumer tariff ascertained by NEPRA for Distribution companies.

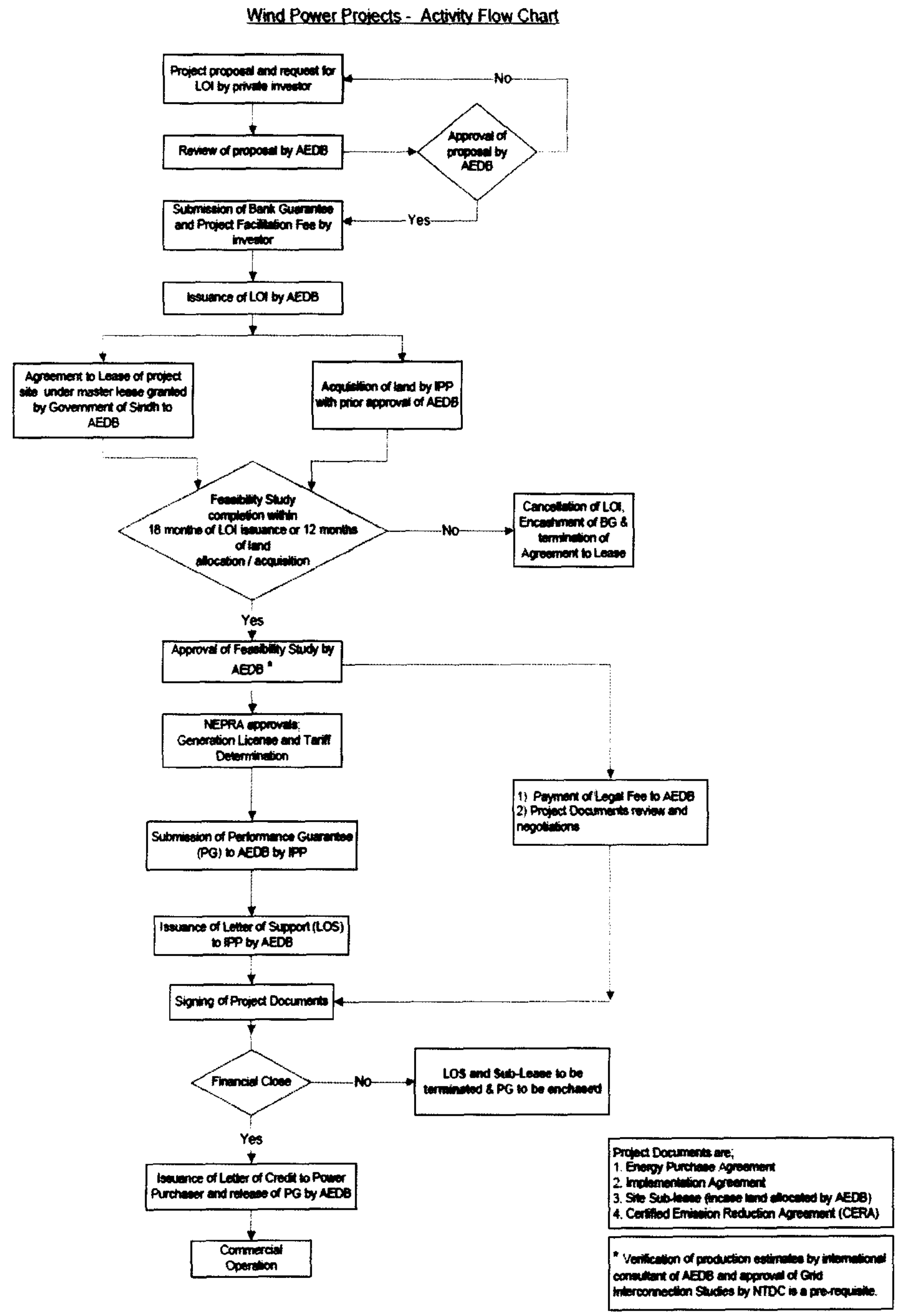
13.4. CENTRAL POWER PURCHASE AGENCY GUARANTEE LIMITED (CPPA-GL)

CPPA-GL is an organization, which has formed, to act as one window operation , and coordinate between Power Plants and NTDC, for all affair related to Signing of (EPA),Power Purchase Agreement (Tariff is determined by NEPRA), establishment of operation committee(OC),Development of Operating Procedures(OP), appointment of Independent Engineer (IE), and Testing of the Project for declaration of successful commercial operation (COD). CPPA-GL, also coordinates with Power producer, for payment of the periodical billing for supply and sale of energy, as invoiced by Power Producer under EPA. And all other NPMV, Non Project Missed Volume covered undrer EPA. Also regulate the Indexation in prices as agreed by EPA, and approved by NEPRA, on quarterly basis.

13.5. DIRECTORATE OF ALTERNATE ENERGY, ENERGY DEPARTMENT, GOVERNMENT OIF SINDH (DAE,ED,GOS)

The Directorate is responsible for harnessing the Alternate/ Renewable energy resources in Sindh, address all issues related to it, at provincial level. Facilitate foreign and local investor and doners for promotion and implementation of such green energy projects. Also plan for such projects, under Public, and Private/Public funding, and improve the policy as per requirements. Liaise with Federal Government, for success of Energy Policy in Sindh.

13.6. FLOW CHART OF ACTIVITIES REQUIRED FOR A WIND POWER PROJECT



14.CARBON CREDIT- CLEAN DEVELOPMENT MECHANISM (CDM)

The Clean Development Mechanism (CDM),is one among the three flexible Kyoto Protocol mechanisms facilitated implementation of Green House Gas (GHG) emission reductions in developing countries. Such GHG emissions are procured by the developed countries to meet their emission reduction targets under the Kyoto Protocol.

The CDM was conceived in order to assist countries with a binding emission reduction target in achieving partial compliance with their country target by carrying out project activities aimed at reducing emissions in the developing countries like Pakistan that yet do not have such obligations.

The underlying idea of the mechanism is to take advantage of cost-efficient mitigation options everywhere in the world; in other words, to achieve the same environmental benefits at lower costs, with so- called least- cost abatement measures. The Protocol hence intends to support industrialized countries in reducing their costs of compliance.

In order to preserve a high probability of keeping global temperature increase below 2 degrees Centigrade, current climate science suggests that atmospheric CO_2 concentrations need to peak below 450ppm. This requires global emissions to peak in this decade and decline to roughly 80% below 1990 levels by the year 2050. Such dramatic emissions reductions require a sharp move away from fossil fuel, significant improvements in energy efficiency and substantial reorganisation of our current economic system. This transition can only be achieved by far-reaching national and international climate policies.

Carbon offsetting is an increasingly popular means of taking action. By paying someone else to reduce GHG emissions elsewhere, the purchaser of a carbon offset aims to compensate for – or "offset" – their own emissions. Individuals seek to offset their travel emissions and companies claim "climate neutrality" by buying large quantities of carbon offsets to "neutralize" their carbon footprint or that of their products.

Carbon offset markets exist both under compliance schemes and as voluntary programs. Compliance markets are created and regulated by mandatory regional, national, and international carbon reduction regimes, such as the Kyoto Protocol and the European Union's Emissions Trading Scheme. Voluntary offset markets function outside of the compliance markets and enable companies and individuals to purchase carbon offsets on a voluntary basis.

14.1 Earning Carbon Credits in Alternative & Renewable Energy Projects in Pakistan

In Pakistan, alternative and renewable energy (ARE)projects have definite prospects for development as carbon offsetting initiatives. Being clean source of energy, theARE projects are best suited for CDM and can earn CERs. The Government of Pakistan (GoP) has taken up a broad spectrum of initiatives for the development of AREs in the country and seeks projects to address the CDM pertaining to sustainable development and should apply to CDM Executive Board as per the guidelines of UNFCCC for get CERs and earn carbon revenues.

To accelerate and streamline activities related to the REs, the Government of Pakistan has authorized Alternative Energy Development Board (AEDB) to act as a focal body of the federal government with mandate of one window facility for ARE development in the country. The GoP approved Policy for Development of Renewable Energy for Power Generation, 2006, in which it specified constitution of Joint Management Committee (JMC) for sale and management of CERs earn through renewable energy projects. The JMC comprise of power purchaser, power producer and AEDB.

14.2 Status of Registration of Alternative and Renewable Energy Projects with CDM

CDM is one of the instruments that developers of the Alternative and Renewable Energy (ARE) Projects pursue and earn financial returns by getting their projects registered with CDM Executive Board and selling the accrued Certified Emission Reduction certificates in the international carbon market.

The sponsors of ARE projects in Pakistan also have been looking at this option. 18 RE projects have been registered for 1.3 million CERs annually, and 29 RE projects are in process of registration for 1.6 million CERs annually. Current Market price of one CER is below USD 1; however it is expected to increase as the developed countries are going to re-affirm their commitments to take target to reduce emissions in COP-21 (to be held in Paris in Oct 2015). To avail max benefits from new market situations, the investors are endeavouring to register their projects with CDM. The details of the ARE projects who have started process for CDM registration are as follows:

Projects Registered with CDM

[illegible]	[illegible]	[illegible]	[illegible]
1	Wind	8	405.9
2	Biomass	8	190
3	Small Hydro	1	15
4	Solar	1	50

Projects In Process of Registered with CDM

[illegible]	[illegible]	[illegible]	[illegible]
1	Wind	10	528

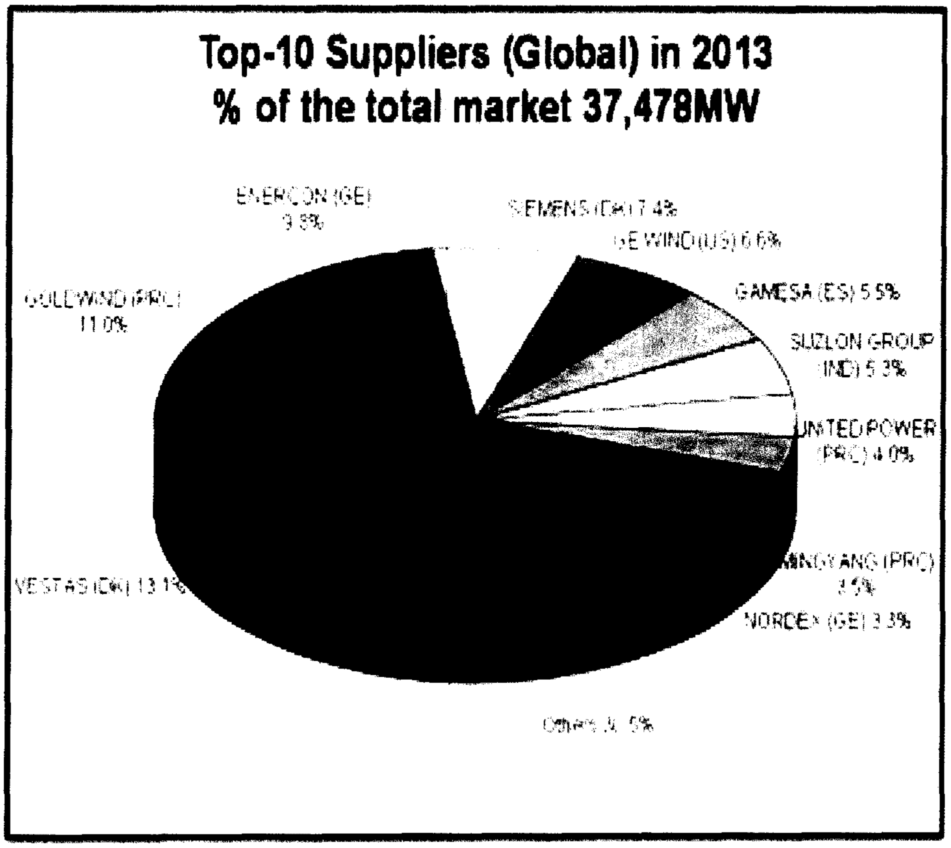
2	Biomass	4	88
3	Small Hydro	12	116.8
4	Solar	3	125

i) Wind Power

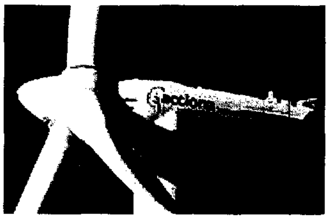
Till to date 18 wind power projects are in advanced stage of CDM registration process. 8 projects of 50 MW each have been registered with CDM Executive Board. Aggregate number of approved CERs from these projects is 709,287. Significant factor about these projects is that these are registered by the end of 2012 which allows them to sell their CERs in European Union market.

15. WIND TURBINES SUPPLIERS

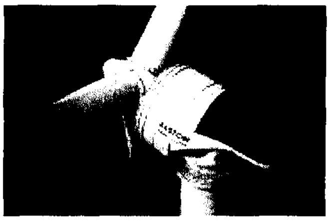
We considered top manufacturers of Wind Turbines for our project, whose briefs are given below; however final selection will depend on available of Debt Financing from that source. Their presence in Pakistan, for After Sales Support, suitability of machines, the Energy yield, and capacity factor, and past track record of such machines in Pakistani and International market Other important factor will be their EPC pricing, and matching Electrical equipment requirement of NTDC.



15.1 Leading Manufacturers Of Wind Turbines



Acciona is one of Spain's leading corporations, active in the construction, infrastructure and water sectors as well as renewable energy. It is a major wind farm developer as well as manufacturing turbines, with production plants in the US and Spain. Acciona wind turbine models include the AW-3000 with a rated capacity of 3MW, and the 1.5MW AW-1500.



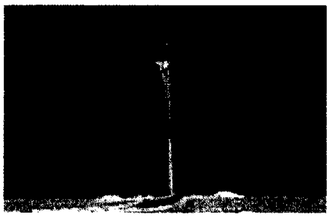
Alstom is a global player in transport infrastructure, electrical grid technology and renewable energy. Alstom's turbine models include the 2.7MW ECO 122, designed for low wind conditions, and the 6MW direct drive Alstom Haliade 150 offshore wind turbine.

Dongfeng, Controlled by the Chinese government, Dongfang Electric Corporation is active in more than 30 countries. It produces turbines with a rated capacity of 1MW, 1.5MW, 2MW and 2.5MW. In 2012 Dongfang announced a collaboration with AMSC to design and develop a 5.5MW offshore wind turbine.

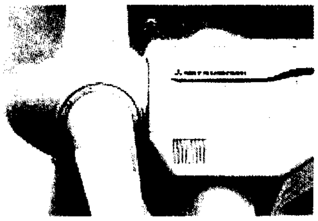
Enercon, Founded in 1984 as a dedicated wind turbine manufacturer, Enercon now has more than 20,000 turbines installed around the world. Its utility-grade models include the E-82, with rated outputs ranging from 2MW to 3MW, the 2.5MW E-115 designed for light wind conditions, and the 7.5MW E-126, one of the largest of all turbines designed for onshore use.

Gamesa, Founded in Spain, Gamesa has wind turbine production plants in Spain, the USA, China, Brazil and India, and an installed turbine capacity of more than 18GW around the world. Gamesa's wind turbine models include a range of 2MW turbines with varying tower heights, the 4.5MW G128, and a 5MW offshore version of the G128.Gamesa has now joined hands with SIEMENS, and has become world's largest Wind Power Producer

GE Energy's 1.5MW series is the world's most widely-deployed wind turbine, with more than 16,000 installed around the globe. GE also produces a range of 2.5MW models and the GE 4.1-113 4.1MW direct drive wind turbine model designed for offshore use.

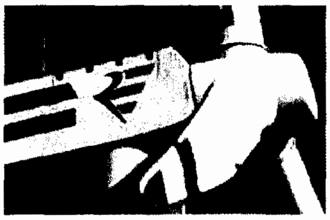


Goldwind is China's second largest wind turbine manufacturer. It also claims to be the world's leading manufacturer of permanent magnet direct drive turbines. Goldwind produces 1.5MW and 2.5MW wind turbine models.

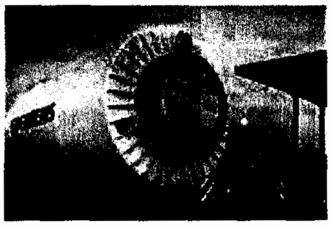


Mitsubishi has been producing wind turbines since 1984, with current models ranging from the 1.2MW MWT62 through to the 2.4MW MWT 102, designed for optimal performance in moderate wind conditions.

Nordex , German Nordex is one of the pioneers in wind turbine technology. It produced the first megawatt-size turbine, in 1995, with the N54 1MW model. Nordex now has more than 7.8GW of turbines installed worldwide. Current models include the 2.4MW N117



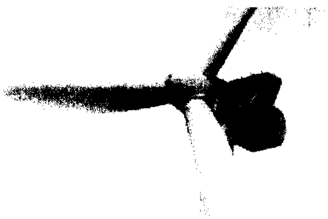
Repower, its best-selling wind turbine model is the 2MW MM92. Other models range from the 1.8MW MM100, designed for low wind conditions, through to the 6.15MW 6M offshore turbine. The 6M is currently the largest wind turbine installed in open water.



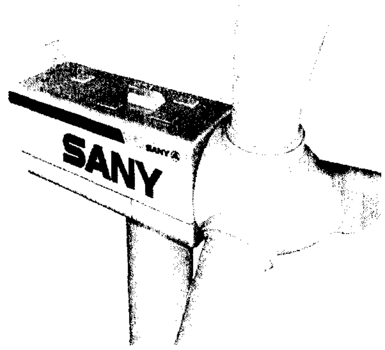
Siemens, is the market leader in offshore wind turbines. In fact, Siemens turbines have been running for more than 20 years at Vindeby, Denmark, the world's first offshore wind farm. Siemens models include the 2.3MW SWT-2.3 series, and the 3.6MW SWT-3.6. The company's largest model is the 6MW SWT-6-154, with a rotor diameter of more than 150m.

Sinovel,Chinese manufacturer Sinovel's SL3000 3MW turbines power the Shanghai Donghai Bridge wind farm, the first offshore wind farm to have been built outside Europe. Sinovel's largest model is the 6MW SL6000 series currently undergoing testing in China.

Sulzon,Headquartered in India, Suzlon Energy has more than 21.5GW of wind turbinesinstalled in 33 countries. It has production facilities in India, Portugal, Germany (through subsidiary REpower) and the USA. suzlon's turbines include the 2.1MW S95 and S97 models for low wind speed conditions.



Vestas has been in the wind business since the 1970s and there are now more than 43,000 Vestas turbines installed in 66 countries. Models include the 3MW V126, designed for low wind conditions, and the widely-used V90, available in 1.8MW and 2MW versions for onshore use, and a 3MW offshore version.



SANY

Another player in Chinese Wind Turbine Market. SANy, is China largest and No:1 manufacturer of Construction Equipment manufacturer, and has also ventured into Alternate Energy field successfully. SANY high speed doubly-fed WTG is the current choice for both onshore and offshore wind power projects. Longer blade, self-adaptive power curves, airfoil optimization, low cut-in and high cut-out guarantee machines' high productivity. Intelligent diagnosis system can automatically collect and analyze operation data and prevent the fault before it occurs. SANY high speed doubly-fed WTG offer you the optimal solution for wind farms

16. SELECTION OF EQUIPMENT SUPPLIER

Following points were considered for short listing OEM, for LOOTAH Project;

- Size of the company and its standing in world market
- Presence in Pakistan, and its reputation within existing business
- Technical ability, and exchange of Technical information.
- EPC contractor partner and O&M partner
- The Performance of the offered WTG for the Project
- Energy yield of the Turbines
- Equipment manufactured under InternaStandards
- Price of the equipment, with EPC cost
- Ability to raise debt
- O&M cost offered with limit of services and liabilities.
- Strength of local partners if any.
- Past experience of offered turbines
- Guarantees to be provided for life of project

After initial assessment three manufacturers of WTG were short listed and negotiations on plant and its technical details were exchanged.

They were China Gold Wind, Gamesa , SANY. experts were involved to carry out the technical analysis of the site and proposed plant, and comprehensive study and technical analysis was carried out on Ghina Goldwind WTG., to take a decision on viability of this site for commercial investment for a Wind Power Plant. Goldwind was chosen, for the study, as they were willing to cooperate for this project, and Chinese experts were hired for the Technical Analysis.

Later on simultaneously similar study was carried out on SANY and GAMESA as well.Technical analysis of project site with China Gold Wind WTG was carried out as detailed in 16.1.

16.1. TECHNICAL ANALYSIS OF THE PROJECT

Considering the available site for the plant a Technical Study was carried out with Technical Experts from China, to look at the technical feasibility of the project. After the study it was found that site is suitable for the project, and China Goldwind Turbine Wind Turbines from China were initially chosen for the project. However, after the Upfront Tariff had expired, and Bidding process was to be introduced with Bench Mark tariff issued, the manufacturers withdrew their original commitments and they adapted wait and see policy, to see what kind of tariff would be workable for Pakistan. Gamesa continued to show interest, and then a new entrant SANY also aggressively got involved the match the bench mark pricing.

Since VESTAS has shown their reluctance at new price levels, Loota negotiated with two other suppliers, Gamesa & Sany, to make sure we remain competitive in Bidding, and go for the best EPC offer.

The detail of the technical study which was carried out on GOLDWIND WTG is as follows;

16.1.1 Objective

This document is a preliminary review of the wind resource, grid connection, geotechnical, transportation, financial analysis of the proposed wind farm in Pakistan to study the feasibility of the project. Based on the wind resource analysis and selection of appropriate turbine type, assessment of the energy production is taken.

16.1.2 Site for Lootah Plant in relation to other plants

Figure 0-1 Location of Pakistan wind farm

The Wind Farm Project which will be developed by two adjacent parts (the "Project") is located in the south of Pakistan, about 80 km to the northeast from the city of Karachi, Area around the project is largely open, flat and featureless. Altitude is between 80 and 180m.a.s.l. (Picture source: Google Earth).

16.1.3 Measurements of wind masts

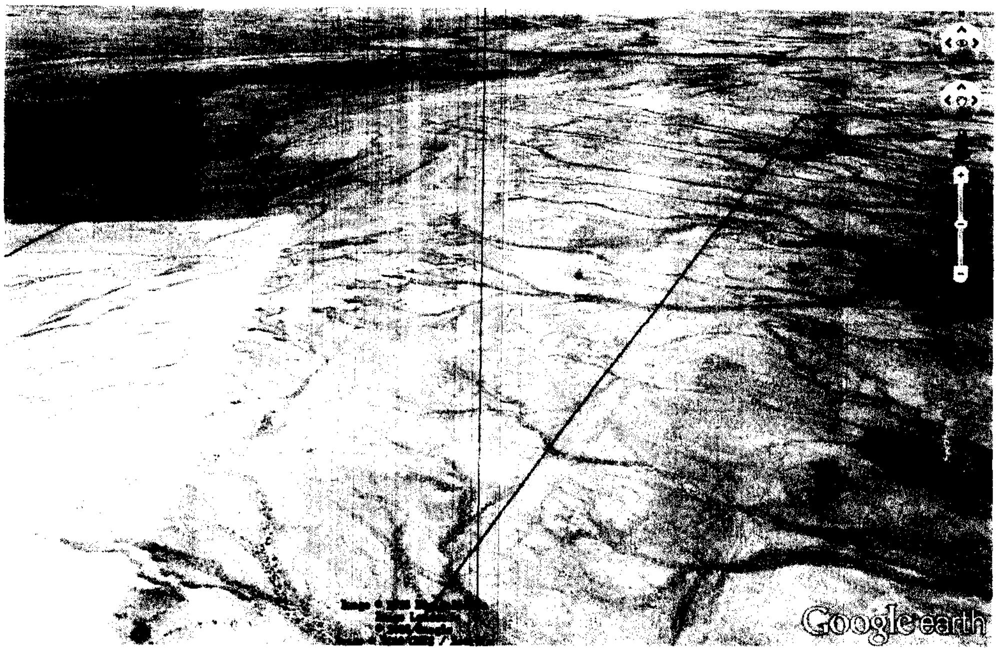
There is a Met Mast of 85m 18km east to the project. The time series of the 85m Met Mast is from 26th March 2007 to 1st April 2009. We choose one year's data of Met Mast to do wind resources assessment and 10 years' data series from MERRA for the Met Mast location is deployed for long term correction at this stage and the period analysis is the latest 30 years. After date analysis and collection, we get the result of one year data; Location and relevant information of the met masts are shown in table below.

Table 0-1 Description of met masts

Name		A
altitude		47
Location	latitude	25° 3.972'N
	longitude	67° 58.050'E
Channel	speed	10m/30m/60m/85m/85m
	direction	30m/80m
Recorded time duration	from	2007.3.26
	to	2009.4.1
Adopted	from	2007.4.1
	To	2009.3.31

The sponsors provide measured data collected from the mast starting in March. 2007 to April 2009. The 85 meter lattice meteorological mast is equipped with a suite of 5 cup anemometers at a variety of heights from 10 meters to 85 meters. The measured items are listed in the table above.

16.1.4 TOPOGRAPHIC ANALYSIS OF WIND FARM



16.1.4 Topography of Project Site

The topographic condition of the site and its vicinity laid out by Google earth is presented in figure above. We can conclude that the terrain is very flat without mountains or hills. It relatively convenient and cost is low for road construction. Additionally, the vegetation coverage is low and there is no forest and meadows because of being a desert.

16.2 WIND RESOURCE ANALYSIS

16.2.1 DATA INTEGRITY RATE

The partner supplied the data since March, 2007 from one meteorological mast with 85m height which is about 18km east to the wind farm site. The data integrity of the mast is shown as following table. In order to get one full year data, we select and analyze the data recorded from 1st, April 2007 to 1st April 2009 of A Met Mast to do the following analysis. After date inspection and exchange, /we get the result of one whole years' valid data which is listed in the table as follows.

Label	Inspection period	ideal records	observed records	errors	effective records	integrity rate
A 1	**1st,April 2007 to 1st April 2009**	105264	5851	0	99413	94.44%

16.2.2 MEAN AIR DENSITY IN MEASURED YEAR

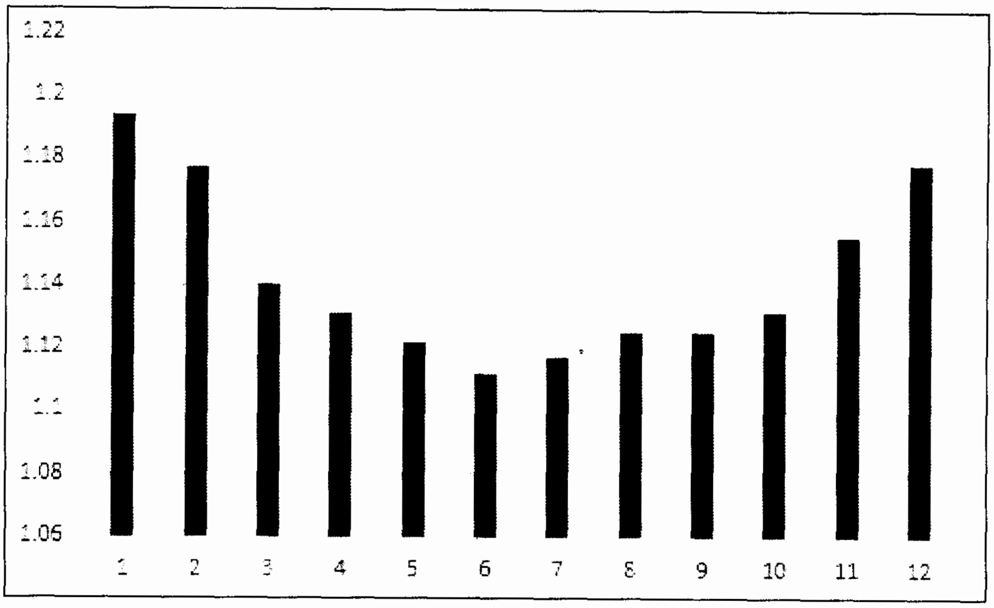
The air density directly affects the energy production, the greater the density, the greater the power output of a wind turbine for the same wind speed distribution. The estimated air density was calculated from the following equation.

$$\rho = \frac{\mathrm{P}}{\mathrm{RT}}$$

T is the monthly temperature with the unit°C, and P is the average pressure of the site. R is specific gas constant. The items and annual air density are shown in the table below.

Table 0-2 Air density of month

Month	1	2	3	4	5	6	7	8	9	10	11	12	[illegible]
Air density	1.194	1.177	1.140	1.132	1.122	1.112	1.118	1.125	1.125	1.132	1.156	1.179	1.



The History Of Air Density

As the figure and table show, the variety of monthly air density is significant. The highest value occurs in winter as the temperature is very low and the lowest one occurs in summer.

16.2.3 WIND SPEED AND WIND FREQUENCY DISTRIBUTION

The table below presents the average wind speed of met mast in measured years.

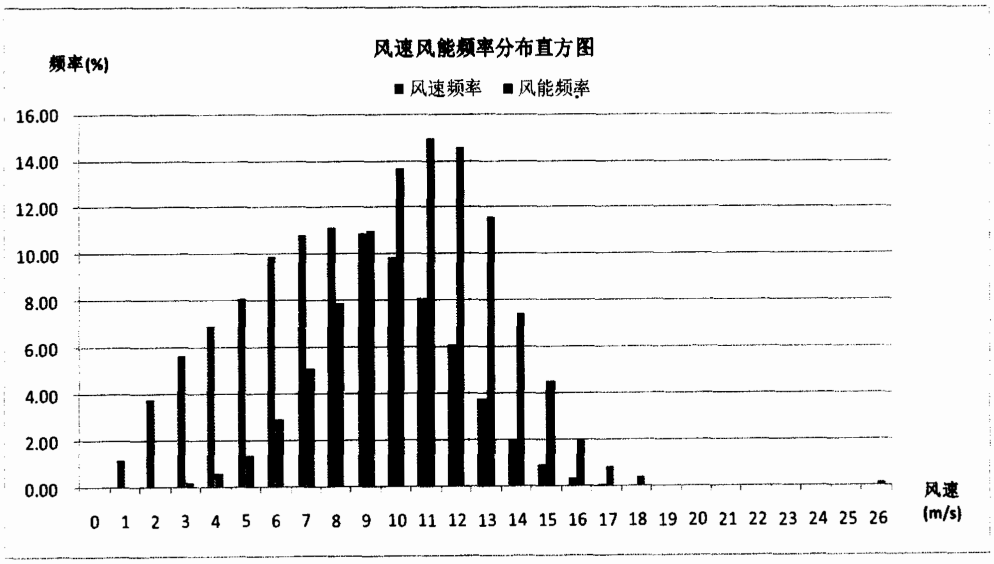
Table 0-3 Mean wind speed of mast A

Label	Period	height	1	2	3	4	5	6	7	8	9	10	11	12	Annual average
A	2007.04.01 ~ 2009.3.31	85m a	7.59	5.51	6.59	7.55	10.63	9.12	9.51	9.16	8.10	6.61	6.40	7.29	7.87
		85m b	7.57	5.50	6.58	7.57	10.67	9.13	9.53	9.19	8.11	6.59	6.38	7.27	7.87
		60m	7.0	5.2	6.2	7.2	10.2	8.8	9.2	8.8	7.7	6.2	5.9	6.7	7.5

Label	Period	height	1	2	3	4	5	6	7	8	9	10	11	12	Annual average
			7	3	3	1	9	7	4	7	6	0	5	8	0
		30m	5.94	4.55	5.49	6.53	9.57	8.28	8.64	8.27	7.06	5.34	4.92	5.66	6.71
		10m	4.78	3.58	4.56	5.61	8.50	7.38	7.70	7.33	6.10	4.21	3.69	4.49	5.67

As it is shown in Figure above, the wind speed is very good and the wind speed is 7.6m/s at 85m, 7.1m/s at 60m, 5.9m/s at 30m, 4.8m/s at 10m.

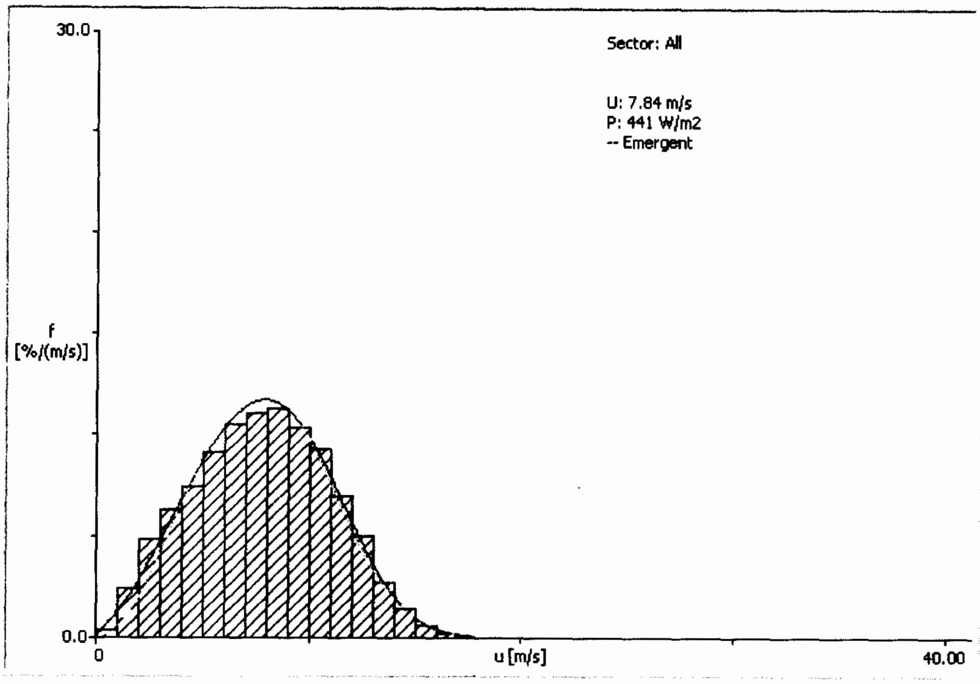
The frequency of the wind speed and wind energy is shown in the following figure.



16.2.3 WIND ENERGY AND FREQUENCY OF MAST A

As shown above, the most wind frequency happened in the range from 3.0 to 12.0m/s which are about 87% of the total. The most wind energy happened in the range from 7.0 to 15.0m/s which is about 91%。 At the same time, values higher than 25m/s happened occasionally.

The weibull distribution is shown as following figure, of which A=8.9, K=2.84.



Weibull Distribution At *5 meters

16.2.4 PREVAILING WIND DIRECTION & ENERGY ROSE

The frequency of wind direction and wind energy of mast A at 85m is shown as follows

Table- The frequency of wind direction and wind energy of mast A at 85m

direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S
speed (%)	0.76	5.96	13.76	5.91	2.08	1.04	0.88	1.50	1.49
energy (%)	0.48	6.71	14.50	2.37	0.50	0.20	0.13	0.25	0.21

direction	SSW	SW	WSW	W	WNW	NW	NNW	C	合计
speed（%）	1.76	5.21	26.74	20.64	6.12	4.22	1.93	0.00	100.00
energy（%）	0.38	2.65	36.72	28.33	3.23	2.49	0.87	0.00	100.00

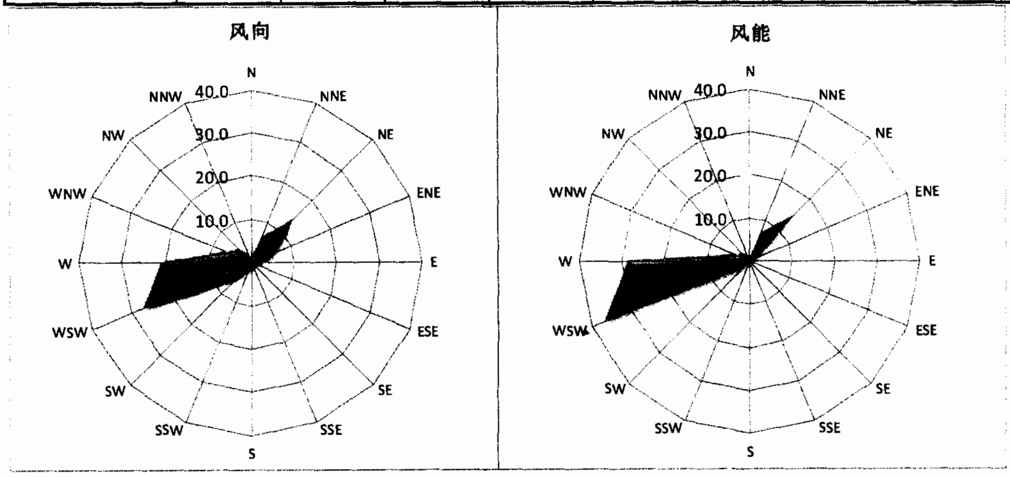


Fig: The wind rose of the wind farm's representative year about wind direction and wind power at 85m

We can conclude that the prevailing wind speed and wind energy direction is WSW which is so concentrated and stable that it is benefit to do the layout of WTGS.

The monthly frequency of wind direction and wind energy of monthly is shown as follows.

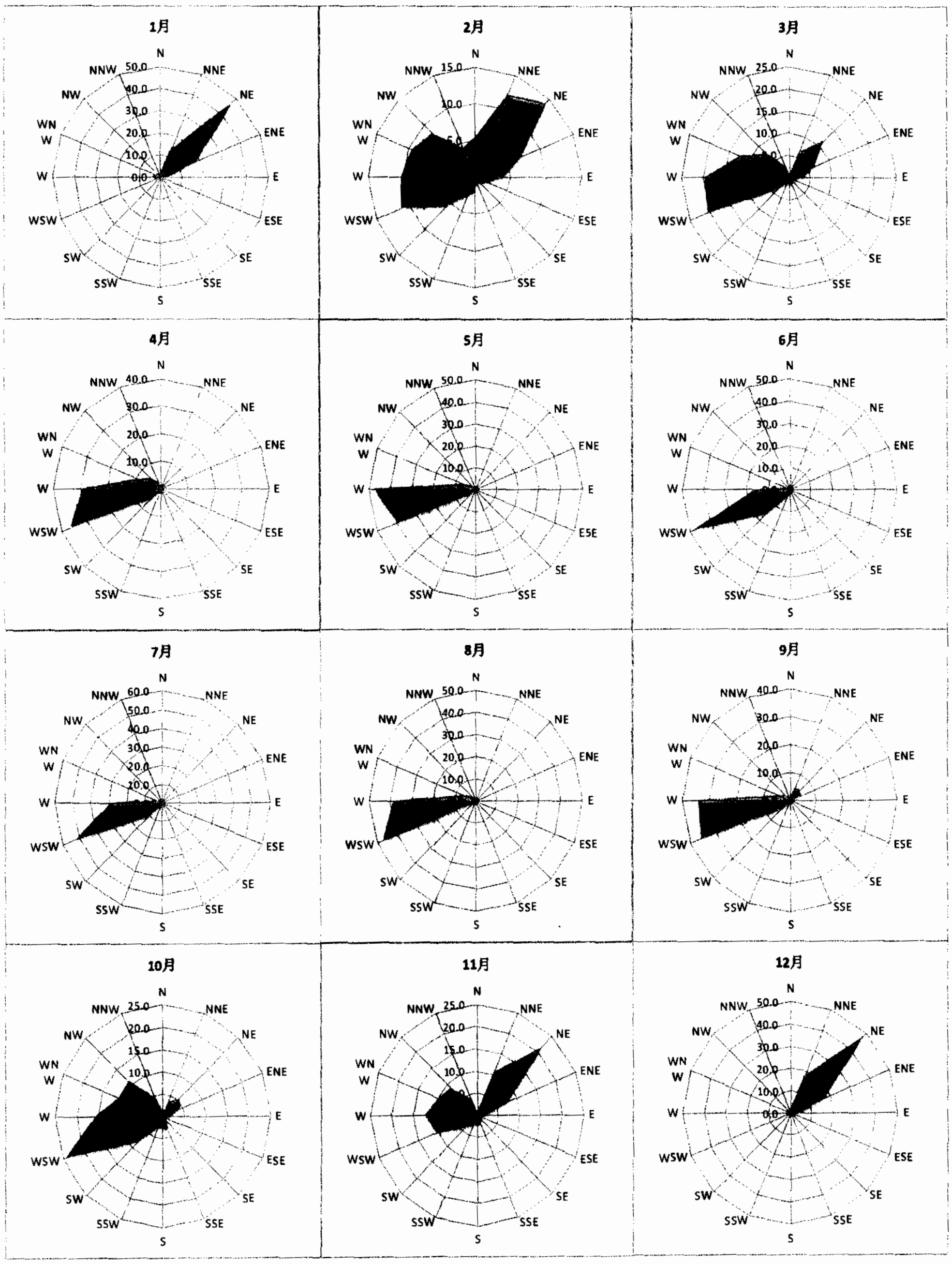


FIG: WIND DIRECTION ROSE AT 85 METERS

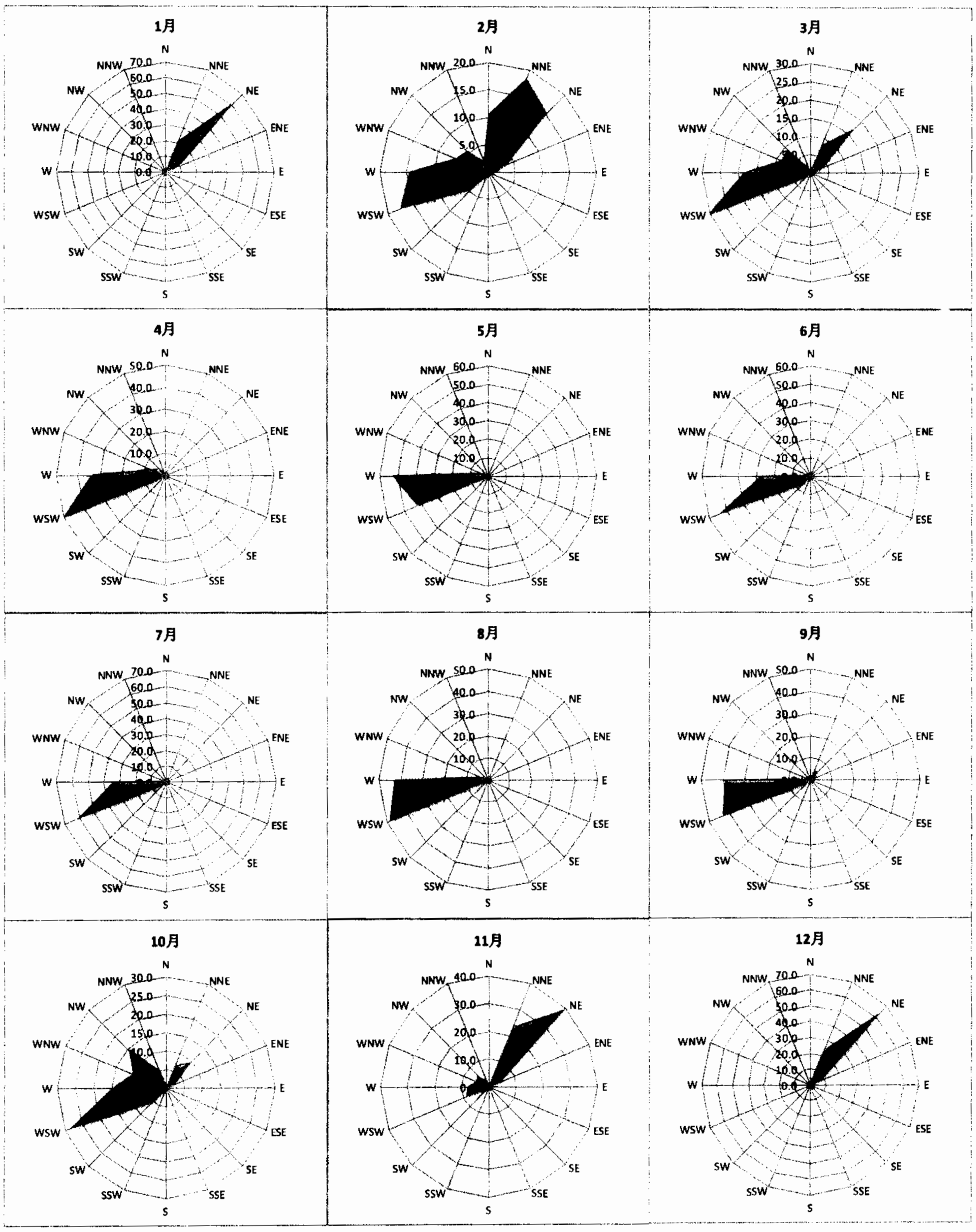


FIG : WIND ENERGY ROSE AT 85 METERS

As shown above, prevailing speed and energy direction is WSW , which is about 36.72% and 26.74% respectively

16.2.5 WIND SHEAR

The wind shears between different heights based on selected data are shown below.

Table 0-4 Wind shear exponents of Mast A

R	10m	30m	60m	85m
10m	-	0.1523	0.1565	0.1533
30m	-	-	0.1631	0.1544
60m	-	-	-	0.1373
85m	-	-	-	-

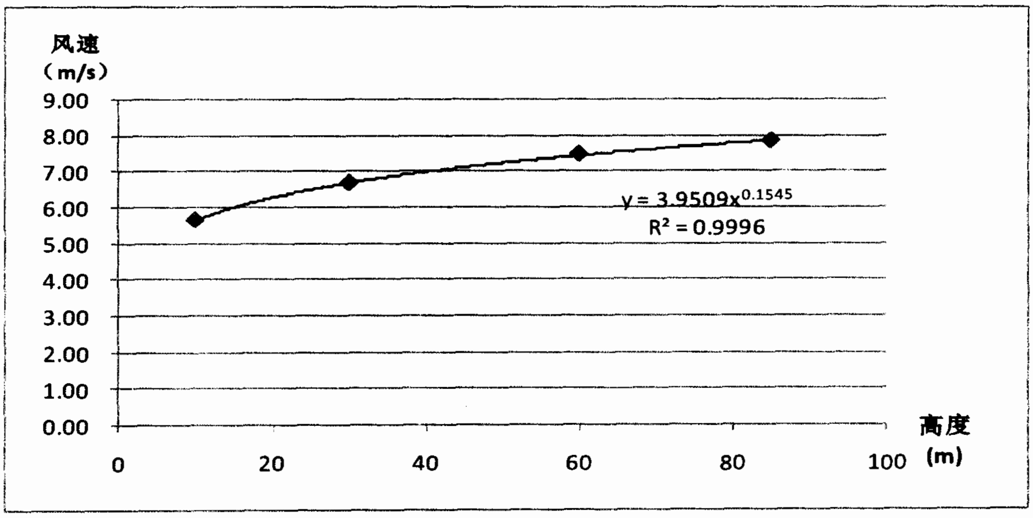


FIG: WIND VERTICAL PROFILE

16.2.6 TURBULENCE INTENSITY ANALYSIS

The mean turbulence intensity at 15 m/s wind speed interval calculated by selected data is shown in the table below, and turbulence intensity comparing to IEC standard is shown in figure below

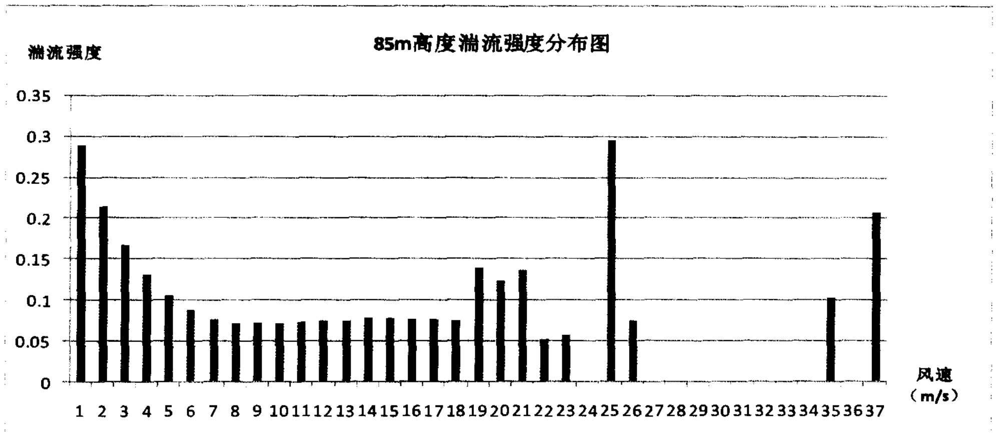
Table Mean turbulence intensity at 15m/s wind speed interval

hight	10m	30m	60m	85m

Mean TI	0.1430	0.1164	0.0897	0.0815
TI (V＝15±0.5m/s)	0.1252	0.0956	0.0848	0.0774

Local turbulence intensity at 15m/s wind interval of Mast A is shown as above, it can clearly be seen that the average turbulence intensity at 15m/s of the masts site is low.

Fig: Turbulence Intensity at 85m height of Mast A (Mean+1.28*SD)



We can see from the figure and table above that the classification belongs to IEC C which is very low and the TI is a little bigger at low speed bins (< cut in wind speed)and high speed bins (>cut out wind speed).

16.2.7 CONCLUSION

(1)Wind speed and wind power density

The terrain of the wind farm is flat with a.s.l 80-180m.the year's mean wind speed of mast A is about**7.87m/s** and the wind power density is **417W/m2** which is at a high level. It is suitable to build a wind farm factory.

(2)Effective hours

As shown above, the most wind frequency happened in the range from 3.0 to 12.0m/s (effective hours) which is about **87%** of the total. The most wind energy happened in the range from 7.0 to 15.0m/s which is about **91%**。 At the same time ,values higher than 25m/s happened occasionally.

(3)Prevailing wind speed and energy direction

We can conclude that the prevailing wind speed and wind energy direction is **WSW** which is so concentrated and stable that it is benefit to do the layout of WTGS.

We get annual wind speed at different hub heights by wind shear above based on the observed data.

16.3 WIND TURBINE LAYOUT AND ENERGY PRODUCTION ANALYSIS BASED ON GOLDWIND TURBINE

16.3.1 SELECTION OF WTG TYPE

The selection of WTG type is affected by so many factors, such as natural environment, transportation, terrain characteristics and so on. In this report factors to be considered are listed as follows:

16.3.1.1 Temperature

According to the data the meteorological station Karachi collected from 1971 to 2010 nearly 40 years of monthly average temperature values, in Karachi meteorological stations, annual average temperatures is 26.5 °C;Extreme maximum temperature is 47 °C;Extreme minimum temperature of 1.3 °C. According to the measured data statistics from A wind tower , time of the temperature over 40 °C is 7150 min, the proportion is 1.36%; time of the temperature over 30 °C is 194620 min, the proportion is 37.0%.According to the measured data statistics from C wind tower, time of the temperature over 40 °C is 6960 min, the proportion is 1.32%;Time of the temperature over 30 °C is 194130 min , the proportion of 36.9%.

Learned from above analysis, the regional wind farm is in a subtropical climate. Diu to high temperature will badly threaten to turbine, we should choose type high temperature wind turbines to satisfy the requirements of the environment temperature.

16.3.1.2 Wind energy resources

Because this area have no data of the wind speed sequence for a long time, the extreme wind conditions of wind farm in 50 years can only be determined by the measured wind speed of wind tower. According to the two methods to calculate the maximum wind speed of the wind farm less than 37.5 m/s, we temporarily use turbine which safety standards is over IEC class III. For each height of the wind tower in wind speed 15 m/s bin the turbulent intensity is between 0.084 ~ 0.102, which is very low. According to the standards of the association of international electrician IEC61400-1 (2005) ,we should choose the turbines over safety standards IEC IIIC class.

16.3.1.3 Comparing of the wind turbine manufacturers

As a result, we select 4 WTG types to calculate the AEP the 4 types are: WTG1-GW108/2.0MW,WTG2-GW121/2.5MW,WTG3-XE105/2.0MW,and WTG4-XE122/2.5xMW, the AEP results are listed as follows

TABLE: PLANS OF WTG SELECTION

Items	Unit	Plan1	Plan2	Plan3	Plan4
		WTG1 GW108/2000	WTG2 GW121/2500	WTG3 XE105/2000	WTG4 XE122/2500
Capacity	MW	200	200	200	200
Power	kW	2000	2500	2000	2500
NO.of WTG	/	100	80	100	80
Diameter	m	108	121	105	122
Hub height	m	80	90	80	90
Production	10MkW·h	61025.3	65640	58421.4	65188.5
Full load hours	H	3051.2	3282	2921.1	3259.4
Priority		3	1	4	2

As the table above show, the full load hours vary from 2921 to 3282 and the highest is plan2 which is also the recommended one.

16.3.1.4 PARAMETERS OF RECOMMENDED WTG

The main parameter of the WTG which was recommend then is shown in table below. The air density at the site is about 1.145kg/m3 and the power and ct curve in that air density is listeTd in table below;

PARAMETERS OF GW/121/2500

Type	WTG2
1. Performance	

Type	WTG2
Power rating（kW)	2500
Pitch	Pitch regulation
Diameter（m)	121.5
Hub height(m)	90
Cut in （m/s)	3
Rated wind speed（m/s)	9.3
Cut out(m/s)	22
Extreme wind speed(m/s)	52.5
Working temperature(°C)	-30°C～+40°C
2. Weight of cabin and tower	
Cabin(t)	84.4
Blade(t)	43.5
Hub(t)	28.57
Tower(t)	278.9

Table: Power and Ct curve of GW121/2500(1.145kg/m3)

Speed	power	Ct
3	60	1.06788
3.5	117	0.94743
4	188	0.85499
4.5	275	0.79692
5	378	0.79698
5.5	505	0.79691
6	656	0.79695
6.5	835	0.797
7	1042	0.79698
7.5	1277	0.79703
8	1542	0.797
8.5	1834	0.79068

9	2133	0.75041
9.5	2475	0.71223
10	2500	0.54578
10.5	2500	0.44914
11	2500	0.37928
11.5	2500	0.32551
12	2500	0.28251
12.5	2500	0.24759
13	2500	0.21862
13.5	2500	0.19433
14	2500	0.17378
14.5	2500	0.15621
15	2500	0.1411
15.5	2500	0.12808
16	2500	0.11665
16.5	2500	0.10664
17	2500	0.09781
17.5	2500	0.09001
18	2500	0.0831
18.5	2500	0.07692
19	2500	0.07138
19.5	2500	0.0664
20	2500	0.06192
20.5	2500	0.05786
21	2500	0.05418
21.5	2500	0.05083
22	2500	0.04778

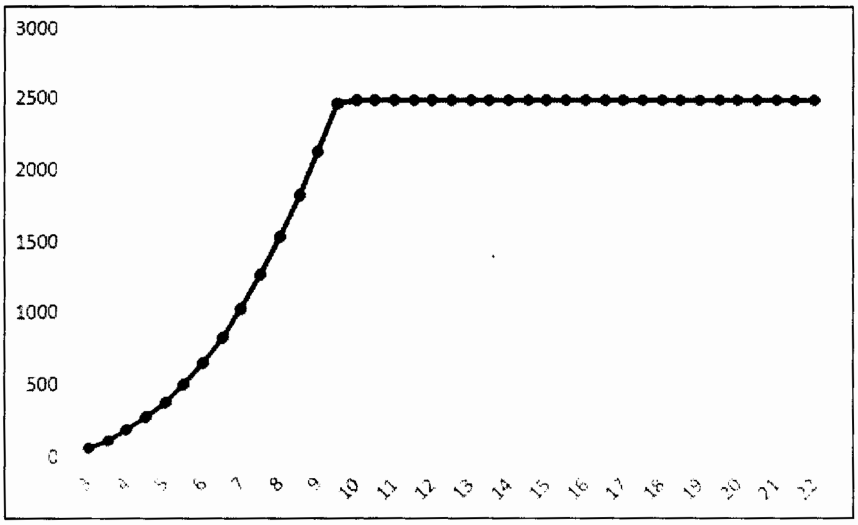


Fig: POWER CURVE (1.145Kg/m3)

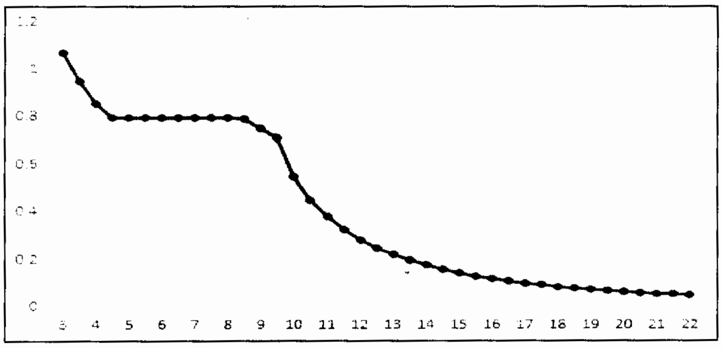


Fig: CT CURVE (1.145Kg/m3)

16.4 LAYOUT OF WTG & PRODUCTION ESTIMATION

16.4.1 RULES OF THE LAYOUT OF WTG

The layout of wind turbines should be mainly based on the characteristics of wind energy resources in the wind farm and the geological conditions. The layout principles are listed as follows:

(1)Firstly the environment condition of the wind farm area should be considered, and the wind turbine layout to be made within the sphere permitted by the authorization;

(2) According to the characteristic of wind resources distribution in the area, the prevailing wind direction of wind farms and the interval distance should be considered when arranging turbines;

(3) When we arrange the turbines, the wake effect of wind turbines should be reduced as more as possible, at the same time, the distance of each turbine should be controlled reasonably to reduce the investment;

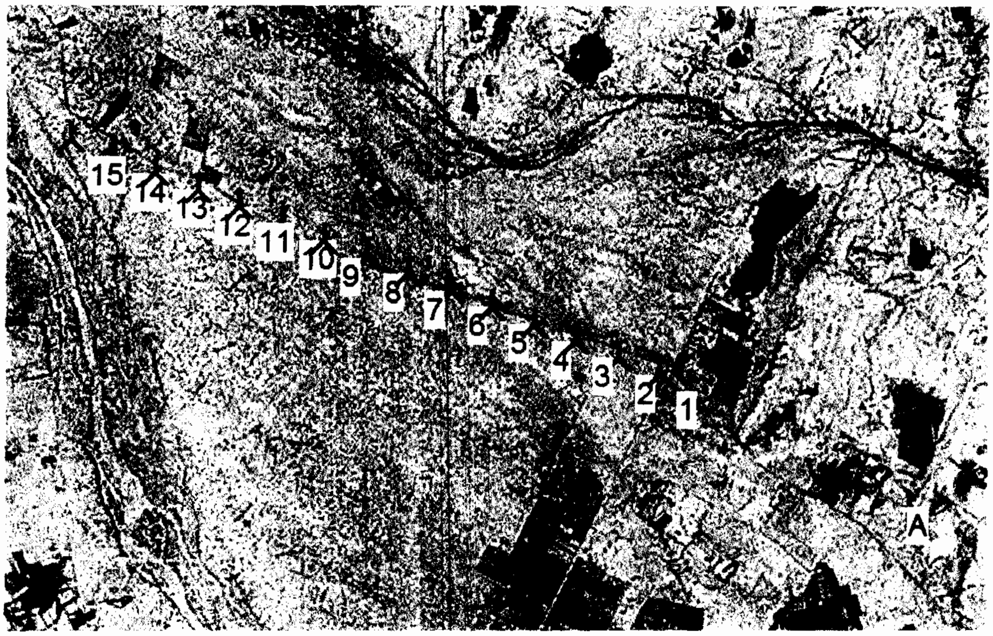
(4) By comparing different layouts, our goal is the maximization of the production.

17. MICRO SITTING ANALYSIS OF THE SITE BY LOOTAH

The wind direction of the wind farm in Pakistan is concentrated and stable. Wind speed from southwest (SW) direction is higher, so is the wind energy. Different location of our existing site were used to plan a Micrositting which will yield best Energy yield, have minimum losses, and at the same time utilize minimum land, as further units are planned on our proposed site.

Three different exercises on three different locations of Micro sitting the WTG were carried out, as per pictures below, and ultimately the best option was chosen for final selection and analysis of Energy yield.

17.1.1 First option of Micrositting- with two different type of Machines, VESTAS and GAMESA



Fifteen no of Units of VESTAS were considered for this option, as first choice, and Energy yield was calculated for this site and for these machines,. The coordinates and location of this micro sitting was as follows;

WTG siting

Geo [deg,min,sec]-WGS84

Longitude Latitude Z Row data/Description[m]

1 New 67°57'37.88" East 25°03'20.06" North 50.0 -68.9°, 504.0 m

2 New 67°57'21.09" East 25°03'25.95" North 50.0

3 New 67°57'04.31" East 25°03'31.83" North 50.0

4 New 67°56'47.52" East 25°03'37.72" North 53.9

5 New 67°56'30.73" East 25°03'43.60" North 54.0

6 New 67°56'13.95" East 25°03'49.49" North 60.0

7 New 67°55'57.16" East 25°03'55.37" North 60.0

8 New 67°55'40.37" East 25°04'01.26" North 60.0

9 New 67°55'23.58" East 25°04'07.14" North 60.9

10 New 67°55'06.80" East 25°04'13.03" North 66.2

11 New 67°54'50.01" East 25°04'18.91" North 70.0

12 New 67°54'33.22" East 25°04'24.80" North 70.0

13 New 67°54'16.43" East 25°04'30.68" North 70.0

14 New 67°53'59.64" East 25°04'36.56" North 70.0

15 New 67°53'42.86" East 25°04'42.45" North 70.0

17.1.2 FIRST OPTION WITH GAMESA WTG:

Same exercise was used and same plan of Micro sitting was used for 25 turbines of Gamesa to assess the Energy yield as per following micro sitting plan

In this scheme, the coordinates of WTG location were as follows; however this scheme was not suitable for the plot, as it was basically wasting 5000 acres of Lootah land, and disconnecting it from main road, and also utilizing land which was prime for other purpose. Lootah had segregated 2000 acres for Power plant, as such new micro sitting scheme had to be worked out.

WTGs Location Coordinates of 50MW Lootah Power (Pvt.) Ltd – Phase 1

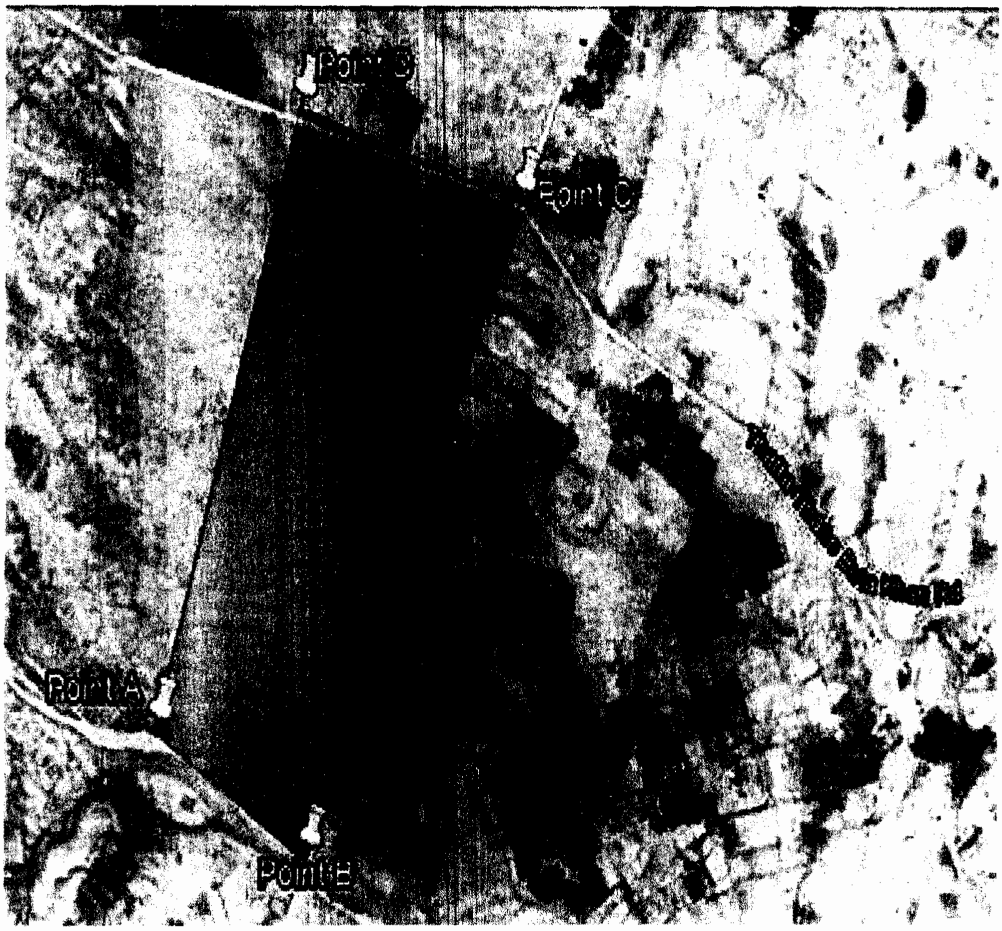
S.No	Latitude	Longitude
1	25°03'20.56"N	67°57'37.85"E
2	25°03'23.51"N	67°57'27.65"E
3	25°03'26.44"N	67°57'17.41"E
4	25°03'29.39"N	67°57'07.21"E
5	25°03'32.32"N	67°56'57.00"E
6	25°03'35.27"N	67°56'46.77"E
7	25°03'38.20"N	67°56'36.55"E
8	25°03'41.17"N	67°56'26.32"E
9	25°03'44.08"N	67°56'16.14"E
10	25°03'47.02"N	67°56'05.93"E
11	25°03'49.96"N	67°55'55.71"E
12	25°03'52.90"N	67°55'45.50"E
13	25°03'55.84"N	67°55'35.29"E
14	25°03'58.78"N	67°55'25.07"E
15	25°04'01.71"N	67°55'14.86"E
16	25° 04'06.45"N	67°55'05.49"E
17	25°04'11.03"N	67°54'55.99"E
18	25°04'15.57"N	67°54'46.49"E
19	25°04'20.09"N	67°54'36.99"E
20	25°04'24.09"N	67°54'27.20"E
21	25°04'27.34"N	67°54'17.06"E
22	25°04'31.09"N	67°54'07.29"E
23	25°04'35.84"N	67°53'57.90"E
24	25°04'40.58"N	67°53'48.54"E
25	25°04'45.34"N	67°53'39.17"E

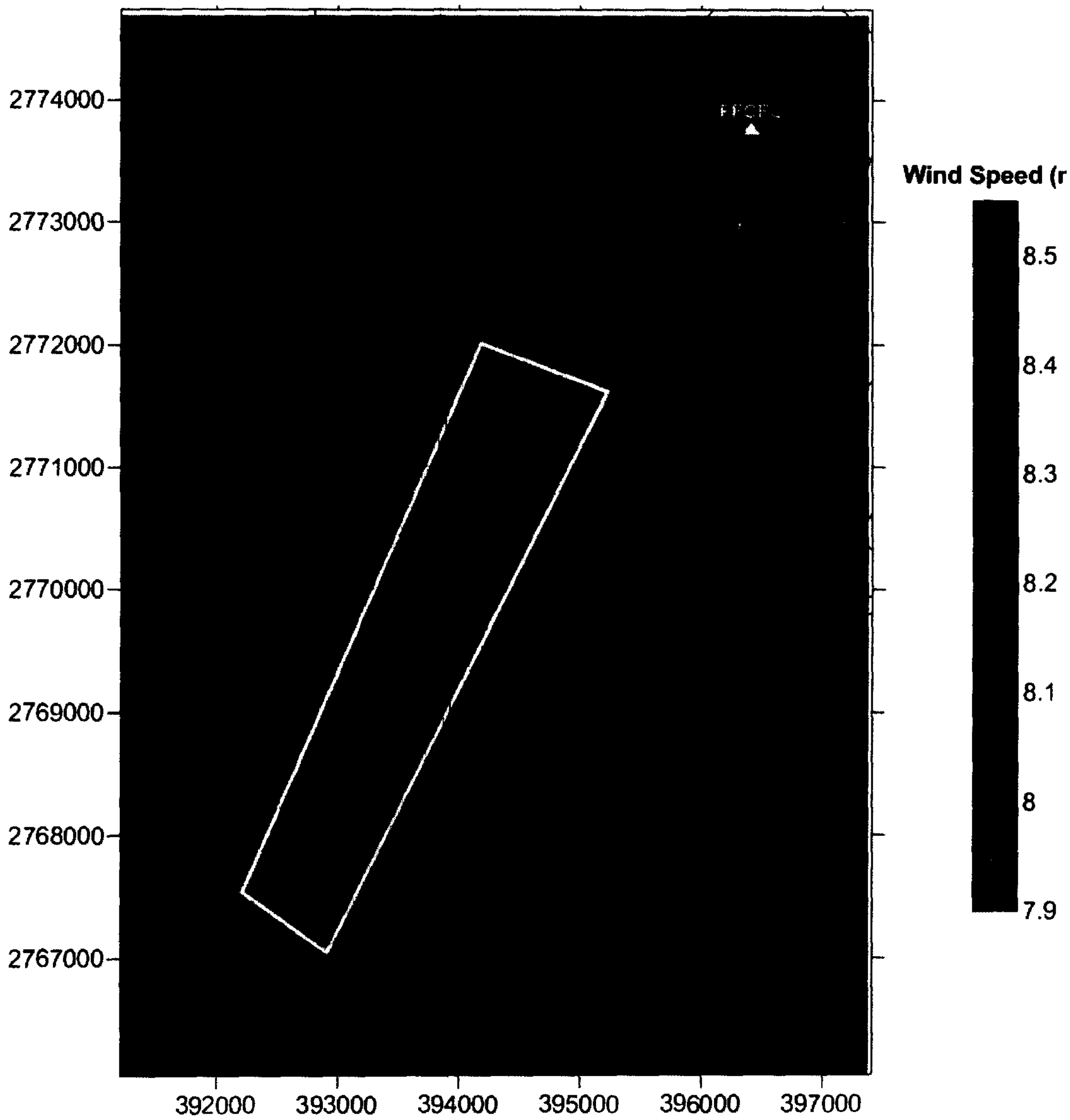
17.1.3 Second Option

After computer simulation by the manufacturers and experts, another sites were then selected to study and select best site .

The Eastern side of the Plot was selected to carry out the investigation, and plotting for a 100MW wind farm, (including second phase) was carried out, the plot carved out and the micro sitting of the WTG was done, as per pictures below;

The Eastern Part of LOOTAH Plot In Jhimpir




Wind Speed (r
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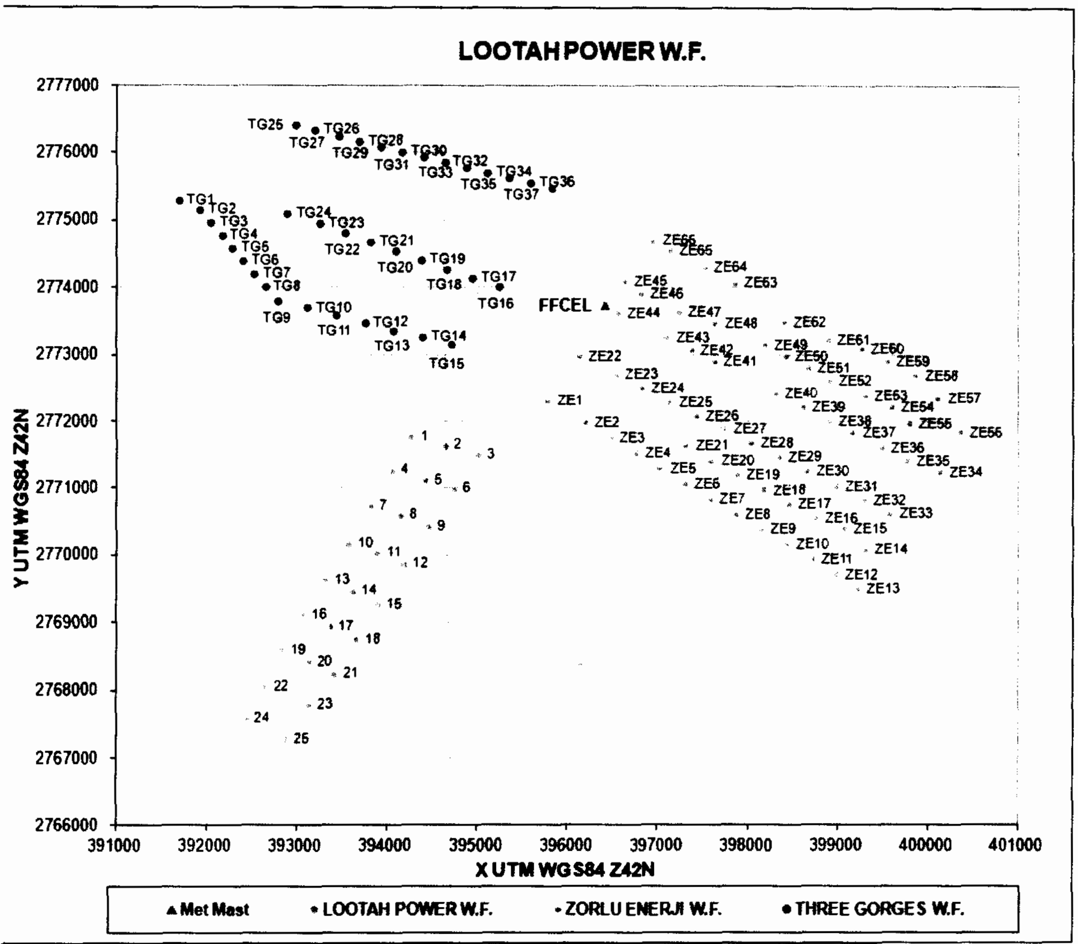
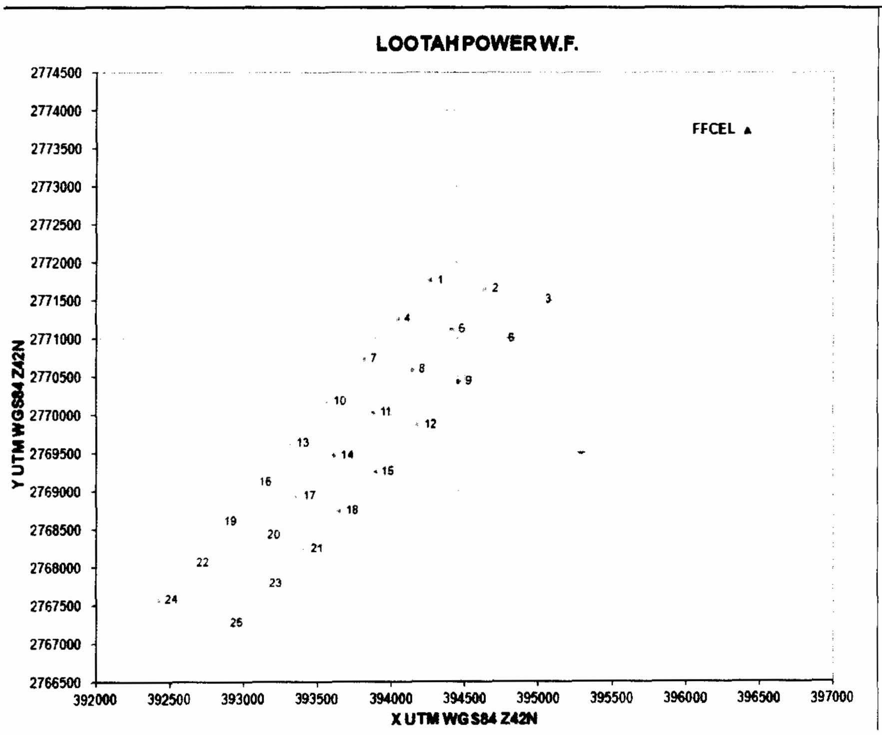

LOOTAH POWER W.F.
Y UTM WGS84 Z42N
X UTM WGS84 Z42N
FFCEL
Met Mast
LOOTAH POWER W.F.
ZORLU ENERJI W.F.
THREE GORGES W.F.


LOOTAH POWER W.F.
Y UTM WGS84 Z42N
X UTM WGS84 Z42N
FFCEL

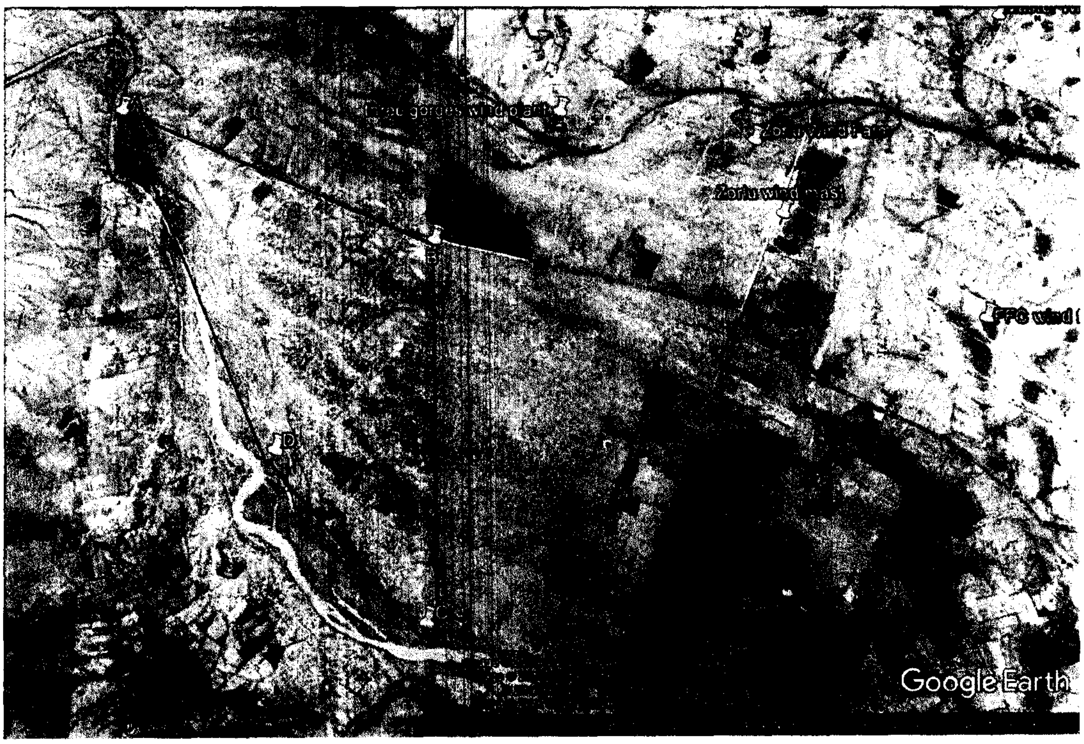
WTGs Location Coordinates of 50MW Lootah Power (Pvt.) Ltd – Phase 1		
S.No	**Latitude**	**Longitude**
1	25°03'20.56"N	67°57'37.85"E
2	25°03'23.51"N	67°57'27.65"E
3	25°03'26.44"N	67°57'17.41"E
4	25°03'29.39"N	67°57'07.21"E
5	25°03'32.32"N	67°56'57.00"E
6	25°03'35.27"N	67°56'46.77"E
7	25°03'38.20"N	67°56'36.55"E
8	25°03'41.17"N	67°56'26.32"E
9	25°03'44.08"N	67°56'16.14"E
10	25°03'47.02"N	67°56'05.93"E
11	25°03'49.96"N	67°55'55.71"E
12	25°03'52.90"N	67°55'45.50"E
13	25°03'55.84"N	67°55'35.29"E
14	25°03'58.78"N	67°55'25.07"E
15	25°04'01.71"N	67°55'14.86"E
16	25° 04'06.45"N	67°55'05.49"E
17	25°04'11.03"N	67°54'55.99"E
18	25°04'15.57"N	67°54'46.49"E
19	25°04'20.09"N	67°54'36.99"E
20	25°04'24.09"N	67°54'27.20"E
21	25°04'27.34"N	67°54'17.06"E
22	25°04'31.09"N	67°54'07.29"E
23	25°04'35.84"N	67°53'57.90"E
24	25°04'40.58"N	67°53'48.54"E
25	25°04'45.34"N	67°53'39.17"E

17.1.4 The Third and Final Location Option

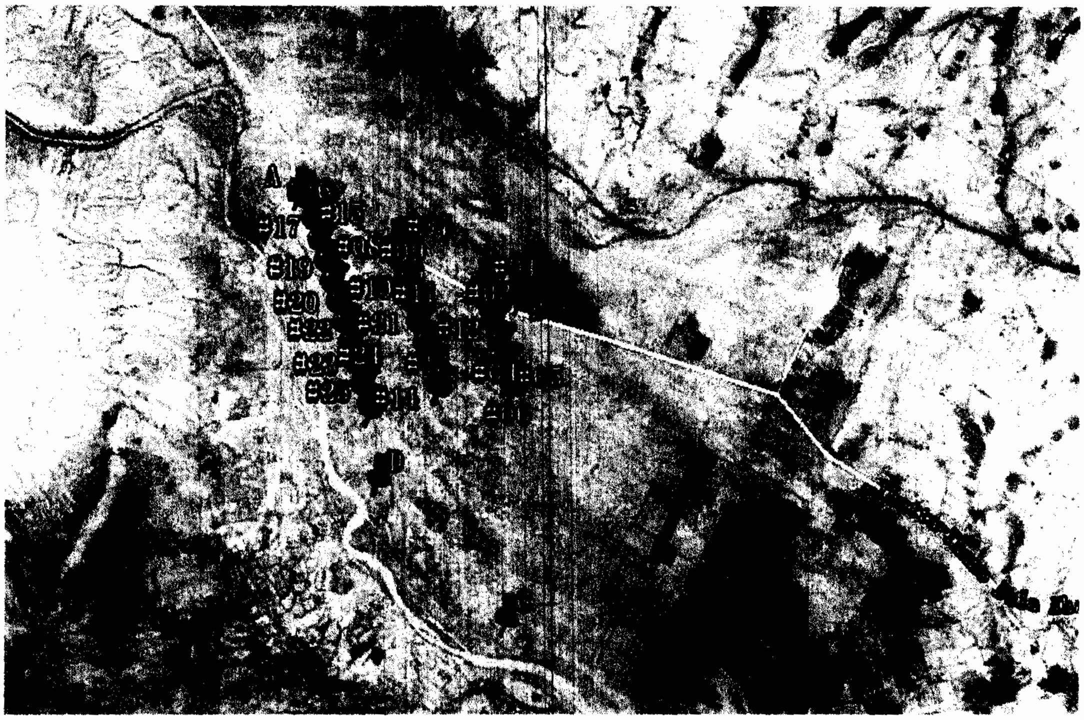
Finally the third location which was on the western side of the Loota Plot was simulated for micro sitting, and found to be the best option, as it used minimum space, had less wake losses, and best energy yield. Subsequently that part of Lootah plot was carved and allocated to Wind Farm, and its usage for Wind Power was requested from Board of revenue. A 2000 acres is being allocated for 2x50MW wind farm and other possible solar projects, which are planned for future.

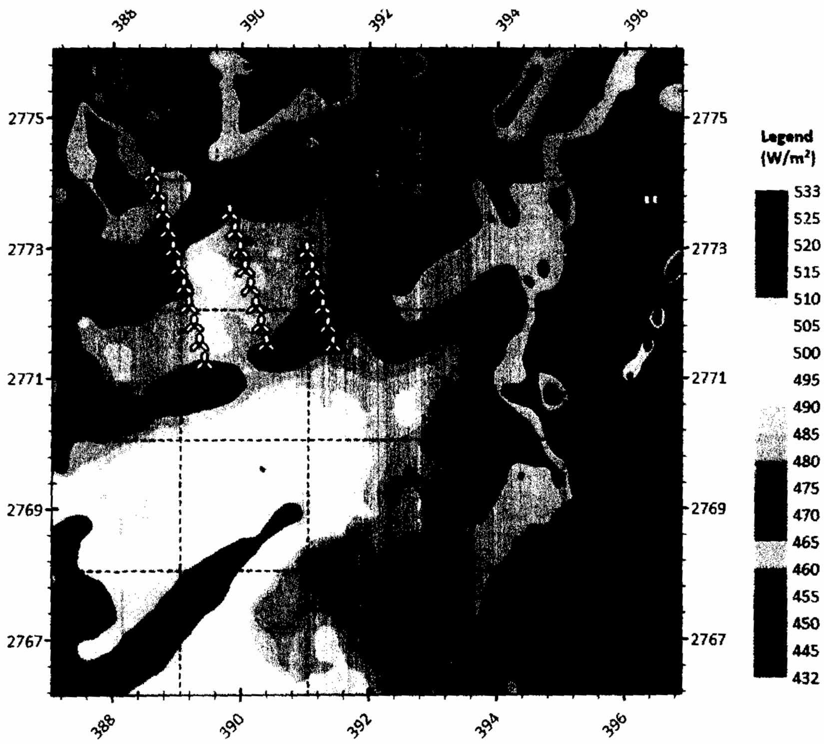
The allocation of land is as per pictures below;

The Allocated Land for LOOTAH Wind Farm



Micro Sitting Of First Phase Of Lootah Wind Farm





COORDINATES OF 25 Units of 2.0 MW WTG

Position Coordinates
25° 04' 06.5979" N, 67° 55' 10.3636" E
25° 03' 57.2578" N, 67° 55' 13.4078" E
25° 03' 47.8848" N, 67° 55' 16.4165" E
25° 03' 38.5447" N, 67° 55' 19.4605" E
25° 03' 29.2045" N, 67° 55' 22.5044" E
25° 03' 19.8317" N, 67° 55' 25.5483" E
25° 04' 25.4605" N, 67° 54' 27.0457" E
25° 04' 16.0879" N, 67° 54' 30.0556" E
25° 04' 06.7480" N, 67° 54' 33.1007" E
25° 03' 57.3756" N, 67° 54' 36.1460" E
25° 03' 48.0354" N, 67° 54' 39.1552" E
25° 03' 38.6955" N, 67° 54' 42.2000" E
25° 03' 29.3230" N, 67° 54' 45.2449" E
25° 03' 19.9830" N, 67° 54' 48.2894" E
25° 04' 44.2866" N, 67° 53' 43.6888" E
25° 04' 34.9471" N, 67° 53' 46.7351" E
25° 04' 25.5750" N, 67° 53' 49.7816" E
25° 04' 16.2351" N, 67° 53' 52.7920" E
25° 04' 06.8955" N, 67° 53' 55.8379" E
25° 03' 57.5233" N, 67° 53' 58.8840" E
25° 03' 48.1837" N, 67° 54' 01.9297" E
25° 03' 38.8112" N, 67° 54' 04.9398" E
25° 03' 29.4715" N, 67° 54' 07.9852" E
25° 03' 20.1317" N, 67° 54' 11.0305" E
25° 03' 10.7592" N, 67° 54' 14.0402" E

18. FINAL SELECTION OF WTG AND MANUFACTURER

a. THE WTG SUPPLIER

After comparing the short listed OEM of WTG, i.e. Siemens Gamesa,VESTAS, China Goldwind, Sany, we selected Siemens Gamesa as the supplier of WTG for our first phase 50MW Wind Power Plant.

The criteria of choosing the OEM and EPC was based on the requirement as defined earlier, as we find Siemens Gamesa, fulfilling most of the selected requirement. They now have become the largest producer of WTG after merger ,their Technical ability, in production Installation, Operation, and maintenance is better than most of the suppliers, and specially the among the short listed suppliers.

They have the flexibility to supply electrical equipment of European source, manufactured in China, which matches the NTDC standards. Their track record of WTG operation is excellent, and the machine being offered, fulfills the requirement ,technically and with installation history. They have offered WTG model G114-2.0 MW and an alternate choice of 2.1 MW WTG as well , which could substantially improve the capacity.

Their O&M contract basically takes total responsibility of operation and maintenance, which is very important, as we in Pakistan do not have any expertise in these machines.

The Energy Yield Study is attached as annexture. However before we apply for Generation Licence and for Tariff approval, the required data will not be shared, as the current proposal for Tariff is based on Cost Plus basis, and even if it is based on Bidding against Bench mark Pricing, we would like to keep the Energy Yield and Capacity, confidential at this stage. Once Generation License is issued and tariff approved the required data will be shared with Sindh Energy Board.

18.1 Basic Specifications of Selected Machine:

The scope is the installation of 25 G114-2.0MW IIA/IIIA wind turbines at 93m hub height or 25 positions G114-2.1MW IIIA wind turbines at 93m hub height in the wind farm area. GAMESA I&T will propose wind turbine positions according to the terrain, wind conditions, boundaries and design restrictions defined by the customer. Lootah has selected Type-3 Gamesa WTGs which they are considering to install on their Wind Farm at Jhimpir. It is a Doubly Fed Induction Generator. Each WTG would step up from its terminal LV voltage of 0.7 kV to a medium voltage (MV) that will be 22 kV. The specifications of electrical data of Turbine is provided here which is critical, for a Wind Power Plant and is also necessary for Load study for Grid Connection.

18.2. Manufacturer & Type of WTG Details

- Gamesa Model G114-2.0
- Type II/IIIA **No: of WTG** **25**

18.2.1.Rotor		
(i).	Number of blades	3
(ii).	Rotor diameter	114 m
(iii).	Swept area	10207 m^2
(iv).	Power regulation	Combination of blade pitches angle adjustment, and generator/converter torque control.
(v).	Cut-in wind speed	3 m/s
(vi).	Rated wind speed	13.07 m/s
(vii)	Cut-out wind speed	25 m/s
(viii)	Survival wind speed	59.5 m/s (Maximum 3 sec)
(ix	Pitch regulation	Pitch Control Hydraulic System consisting of Independent Hydraulic Actuators for each blade
18.2.2 Gearbox		
(i).	Type	3 combined stages: 1 stage planetary, 2 parallel shift gears
(ii).	Gear ratio	1:128.5
(iii).	Main shaft	Cast Shaft
18.2.3 Blades		
(i).	Blade length	56 m
(ii).	Material	Composite material reinforced with fiberglass through resin infusion technology.
18.2.4 Generator		
	Nominal Power	2040 (kVA)
(ii).	Voltage	690 V
(iii).	Type	Double-Fed Induction Generator with a Coil Rotor and Slip Rings
(iv).	Degree of Protection	IP54 Turbine-IP21 Ring Body
(v).	Coupling	Main Shaft: Cone Collar High Speed Shaft: Flexible Coupling
(vi).	Power factor	0.95 Inductive – 0.95 Capacitive
18.2.5 Control System		
(i).	Type	PLC based Control System

(ii).	Scope of monitoring	Remote monitoring of different parameters, e.g. temperature sensors, pitch parameters, speed, generator torque, wind speed and direction, etc.
1 7 (iii).	Recording	Production data, event list, long and short-term trends
.**18.2.6 Brake**		
1 (i).	Design	Mechanical brakes
. (ii).	Operational brake	Aerodynamic brake achieved by feathering blades
3 (iii).	Secondary brake	Mechanical brakes on high speed shaft of gearbox
18.2.7 Tower		
W (i).	Type	Conical barrel tube
i (ii).	Hub height	80
n **18.2.8 Yaw System** d		
(i).	Yaw bearing	PETP
G (ii). e	Brake	Active Yaw
(iii). n	Yaw drive	Motor Drive
e (iv).	Speed	0.42/s controlling speed
r **a. Other Details** a		
(i).	Project Commissioning Date (Anticipated)	2018-2019

18.3 ELECTRICAL DATA

18.3.1. Voltage,GrossCapacity[MVA,MW],Power Factor(Lagging/Leading)

- Voltage 690V
- Gross Capacity 2.0MW
- Power Factor 0.95 Inductive, 0.95 Capacitive

i. No. Of Collector Groups

- Collector Group 04

ii. WTG Connection In Each Group:

- 03 collector groups of 06 WTG each
- 01 Collector Group of 07 WTG

iii. Length of Each Collector Group with the Switchyard:

- Approx. 3Km, but will be calculated again

iv. Type of Conductor or cable for collector group:

- Medium Voltage XLPE (Cross-Linked Polyethelyne) armoured each core separate metallic cable (A1) suitable for laying in Ground for intervonnection between WTG and the Interconnection of collector Group with MV Switchgear

v. Total Wind Farm Capacity

vi. Total Gross Capacity (MW)

18.3 ELECTRICAL DATA

18.3.1. Voltage,GrossCapacity[MVA,MW],Power Factor(Lagging/Leading)

- Voltage 690V
- Gross Capacity 2.0MW
- Power Factor 0.95 Inductive, 0.95 Capacitive

i. No. Of Collector Groups

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ii. WTG Connection In Each Group:

- 03 collector groups of 06 WTG each
- 01 Collector Group of 07 WTG

iii. Length of Each Collector Group with the Switchyard:

- Approx. 3Km, but will be calculated again

iv. Type of Conductor or cable for collector group:

- Medium Voltage XLPE (Cross-Linked Polyethelyne) armoured each core separate metallic cable (A1) suitable for laying in Ground for intervonnection between WTG and the Interconnection of collector Group with MV Switchgear

v. Total Wind Farm Capacity

vi. Total Gross Capacity (MW)

18.3 ELECTRICAL DATA

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- Voltage 690V
- Gross Capacity 2.0MW
- Power Factor 0.95 Inductive, 0.95 Capacitive

i. No. Of Collector Groups

- Collector Group 04

ii. WTG Connection In Each Group:

- 03 collector groups of 06 WTG each
- 01 Collector Group of 07 WTG

iii. Length of Each Collector Group with the Switchyard:

- Approx. 3Km, but will be calculated again

iv. Type of Conductor or cable for collector group:

- Medium Voltage XLPE (Cross-Linked Polyethelyne) armoured each core separate metallic cable (A1) suitable for laying in Ground for intervonnection between WTG and the Interconnection of collector Group with MV Switchgear

v. Total Wind Farm Capacity

vi. Total Gross Capacity (MW)

- Total Gross Capacity 50MW

vii. Wake Losses, EBOP Losses, Auxiliary Consumption

- Wake Losses 10.14%
- EBOP Losses 1500Kw
- Auxiliary Consumption 600Kw

viii. Total Net Output Capacity (MW) that will flow to Grid

- Total Net Output 47.9 MW

b. Generator Step Up Transformer Data

i. No. of Step Up Transformers

- No Of Step up Transformers 25

ii. Voltage Ratio

- Voltage Ration 0.69/22Kv

iii. MVA Rating

- MVA Rating 2.35MVA

iv. Percentage Impedance

- % Impedance 10.5%

v. Number Of Generators Connected to Each Stepup Transformer

- Each WTG to be connected with one Transformer

c. Proposed Switchyard Of Wind Power Project

i. Single Line Diagram

- **Please see Major equipment planned for the project includes the following;**
- **Two-132/22KV,31.5/40/50MVA,Power Transformers**
- **HV Switchgear 132KV has following bays**
    - **Two Bays for OHTL**
    - **Two Bays for Power Transformers**
    - **One Bay for Bus coupler**

They comprise of following;

- **132 KV circuit breaker**
- **Dis-Connection / Isolators**
- **Earthing Isolators**
- **Voltage Transformers**
- **Current Transformers**
- **132KV Surge Arrestors**
- **132KV Coupling Capacitor Voltage Transformers**
- **Protection System with realays**

ii. Lay out of Switchyard Of Proposed Power Project Indicating Plant and Switchyard Equipment

- **To be provided after detailed design drawing**

iii. High Voltage (HV) Level

- HV Level 132KV

iv. Medium Voltage HV Level

- MV Level 22KV

18.3.2. HV/MV Transformer: No. of Transformers, Voltage Ratio, MVA Rating, Percentage Impedance

- HVTransformer Two132KV/22KV, 31.5/40/50 MVA, 10- 12 %

18.3.3. Bus Bar Scheme: One & Half Breaker or Double Bus Breaker:

- Bus Bar Scheme: Double Bus Bar

18.3.4. HV Switchgear (Circuit Breaker, Disconnector etc) data: Rated Voltage, Normal Current Rating, Short Circuit Rating

- Circuit Breaker: 145KV rated, 2500A, 40KA, 3 Sec, 50Hz
- Disconnector: Motor Operated Three Poles, 145KV rated, 2500A, 40KA, 3 Sec. , 50Hz

18.3.5. Bus Bar Type/Conductor Name, Maximum Current Rating

- Bus Bar Type:Standard Aluminium Conductor
- Bus Bar Rating: 2500A

d. Proposed Reactive Power Compensation

18.3.6. Type Of Reactive Compensation Device at MV Level (SVC or Switched Capacitor)

- Type: ReactiveCompensation System, whether capacitor bank based or SVC, to be decided in detailed design
-

18.3.7. MVAR Rating

- MVAR Rating: 2x10MVAR

19 .Electrical Design

19.1. Electrical Layout Of Lootah Farm

The WTGs would be connected to MV collector cables of 22 kV laid down in the Farm connecting each line (row) of the WTGs to the Farm substation. The layout is shown
in **Sketch – 3** (Appendix-5), briefly described as follows;

Line – 1 WTGs 1-6 (6 x 2 = 12 MW)

Line – 2 WTGs 7-12 (6 x 2 = 12 MW)

Line – 3 WTGs 13-18 (6 x 2 = 12 MW)

Line – 4 WTGs 19-25 (7 x 2 = 14 MW)

The average length of cable between the two WTGs has to be enough to completely outdo the wake effect from the adjoining WTG based on thumb rule to leave 4xD (rotor diameter) between the WTGs to take care of wake effect. In actual micro-siting the distances between WTGs might be slightly different due to many other factors. We have taken about 400 meters distances between the WTGs.

The Farm Substation has been assumed to be located somewhere in the middle of the Farm.

The three collector circuits of 22 kV would thus be laid as shown in Sketch-3 and explained as follows;

Collector Line-1 from WTG-1 to Farm Substation

Collector Line-2 from WTG-7 to Farm Substation

Collector Line-3 from WTG-13 to Farm Substation

Collector Line-4 from WTG-19 to Farm Substation.

Since each collector would carry a max of approximately 14 MW at normal rating, the 22 kV collector circuits loading capacity should be in the range of 16 MVA each, giving some margin for reactive power at 0.95 Power Factor and some losses in the circuits with certain overload capacity as well.

19.2 22KV Collector Circuit

The MV voltage level selected by Lootah for interconnection of collector groups of WTGs in the Farm is 22 kV. Underground cables will be used with length of approx. 3 km. Further details regarding the type of cable is provided in specifications.

19.3 Wind Farm Substation 132/22 kV

A substation would be built in the middle of the Farm to collect all the power from the WTGs, spread out in the Farm, at medium voltage (MV) level of 22 kV and step-up this power to high voltage (HV) level of 132 kV so that the Farm's output may be evacuated

to the main grid of NTDC. The single line diagrams of the substation are briefly shown

in Sketch-1 and 2 in Appendix-5 for 22 kV and 132 kV respectively. Keeping in view the data provided by the Client, the bus bar scheme for 132 kV level is double bus with a coupler i.e. double bus-single-breaker scheme. Keeping in view the NTDC/DISCOs practice, we propose to provide good reliability to a power plant as follows:

- Single bus scheme with a sectionalizer to enable to have two bus sections at 22 kV.

- Double-bus single-breaker scheme with a Bus Coupler at 132 kV
- The schemes are shown in Sketch-1 and 2 respectively and described as follows.

19.3.1 Conceptual Design of 22 kV

The single line diagram SLD–1 in Appendix-5 shows the conceptual design of 22 kV(MV) bus bar of the Farm substation. It comprises of

- Two single bus-sections of 22 kV with a bus sectionalizer
- Four breaker bays to connect four collector double circuits of WTG Lines 1-4
- Two breaker bays to connect two transformers of 132/22 kV
- Two breaker bays for connecting two auxiliary transformers of 22/0.4 kV
- Two breaker bays to connect switched shunt capacitor banks

Rating of all the breakers and bus bar equipment would be

- Short circuit rupturing capacity = 31.5 kA
- Normal continuous current = 1250 A for line breakers
- = 2500A for Bus Sectionalizer and Power TF

19.3.2 Conceptual Design of 132 kV

- Single-line-diagram SLD–2 (Appendix–5) shows 132 kV bus bars of the Farm
- substation, which would comprise as follows:
- ⍰ Double bus bars with a Bus Coupler
- ⍰ Two breaker bays to connect two transformers 132/22 kV

- ⍰ Two breaker bays to connect two circuits of 132 kV i.e. double circuit on single
- tower overhead line to connect to the grid system.

Rating of all the breakers and bus bar equipment would be

- Short circuit rupturing capacity = 40 kA
- Normal continuous current = 1250 A for line and TF breakers
- = 2500 A for Bus Sectionalizer

The other equipment of the substation consists of:

- ⍰ Two 132/22 kV, 31.5/40/50 MVA ONAN/ONAF1/ONAF2 OLTC transformers,
- 132±11×1%/22kV, to fulfill N-1 criteria of Grid Code
- ⍰ Two station auxiliary transformers 22/0.4 kV
- ⍰ Two switched shunt capacitor banks each of the size of 10 MVAR (5 x 2 MVAR)
- with contactors and PLC (Programmable Logic Controller).
- ⍰ Energy meters would be installed on HV side (132 kV) of the 132/22kV transformers.

19.3.3. Reactive Power Requirement.

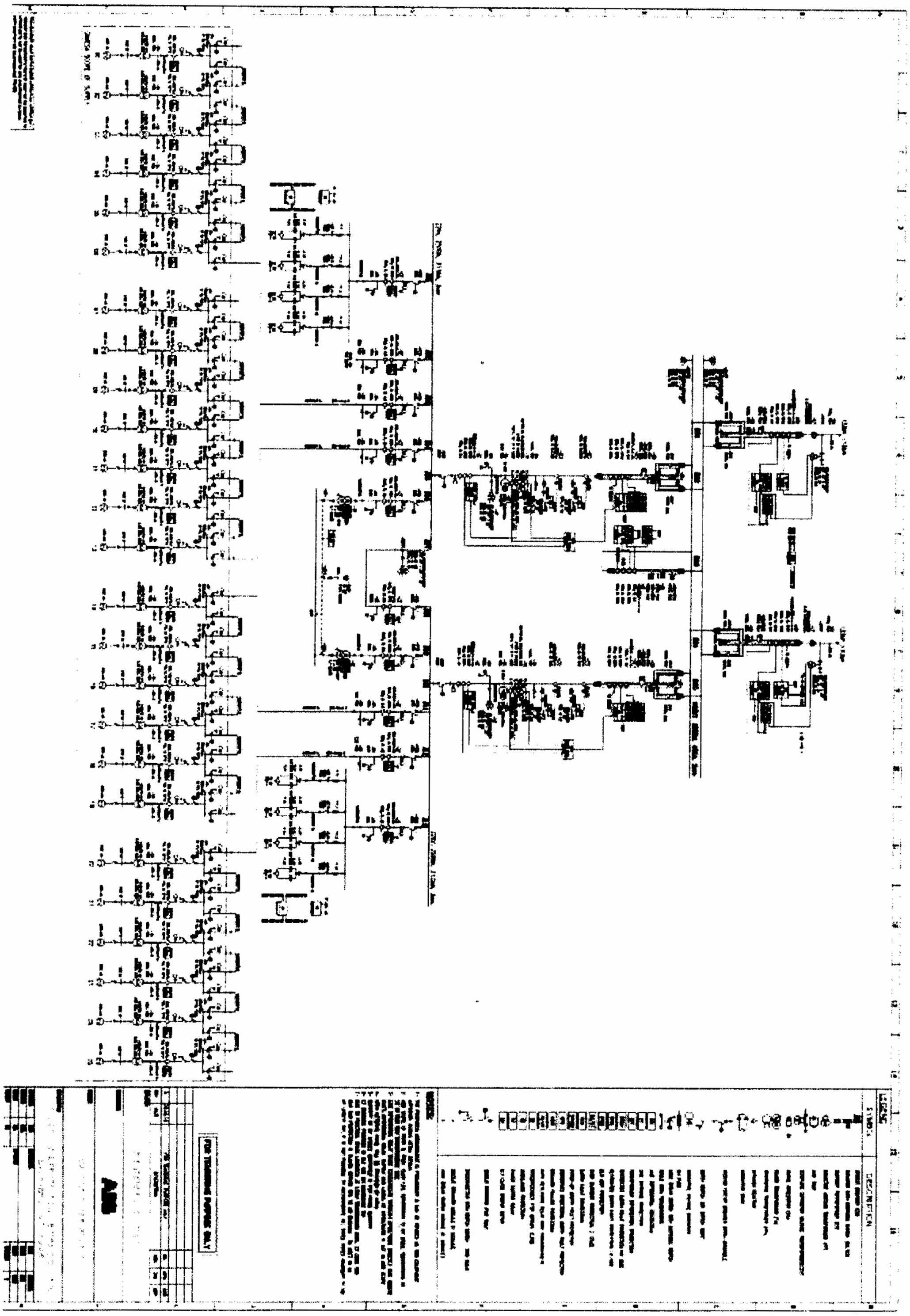
Lootah is considering using 2 MW Gamesa Type-3 WTGs, which are doubly fed induction generators, in their WPP. Its power factor is 0.95 lagging (capacitive/generating) and 0.95 leading (inductive/absorbing). The maximum reactive power output that can be available at the 0.7 kV terminal is 0.66 MVAR for

each WTG. Part of this reactive power will be consumed by the 0.7/22 kV step-up (GSU) transformer and the rest may be consumed in the MV collector cables of the wind farm. However some reactive power might reach the MV bus bar of Farm

substation. That means each WTG is self sufficient to meet VAR absorption requirement of its step-up transformer with some contribution of VARs to the Farm MV network.

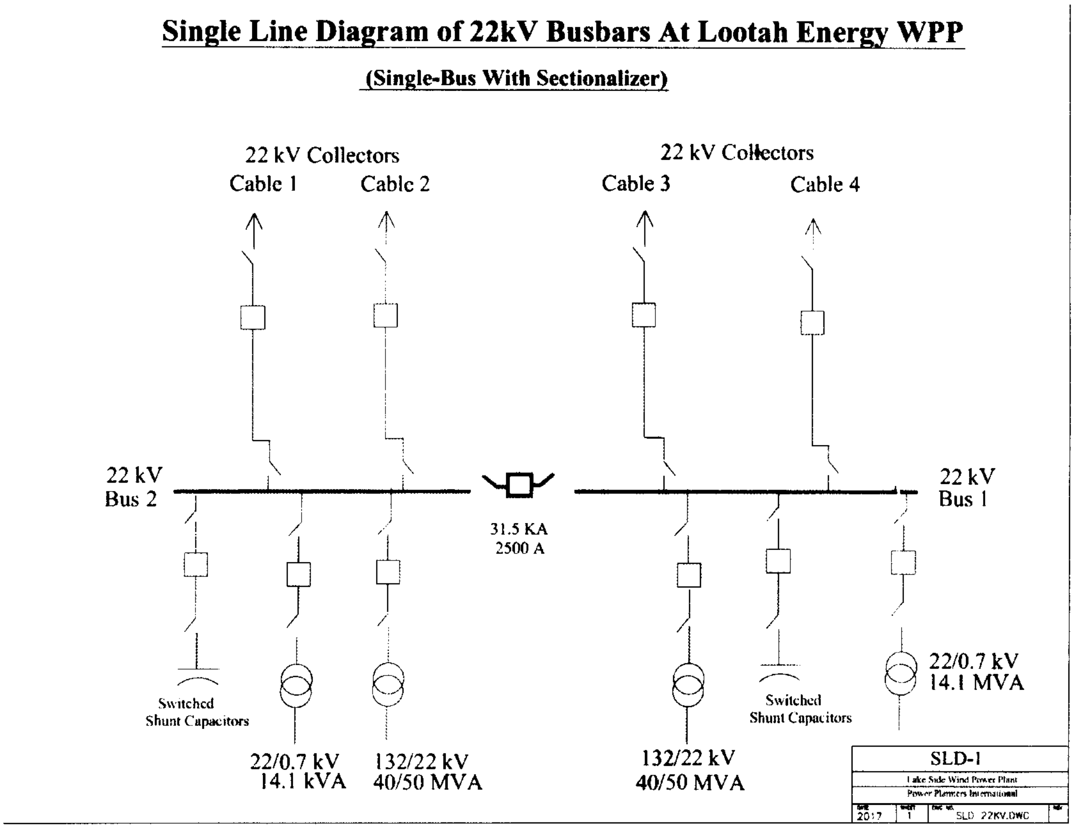
The Grid Code Addendum No.1 requires to meet the criteria of ± 0.95 power factor at the point of interconnection with the NTDC/HESCO grid at 132 kV (point of common coupling). Therefore a Farm of 50 MW generating capacity is required to pump 16.4 MVAR to the grid at full output of 50 MW. The VAR generating capability of WTG at 0.95 PF will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers, collector cables and the HV/MV 132/22 kV transformers at the Farm substation. In order to meet the Grid Code criteria, we need to install switched shunt capacitor bank at 22 kV bus of the Farm substation of sufficient size capable of delivering approx. 16.4 MVAR at 132 kV bus after VAR loss across 132/22 kV transformers.

19.4 SINGLE LINE DIAGRAM

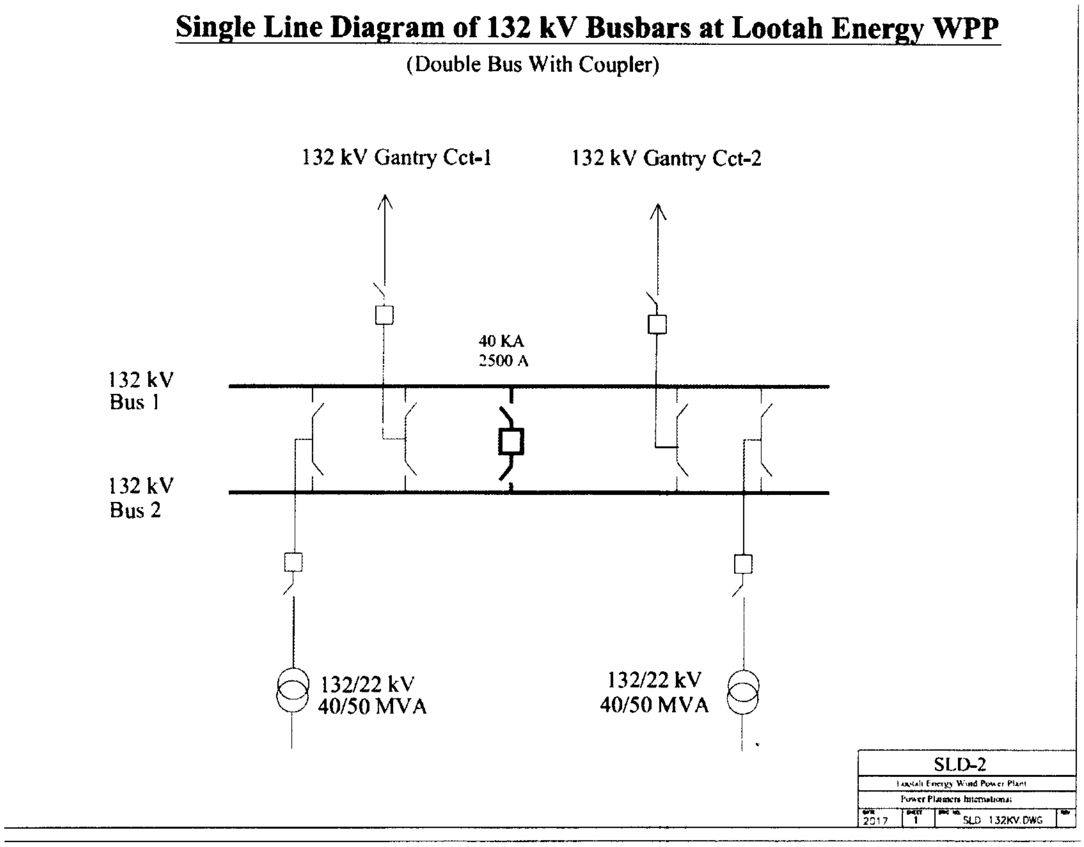


Single Line Diagram (Electrical) of the Generation

19.5. SINGLE LINE DIAGRAM OF 22K BUS BAR

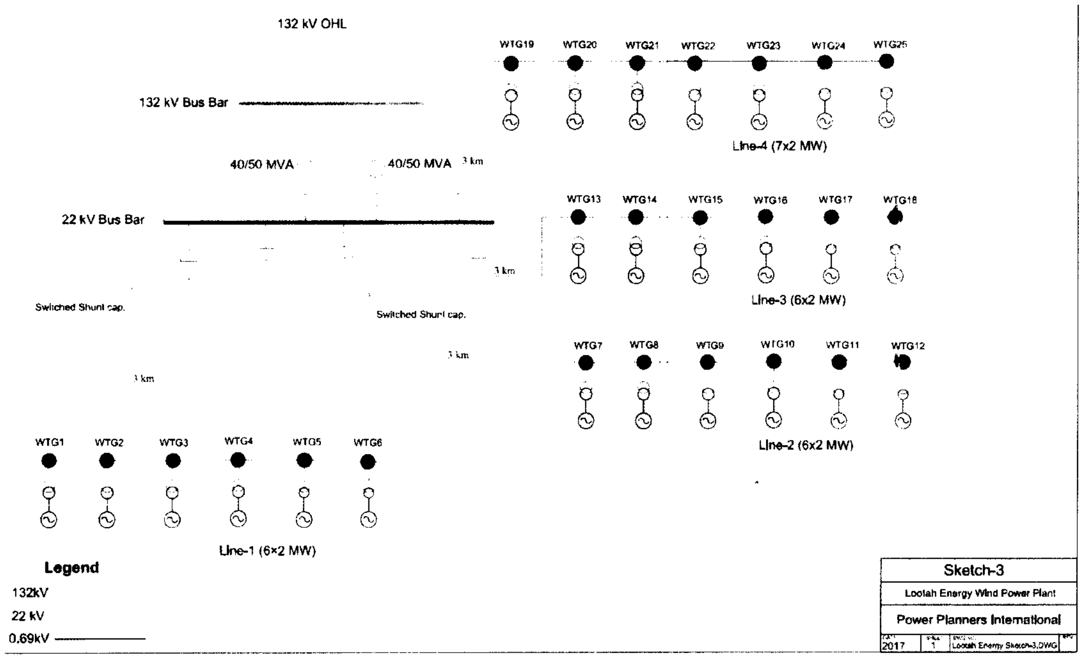


19.6. SINGLE LINE DIAGRAM OF 132KV BUSBAR



19.7 WTG CONNECTIVITY DIAGRAM

Lootah Energy 50 MW Wind Farm
25 x 2 MW WTGs



The Baisc design given in the feasibility study is just to make sure data required for Grid Interconnectivity study is fulfilled, and basic concept is cleared. Detailed design will be carried out once contract is signed with EPC.The Principle od design is given to clear concepts only, as guidelines of Pakistan NEPRA Grid code including its addendum for Wind Power Plants, specifically considering, conditions peculiar to Wind Power Plants.

20.CIVIL ENGINEERING DESIGN

20.1 Designing of the base for turbine and box-type substation

The Civil design activity and its works are the responsibility of EPC and is part of EPC contract. The will also take the GEO technical Risk, as such they will again carry out the bore hole study for each foundation of WTG and design the base for the Turbine Mast tower. In our case the Turbine Mast Height is 93 meters, so previous experience of existing desin in existing site will not completely assist. However basic guide lines are given here for guideline of EPC to enable them work out cost of such works.

20.1.1Base designing for wind turbine

(1) Wind turbine basic bearing layer

According to the load data and geological exploration data by wind turbine manufacturers, wind turbine basic bearing layer belongs to strong weathering limestone, characteristic value of subsoil is 300kpa~450kpa. The buried depth of wind turbine is 3.1m, proposes for large natural foundation reinforced concrete independent foundation.

(2) Base design for wind turbine

According to the upper part of the load provided by wind turbine manufacturers, calculate wind turbine foundation for the side length of 7.870 m octagon, base release area under the bearing capacity limit state is less than a quarter of the base area, In the normal condition, basal surface doesn't release. The embedded depth is 3.1 m; the excavation slope is1-0. 5. Basic concrete strength is C35; basement consists of 200 mm thick C20 concrete layer.

(3) Base calculation results on wind turbine generator :

Table: 20.1.1

No.	Design content		Load condition		Remark
			The normal operation load condition	Extreme load condition	
1	foundation pressure（kPa)			200	f_{ak}=300~350kP
2	Basal release area		Basal unreleased	22.776%	Standard requirement≤25%
3	deformation computation	settling volume （mm ）			Standard requirement 100mm
		slant			Standard requirement 5‰
4	resistive overturning safety factor			4.843	
5	resistive overturning safety factor			2.199	extreme load as the control load
6	checking calculation on punching resistance			satisfaction	
7	checking calculation on bend section (mm2)			89810	area of reinforcement
8	checking calculation on shear strength			satisfaction	
9	checking calculation on fracture width（mm ）			0.115	

e next phase, takes detail geotechnical engineering investigation on construction sites, wind turbines can be designed according to the detailed geotechnical survey and the load data of wind turbine generator.

In the construction phase, pit excavation the basic hole, backfilling construction stage, and the underlying concrete construction method must follow the current specification and related technical requirements put forward by the wind turbine manufacturers.

20.2 Building Structure Design

Table 20.2.1 Main building (structure) Classification

No.	Project	architectural structure Security Level	earthquake fortification	seismic fortification intensity	
				earthquake action	seismic fortification measures
1	Comprehensive Building	2	Class C	7 Degree	8 Degree
2	High and low voltage transformer room	2	Class C	7 Degree	8 Degree
3	Integrated warehouse	2	Class C	7 Degree	7 Degree
4	Outdoor distribution equipment architecture supporter	2	Class C	7 Degree	7 Degree

Table 20.2-2 The main building structure Design Table

No.	Project	Structure type	Foundation type	foundation plan
1	Comprehensive Building	second floor frame structure	independent foundation column	natural foundation
2	High and low voltage transformer room	first floor brick structure	Rubble concrete strip foundation	natural foundation
3	integrated warehouse	first floor brick structure	Rubble concrete strip foundation	natural foundation

21.Transportation Study

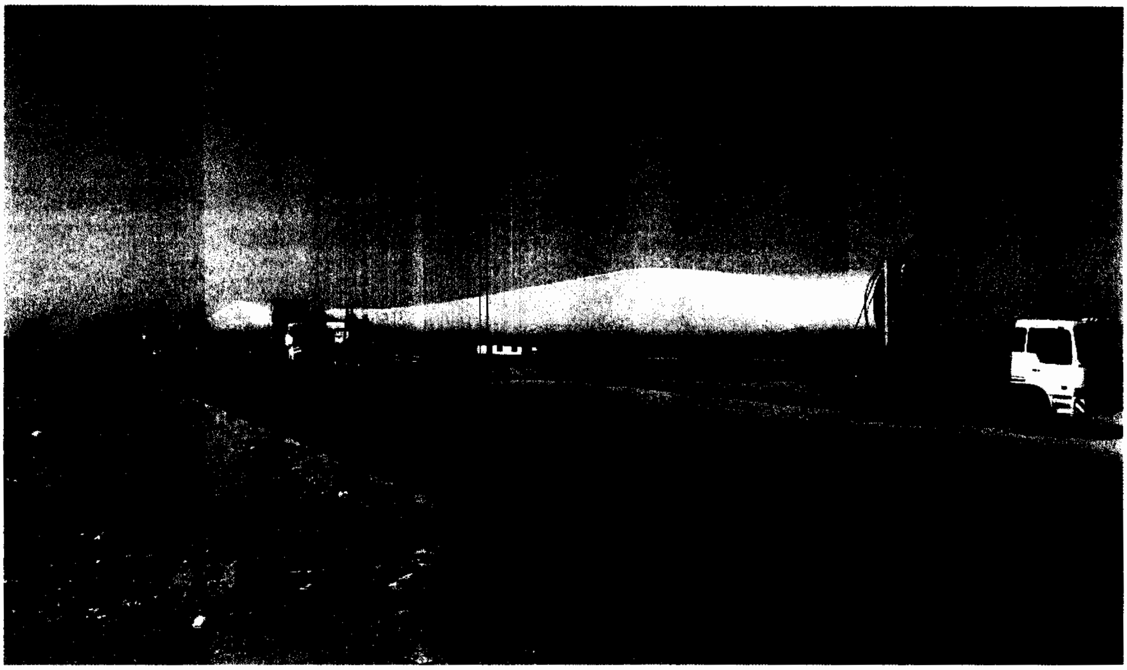
21.1Access roads & Transportability

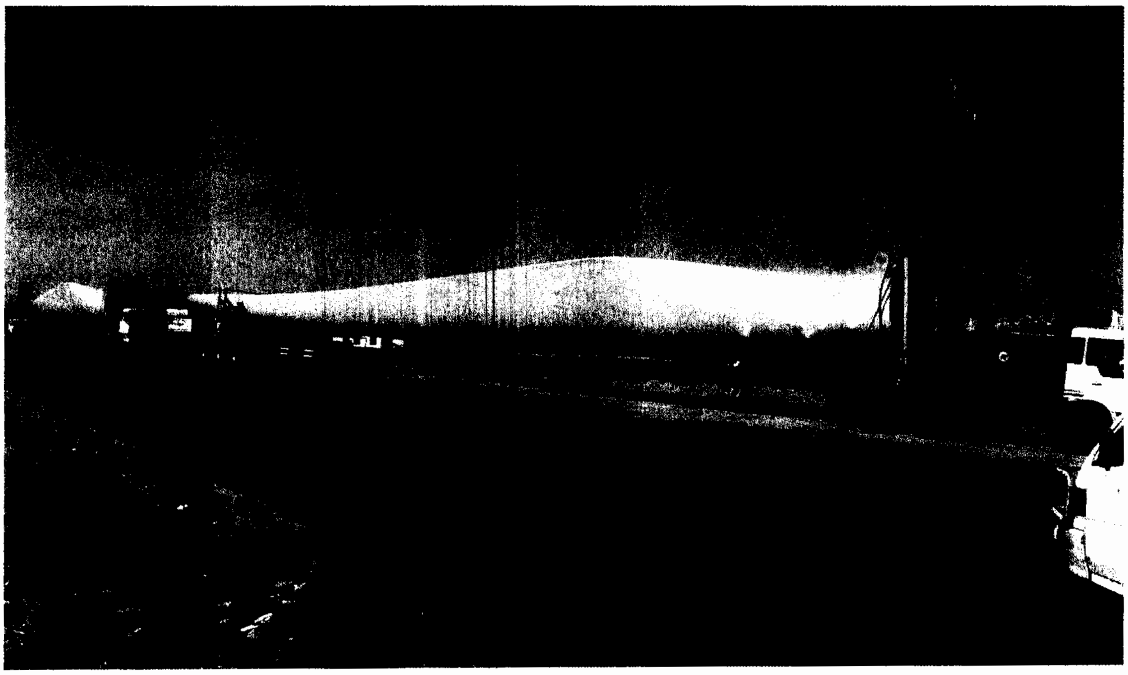
The site is located in Jhimpir area, Jhimpir has a well-developed transport network with good road, rail and air links. The road network from Karachi links to the Northeast with high Road M9.

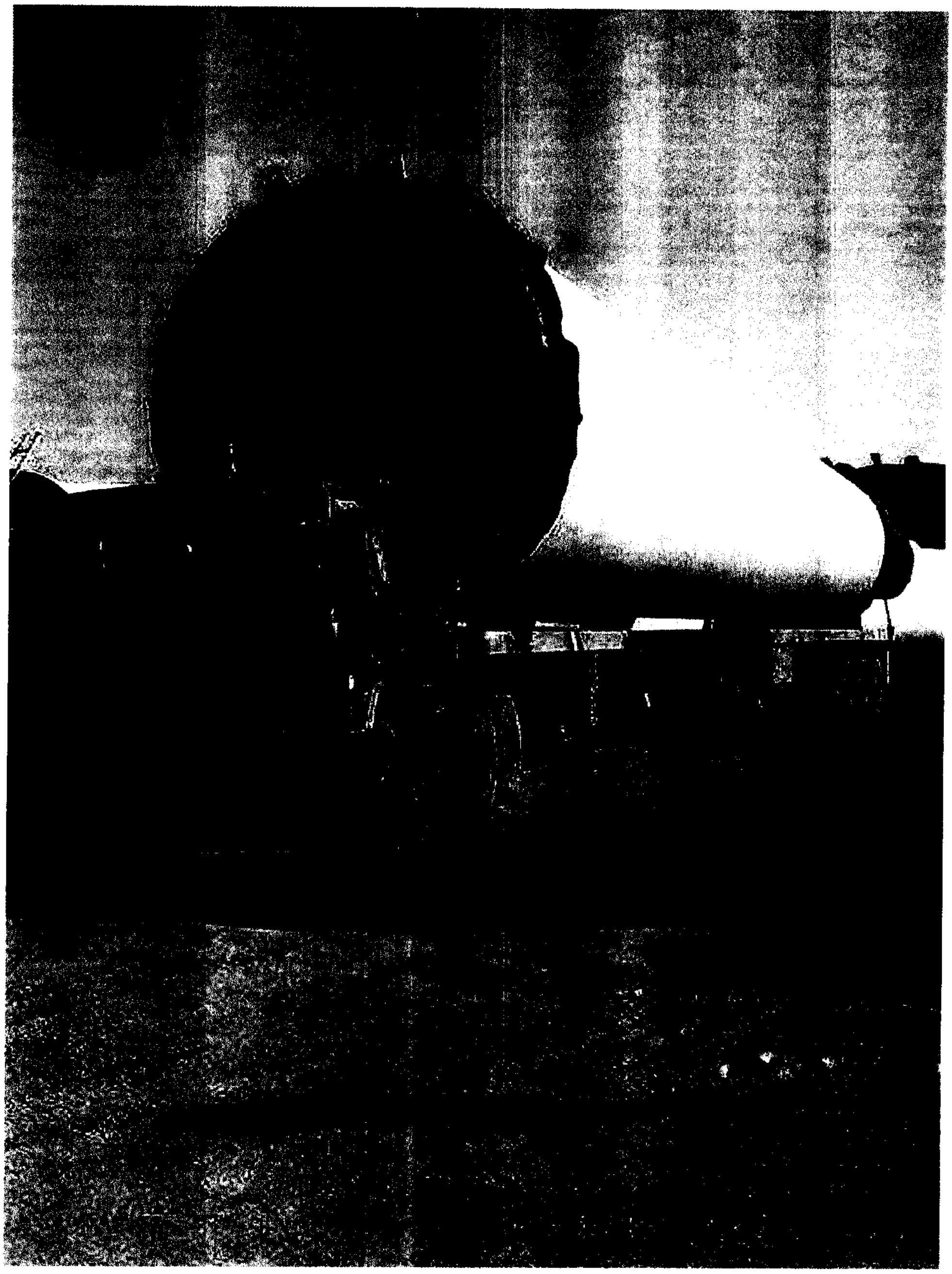
It is foreseen to ship the turbines and the equipment to Port Qasim port. The road from Karachi via M9 is mainly paved. The width of the road is suitable for the transport of wind turbine. The overall conditions of the roads are good. It can be stated, that the roads are suitable for the transportation of the wind turbines. Nevertheless, it is necessary to further investigate the road condition of the section between Karachi and Jhimpir in the next phase. The axle loads of the trucks carrying the turbine nacelles and the towers do not exceed 12 tons and are within the limit, the above mentioned roads can bear.

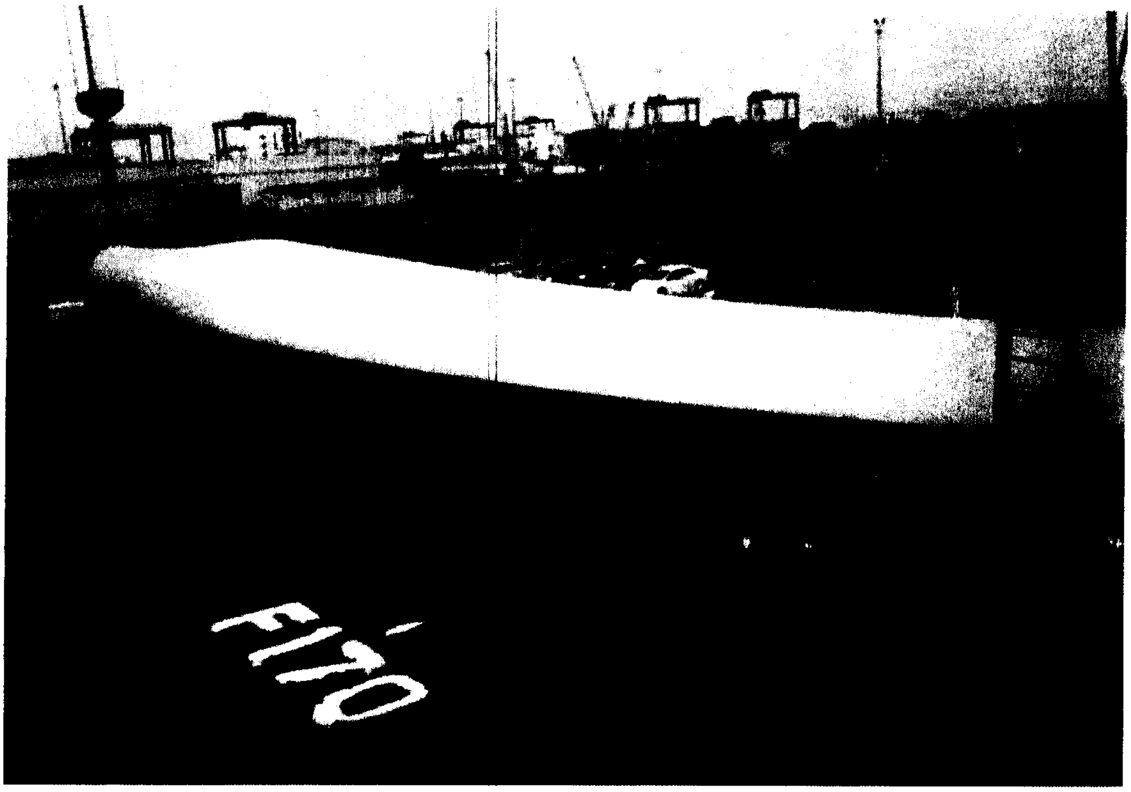
In general the site may be supplied by turbines, towers and balance of plant from Port Qasim without apparent difficulty.

On selection of turbines a detailed survey of local transport infrastructure will be necessary, however during recent installation of a plant in Jhimpir, the local transport facility was verified, and found adequate, as we Physicaly checked all parts and components of WTG plant being loaded at port and transported to site, by local Transport Companies.Some of the Pictures taken during that unloading from ship, loading on trailers and transportation to site are as follows;





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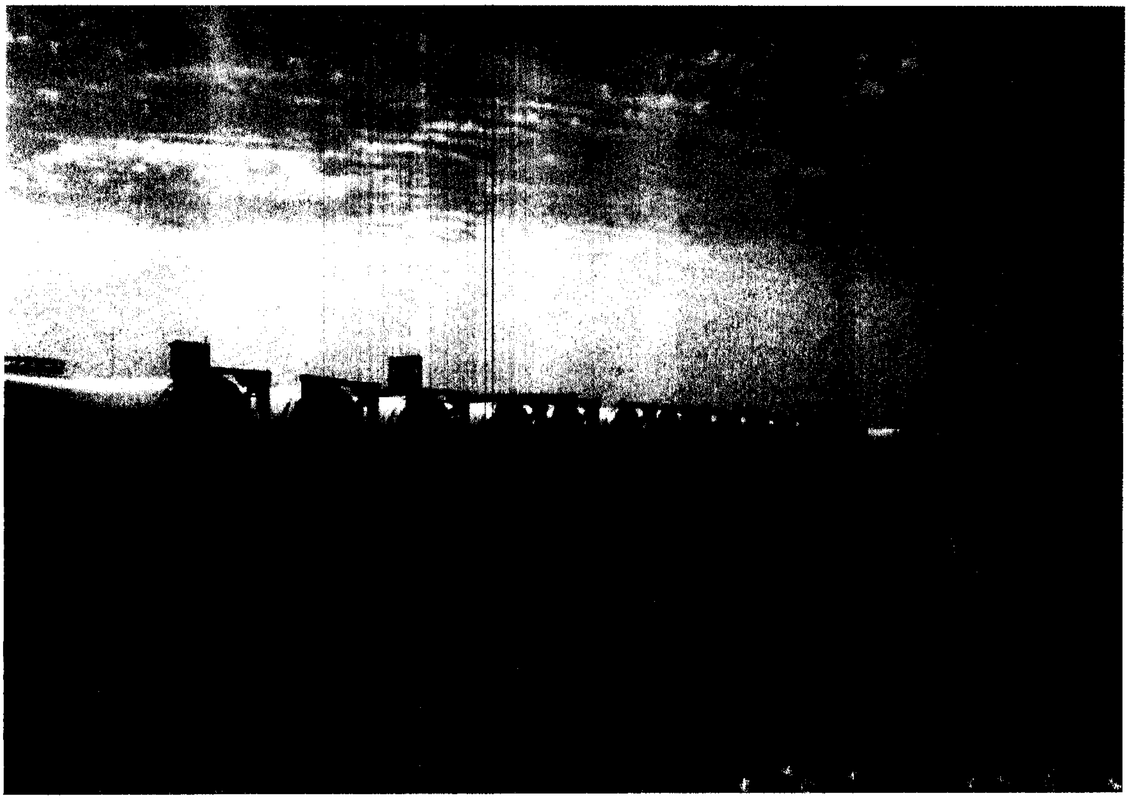


21.2. Internal Access Roads

The access roads have been preliminary designed. Here, it has to be separated between:

-access road to be newly built

-existing road to be improved

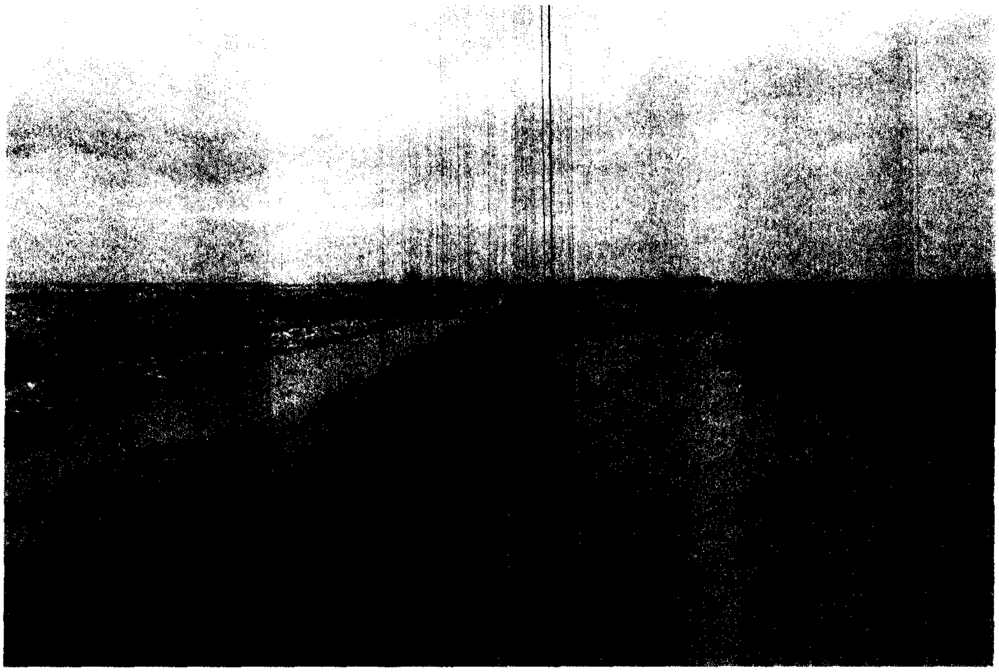


Figure 0-1 Road to Site

The paved main road from Karachi to Jimpphir passes approximately in 118 km distance. From the existing intersection of a wide road which is used mainly by off-road cars. There is no additional obstacle like trees or signposts exist. Most of the internal access roads have to be newly built, the existing major internal road has to be reinforced and adjusted for slope.For the installation of the wind turbines an area of approximately 30 m x 40 m has to be levelled at each turbine site for the cranes.

Copy of the Transport Study is attached as annexure .

22.CONSTRUCTION MANAGEMENT

22.1. Natural condition

Most of Pakistan is belonged to subtropical climate; southern part is coastal tropical desert climate. Overall, the climate is hot and dry, The heartiest seasons are June and July, most of the areas are midday temperatures upper than 40 °C, and in parts of Sindh province and Baluchistan province, the temperature at noon may be as high as more than 50 °C.

Sindh province (Subtropical Monsoon Climate) is hot in summer and cold in winter. From May to August, the temperature often reaches to 46 °C, and from December and January average temperature may be lower to 2 °C. Rainy season is concentrated in July and August, southwest monsoon starts to blow in February, which will be ended in September.

22.2. Transportation condition

The project site is located in the northeast of Karachi Jhimpir region; the region is flat where a better transportation condition has from Karachi (port) to the wind farm area, via a M9 highway and hatta - Thano bula Khan Highway can be reached. The transportation condition is quit convenient.

M9 highway is the important channel of connection between Karachi and Hyderabad. Thatta-Thano bula Khan Road is sclerosis of asphalt pavement, besides merges with M9 highway, there are no buildings and tall trees on both sides of the road, the road slope fluctuation is not big, and traffic condition is good which can meet the wind turbine blades and other large transport conditions. The junction of Highway is Karachi port to Thatta - Thano bula Khan. The Highway is about 96 km, highway mileage between intersections to wind farm site is about 10 km.

Large equipment transportation (fan and main transformer) is from Beijing (China) - Tianjin port (China)- Karachi Port Qasim (Pakistan) – Jhimpir (Pakistan) - wind power station (Pakistan), Land mileage (Beijing – Tianjin) is about 165km (Karachi - wind power station) is about 118km, Sea mileage (Tianjin- Karachi) is about 6263.5 sea mile （11600km）, total mileage is about 11883 km.

22.3. General construction arrangement

22.3.1.Principle

Since as Per Practice in Pakistan, most of the Power Projects are developed on TurnKey basis where EPC contractor is awarded the contract and to complete it as per schedule agreed with Sponsors and the Buyer of Electricity. The only requirement of Sponsor is to supervise the construction, activities, and monitor the schedule, the quality as per HSE guidelines. Lootahs have already organised an inhouse Construction management team, who will work in coordination with Project Adviser, Independent Enginerer. A regular monitoring plan be set up which will have regular meetings to to control project schedule. In Wind power project nearly all equipment, and material is imported from source country by OEM, and need to make sure that total bill of quantity is very clear, and contain 100% supply.

However, guidelines are given in the feasibility to the EPC on the Principles of construction and Project management,

According to the project characteristic, consider the following principles in the construction layout：

（1） The construction layout generally follow principles of local conditions, good production, life convenient, safe and reliable, easy to manage and economy applicable.

（2） Fully consider the characteristics of wind power project layout；

（3） Project is located in relatively flat topography which has a little ups and downs, sparse vegetation with a portion of the cultivated land and multiple sand. Engineering construction should avoid pollution of the environment, according with environmental protection requirement；

（4） According to the existing topography condition, the construction layout is compact, economical use of land, overall planning, reasonable decorate construction and temporary facilities, making construction layout as long as possible.

22.3.2. Construction facilities

In terms of construction layout principles while combining with the existing topography condition and wind turbines layout, etc. According to the principle of combining centralization and decentralization, arrange overlay facilities layout construction. Strive to layout is compact, economical use of land, convenient construction and management, but also meet the requirements of environmental protection.

Construction equipment warehouse, materials and equipment warehouse, the main subsidiary workshops, temporary living quarters should arrange in traffic convenient place in wind farms.

1. Concrete System

Set up a concrete mixing station in the southern part of wind field. Set a HZS60 type concrete mixing station, production capacity is $60m^3/h$, which can meet a 2500 kW wind turbine foundation concrete pouring. The strength of wind turbine foundation in Peak concretes pouring will reach to $45m^3/h$.

2. Sand-gravel material plant

Because the project aggregates concrete dosage is not big, this project does not adopt application of machining system, which only layouts the sand-gravel material plant that is located near the concrete system, application of pile according to the peak of five days of sand and gravel aggregate concrete storage, through calculation, the application of yard area is about 3000 m squared with height of 4 m.

3. Mechanical replacement and comprehensive processing Workshop

Overlay area is set machinery replacement factory and comprehensive processing factory (including steel processing plant). For better management, construction plant is concentrated on the source and the transportation is convenient. Machinery replacement factory mainly undertake the medium and minor repairs construction, simple parts and metal components processing tasks, large repair entrust local related companies.

4. Layout of warehouse

This project requires warehouse centralized arrangement which is near the source and construction production living area.

Table 22.3-3 Temporary construction facilities area and land occupation table

Temporary construction facilities area covers an area seen in below table

No.	Project	building area（m2)	occupied area（m2)	occupied area（Mu)
1	temporary residence and office	2000	5000	7.5
2	Material warehouse	520	1000	1.5
3	Equipment warehouse	820	2000	3.0
4	Wood, steel processing plant	280	600	0.9
5	concrete batching plant	200	1200	1.8
7	Sand-gravel material plant	20	3000	4.5
8	maintenance shop	100	200	0.3
9	Total	3940	13000	19.5

22.4.Transportation for construction

(1) Construction road : According to the arrangement of wind field and terrain conditions, temporary road construction should be consistent with the fan arrangement, designed for gravel road. Its total length of road is 10.6 km, 9.0 m right which can carry out 400 t crawler crane. Road construction is connecting to each fan hoisting construction sit and keeping for the permanent access road with right of 3.5 m in the future.

(2) Permanent road is the way to the 132 kV step-up substation, connected to Tactel - Napolitano Khan road. Road is level 4 way with gravel pavement about 2.5 km long, roadbed width of 6.0 m. And the width is 4.5 m, set up asphalt pavement according to the need of permanent roads pass by the wind of the floor, where to build a concrete slab bridge with the span of 2 x 8 m.

22.5. Lifting platform

Lifting platform for wind turbine is for the need of construction, beside each wind turbine foundation; there is a hoisting construction site which is connected to the stadium construction road. Beside each typhoon electric unit set up a hoisting construction with size of 50 m x 40 m, the site of the hoisting covers a total area of 66,000 m2. It will be restored to the original landscape construction in the late term of construction.

22.6. Supplication of water、electricity and material

Project construction layout, seen in the general construction plan

(1) Water supplication on construction : Dig a deep well in the wind field 132 kV booster station, set up a temporary water supply system, and receive to concrete mixing station, construction area and temporary living constructions. Other further construction sites can use tanker transportation. Domestic water requirement is according to the national drinking water standard which is drinkable after processing of qualified. The peak period water use in is 40m3/h.

(2) Power supply on construction: Jhimpir region has a 132 kV / 11 kV substation which is located in the eastern of farm with the linear distance of 6 ~ 7km. Though 132kV/11kV substation connects the 11 ~ 33 kV transmission lines, as a wind farm construction power, and install a construction transformer at the end of line. Besides, equip with two 200 kW portable diesel generators which are used as a backup power of construction. The peak load of construction is about 400 kW.

(3) Building materials : This project needs sand, gravel, limestone, brick, steel, cement and other building materials which are supported by building materials market and quarry near Nooriabad Town.

22.7. General schedule for construction

Assume that construction period is from January 1 of current year, the total time limit for a project is 16 months, the construction would be completed into commercial operation in April 31, next year.

From January 1, 1st year to April 31, 1st year is construction preparation period, mainly complete factory construction, tower drum play materials preparation, the temporary living facilities and flat the ground.

Construction water, power supply system and the concrete mixing station are the necessary premise of engineering construction, completed from January 1, 1st year to April 31 1st year. Floor construction concrete road and bridge construction period is from February 1, 1st year to April 1, 2nd year.

Wind turbines and box foundation excavation, concrete pouring foundation construction is from May 1, 1st year to August 31. When the wind turbine foundation excavation, at the same time for hoisting construction site. 132 kV step-up substation civil works construction period is from May 1, 1st year to September 30th.

Transmission cable, communications and monitoring cable construction period is from May 1,1st year to October 31.

132 kV step-up substation electrical equipment installation construction periods is from September 1, 1st year to December 20.

The installation period of wind turbine and Box-type construction is from January 1, the 2nd year, up to April 30, the 2nd year, 33 sets of wind turbines and Box-type complete installation.

On March 1 of the 2nd year, wind power begins to generate. The whole project can be finished on April 30,2nd year, total duration is for 16 months.

23. INITIAL ENVIRONMENTAL EXAMINATION (IEE)

IEE of the project has been carried out as per the Pakistan Environmental Protection Act 1977, and an NOC has been applied from Sindh Environmental Protection Agency. Copy of the IEE report prepared by EMC Pakistan Pvt Ltd , a leading consultants on Environment. Copy of the final report is attached as Annexture -   for study.The Study gives its conclusion and recommendations for implementation which is as follows, and will be studied, and mitigation measures will be taken to implement the recommendations fully;

23.1 FINDINGS, RECOMMENDATIONS & CONCLUSION

The main benefit of the Project will be the replacement of conventional power generation which utilizes fossil fuel, with the renewable energy. Wind energy will replace fossil fuel powered generation; therefore reduce particulate and greenhouse gas emissions into the atmosphere. Impacts are manageable and can be managed cost effectively. Adverse Environmental impacts are unlikely to result from the proposed Wind Power Project. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as correction in work practices at the construction sites, or through the careful selection of sites and access routes. Since proposed land is sparsely vegetated, thus there is no need for major floral removal.

The proposed Project will have number of positive impacts and negligible negative impacts to the existing environment as follows:

 Significantly improvement in the economic activities in the surrounding areas due to generation of direct and indirect employment opportunities.

 There is negligible removal of trees and Xerophytic floral for the Project activities.

 Environmental pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, black smoke, vibration are the short term negative impacts of the proposed Project which will be mitigated through proposed measures.

Proper Grievance Redressal Mechanism (GRM) will have to be implemented by the proponent to overcome public inconvenience during the proposed Project activities.

Based on the environmental and social assessment and surveys conducted for the Project, the potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the mitigation measures identified in the EMP. Adequate provisions are being made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs. Adequate provisions are being made by the proponent to cover the environmental mitigation and monitoring requirements, and their associated costs.

An environment and social analysis has been carried out looking at various criteria such as topology, air, noise, water resources and water quality, ecology, demography of the area, climate and natural habitat, community and employee health and safety etc. The impact analysis, found that due to careful consideration of environmental and social aspects during route and site selection by proponent, no major adverse impacts are expected. There is no adverse impact on the migration of habitat, any natural existing land resources and effect in the regular life of people.

Micro sitting analysis of the project reveals the 2nd option in Section 2.5 i.e. Site 2 to be the most optimal in terms of economics and energy yield. The environment and social impact associated with Project is limited to the extent of construction phase and can be mitigated through a set of recommended measures and adequate provision for environment and social impacts which cover monitoring, measuring and mitigation.

EMP has been prepared. Most impacts are expected to occur during the construction phase and are considered to be of a temporary nature. The transmission corridor will be carefully selected after undergoing a detailed assessment. This enabled the right of way alignment to bypass villages and important water supplies and resources. The main Project impacts are associated with clearing of shrub vegetation, waste management and excavation and removal of topsoil.

From this perspective, the Project is expected to have a small "environmental footprint". No endangered or protected species of flora or fauna are reported at the Project site.

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The Project is not considered highly sensitive or complex. Mitigation measures related to construction, as specified in the EMP, will be incorporated into civil works contracts, and their implementation will be primarily the responsibility of the contractors. Hence, the proposed Project has limited adverse environmental and social impacts which can be mitigated following the EMP & shall be a pollution free renewable source of Power in the region.

Screening of potential impacts suggest that the Construction & Operation of 50 MW Lootah Energy (Pvt.) Ltd Wind Farm (Phase-I) Project will, on adoption of the suggested mitigation measures, be an environmentally acceptable proposition and provide clean and renewable energy. It is recommended that the IEE be approved with the condition that recommendations given in the IEE and NOC will be duly followed by the proponent.

24. CONCLUSION AND RECOMMENDATIONS OF FEASIBILITY REPORT

This detailed Comprehensive feasibility was prepared, which covers all aspects of Project Development, and in this case, a 50MW Wind Power Farm, in Jhimpir Area of Sind , on Land owned by the Sponsors Lootah Energy.

After receiving the LOI, considerable delay took place in taking any further action, as due to Non Availability of Power Evacuation from the Wind Corridor, all activities towards development of the projects were curtailed by most of the sponsor. With some progress on the Evacuation end where a new Transmission Project of 500MW was approved to cater for 10 Wind Power Plants of 50MW each, whose number was increased to 13, as a Chinese company with approval of evacuation had withdrawn. Lootah, was allowed to be part of these 13 projects, in priority list, as such, further action on development of the project was accelerated. Consultants were hired early this year for preparation of the Bankable Feasibility study and to act as advisers for the Project.

During last six months all required studies such as IEE Report, Geo Study, Topographic Survey, Transport Study, GI study were awarded to different consultants and specialist companies, and progress on the Feasibility study was made, resulting in its completion.

The Financial part of the Project, was delayed, as the Upfront Tariff Regime was discontinued in December 2016, and instead a Benchmark tariff was issued, for Bidding process, to be introduced by NEPRA for all future projects of Alternate Energy.

The Benchmark tariff was low that effectively its reduced Project Cost by 40%. Other changes were that the Debt period was increased from 10 to 13 years. Then in Bench mark tariff the Debt Equity ratio was changed from 75:25 to 80:20. The Wind Risk was made sponsors responsibility, and Capacity factor of plant was increased.

Introduction of Bidding Process was to be introduced in April 2017, but till October, nothing was forecoming, as both Sindh and Punjab has petitioned against bidding process. The reasons were genuine, as Wind is not same in every area, and the terrain is also different. These two items impact the capacity, and cost of construction, so it does not leave a level playing field.

With decrease in project cost who main impact was on EPC cost, all the active OEM went back for home work, to find more cost effective and high production machines, so that per MW cost could be brought down. Rest of the Project costs and EPC cost remains same, its only the equipment cost which need to be removed. Further a 10% with holding tax on Dividends was also introduced , so effectively, the IRR was reduced, and ROE comes down to about 16%.

O&M costs and insurance were also reduced, which put an impact on the OEM, to engage low cost O&M contractors, and also bring good quality machines. The only positive step taken was the project life was increased from 20 years to 25 years, which partly balanced the return on investment.

Nearly all sponsors, including LOOTAH, started negotiating with OEM/EPC contractors for reduction of prices , and to get them involved in Bidding process where they could bid and compete if they wanted to sell their machines in Pakistan.

Some new Chinese players came into market, with lower prices, but still five previous OEM continued to remain market.

Lootah was negotiating with Gamesa, China Goldwind, Vestas, and new comer SANY., and continued to evaluate the machines, for quality, Energy yield, Capacity, and capabilities to provide good after sales service, and most importantly, Debt Financing for the project.

After making evaluation on all these issues, Lootah chose to go for Gamesa which after its merger with Siemans has become a giant. There machines are well tested, f high quality, as they are using European Standards in manufacturing and operation, which are verifiable by Independent Standards bodies.

There price is reasonable not as low as some Chinese new comers, but still competitive with all their equivalent brands. They had offered to get Debt for the project, and also have strong arrangement with a leading local Aftersales company, who, have long experience, and currently represent leading Machinery manufacturers. They are also local EPC for Gamesa as well. The O&M contract offered by Gamesa in partnership with their local partners, is very responsive, and literally take care of all O&M needs of the plant, with practically no responsibility on Sponsors.

Recent development, by NEPRA where they gave indications of accepting Tariff applications based on Cost Plus basis, prompted LOOTAH to move on fast track, and we intend to file for a Generation Licence this month of October, and also file a Tariff Petition Tariff

Petition, this month.

Lootah have engaged a Financial Consultant to work on Cost Plus module, which will be acceptable to NEPRA, and also give required Return on Investment.

Once that module is ready then the Financial Part of this Feasibility will be completed for Banking purpose

LOOTAH also plan to file for a generation license of its second phase after the first phase goes into LOS stage.

We intend to petition for a Cost Plus basis on tariff , and will use a 75:25 debt equity ration for project financing. Part of the debt will be arranged through EPC, but will also work with Local and Middle Eastern Banks for raising part of debt. Sponsors have indicated, availability of Equity for the Project.

B. FINANCIAL FEASIBILITY

Financial Feasibility details will be worked out, once the process of Tariff Determination is Finalised By Authorities. Currently, three possible options are available;

1. Upfront Tariff
2. Cost Plus Basis Tariff
3. Bidding against Bench Mark Tariff.

We await the decision before this part of feasibility study is completed for Banking purpose.

NATIONAL TRANSMISSION & DESPATCH CO. LTD (NTDC)

General Manager Power System Planning, NTDC

No. GMPP/CEMP/TRP-380/ 4047-51

Dated: 10-07-2017

Chief Executive Officer CPPA(G) Ltd.
Shaheed-e-Millat Secretariat,
6th Floor, Jinnah Avenue,
Blue Area, Islamabad.
Fax#051-9213616

Sub: Approval of Electrical Grid Study Report for 50 MW Wind Power Project (WPP) at Jhimpir, District Thatta, Sindh by M/s Lootah Energy (Pvt) Ltd

Ref: CPPA-G letter No. CPPA(G)L CEO/DGM-IEMT-V/LEPL/24009-10 dated 25-05-2017.

This office has received the final grid interconnection study report of the subject WPP vide above referred letter. After review of the report, it was found that some corrections in the studies were needed which were communicated to M/s PPI and afterwards, M/s PPI submitted the said report after the required corrections on 10-07-2017. Therefore, the grid interconnection study report of Lootah Energy WPP is approved at NTDC end as per assumptions and study results presented in the report.

It is intimated that the Grid Code Addendum for Wind Power Projects is being updated at present and after its approval from NEPRA, the developers of the subject wind power project will be required to follow/implement the requirements/recommendations as given in the Grid Code Addendum for Wind Power Projects. It is added that during EPA, if there is any major change in the parameters of the subject WPP as used in the grid interconnection study, then relevant studies will have to be revised.

It is also important to intimate that the subject report has been approved only for power evacuation/ interconnectivity aspects of the subject WPP. Moreover, there may be some modification in the interconnection arrangement of the subject WPP depending on variation in its COD as well as other power plants in the area. Any commitment regarding project execution or for any other purpose should be discussed with CPPA(G) and relevant departments of NTDC/HESCO. Moreover, the comments of HESCO on the subject report may be obtained.

10/7

(Maqsood Ahmad Qureshi)
General Manager PSP NTDC

cc:
- Chief Executive Officer, HESCO
- General Manager (Services Division) NTDC
- Chief Executive Officer, M/s Lootah Energy (Pvt) Limited, 201,202,301 & 302 Fareed Chamber Abdullah Haroon Road, Karachi.
- M/s PPI, 64-F/1 Wapda Town, Lahore.
- *Master File (MP)*

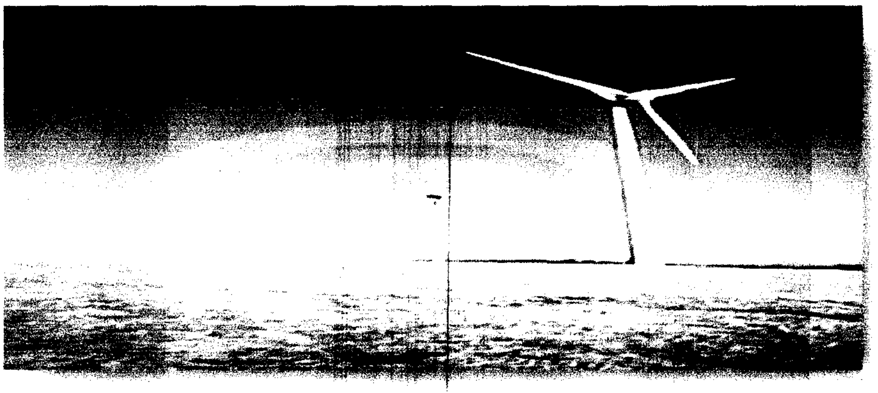
Report No. PPI-237.2-Final-Lootah-Energy/17

PPI

ELECTRICAL GRID STUDIES

For

50 MW Wind Power Plant by Lootah Energy (Pvt) Limited at Jhimpir



Final Report
(April 2017)

Power Planners International

UK OFFICE

3- Sylvester Road,
Sudbury Town, Middlesex
HAO 3AQ U.K.
Ph. No. +44-208-9223219
Fax +44-208-9220657

PAKISTAN OFFICE

64-F1, Wapda Town, Lahore
Ph. Nos. +92-42-35182835
+92-42-35224247
Fax +92-42-35183166

Email: info@powerplannersint.com
Website: www.powerplannersint.com

Executive Summary

- The study objective, approach and methodology have been described and the plant's data received from the client Lootah Energy Limited has been validated.
- The wind project by Lootah Energy Limited, referred to as Lootah WPP in the remainder of the report, is expected to start commercial operation by summer 2019. Therefore, the scenario of August/September 2019 has been selected to carry out the study as it will help determine the maximum impact of the project.
- The latest generation, transmission plan and load forecast provided by NTDC has been used for the study, attached in Appendix – 2, vide data permission letter no. GMPP/CEMP/TRP-380/5172-75 dated 02-12-2016.
- Recently a study of 10 WPPs was carried out by NTDCL planning department to fill the power capacity vacated by NBT Wind Power Pakistan II & III. A new 220kV grid station with the name of Jhimpir-2 was proposed which was connected by loop in-loop out configuration of Jamshoro – KDA 220kV single circuit and Jhimpir-1 – Gharo 220kV single circuit. This study is carried out for 15 new WPPs in integration with the already planned WPPs and other upcoming WPPs in its vicinity.
- Out of these 15 WPPs, 9 plants which lie in the southern part of Jhimpir namely Indus, Lakeside, DHA City, Noor, Metro-2, Iran Pak, Nasda, Uni-energy and Shafi Energy WPPs, are proposed to be connected to the newly proposed Jhimpir-2 220/132kV Grid station. Since the site of Jhimpir-2 220/132kV grid station has recently been finalized hence a site visit was carried out on 25th January 2017 along with NTDC official to verify the distances of the upcoming 220kV circuits emanating from this grid station. Moreover sites of the above mentioned 9 WPPs were also visited to develop technically correct as well as least cost scheme for evacuation of power from these WPPs. Based on the location of the WPPs, two loops (each having 8 WPPs) were proposed at Jhimpir-2 grid station. The configuration of the new loops is shown in Appendix-4 and the list of WPPs in each loop is provided below:

First Loop: Lakeside, Nasda, Trans-Atlantic, Uni-Energy, Iran Pak, Artistic, Act-2 and Cacho WPPs

Second Loop: Indus, Gul Ahmed, Metro-2, Zulaikha, Din Energy, Noor, Shafi Energy and DHA-City WPPs

- Sites of 3 plants out of these 15 WPPs which lie in the northern part of Jhimpir namely Norinco-2, Sinowell and Tricom WPPs were also visited and they are proposed to be connected via loop in-loop out of upcoming Jhimpir-1 - T.M Khan 132kV single circuit. Similarly Burj WPP is proposed to be connected via loop in-loop out of Thatta – FWEL-I 132kV S/C and Lootah WPP which is located in Jamshoro district is proposed to be connected by loop in-loop out configuration of the newly proposed Nooriabad - Jamshoro old 132kV single circuit. Lastly, Lootah Energy WPP is proposed to be connected via loop in-loop out of upcoming Jhimpir-1 – Tricon-A 132kV S/C
- As discussed above, Lootah WPP which is the plant under study has been located in Jhimpir district. Lootah Wind Power Plant would be connected by loop in-loop out configuration of upcoming Jhimpir-1 – Tricon-A 132kV S/C 132kV single circuit. It should be noted that the length of circuits used for the simulations are confirmed from site visit and agreed with NTDC official. They may change slightly during the implementation of the project. In addition, the connectivity of Lootah WPP with neighboring wind power plants may change, depending upon the COD of the project.
- The scheme of interconnection of these newly proposed WPPs proposes the following reinforcements in place at Jhimpir cluster.
  - 220 kV D/C transmission line approx. 5km long on twin bundled Greeley conductor looping In/out of second circuit of existing Jamshoro – KDA-33 D/C transmission line at the proposed Jhimpir-2 220/132 kV substation
  - Addition of 4th 220/132 kV transformer at the newly proposed Jhimpir-2 220/132 kV substation.

- 132kV double circuit transmission line approx. 135 km long on twin bundled Greeley conductor for connecting 8 WPPs in the first loop to Jhimpir-2 220/132 newly proposed substation.
- 132kV double circuit transmission line approx. 168 km long on twin bundled Greeley conductor for connecting 8 WPPs in the second loop to Jhimpir-2 220/132 newly proposed substation.
- In this Integrated study, the interconnection of Lootah WPP includes 132 kV D/C transmission line approx. 6 km long, on Greeley conductor for looping in/out on the 132kV single circuit from Jhimpir-1 to Tricon-A grid station.

➢ The existing grid system of HESCO and NTDC in the vicinity of Lootah WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Lootah WPP and no bottlenecks or constraints have been found in the grid system.

➢ Wind Farm of Lootah has been modeled considering Type-3 WTGs. They are Doubly Fed Induction Generators which are designated as Type-3 WTG. The terminal voltage is 0.7 kV. The medium voltage level of wind farm has been selected as 22 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Farm substation.

➢ The design of scheme of 132/22 kV substation of Lootah Wind Farm has been provided by the Client and is attached in Appendix – 2.

➢ Load flow analysis has been carried out for peak and Off Peak scenarios of August/September 2019 considering the COD targeted by Lootah WPP and a future scenario of 2022, for the dispersal of power from Lootah WPP into NTDC system using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme has been evolved by performing the load flow studies testing the steady state performance for normal as well as N-1 contingency conditions fulfilling the Grid Code criteria of Wind Power Plants. The reactive power requirement at point of common coupling to meet PF of ± 0.95, voltage and line loading criteria are fulfilled by these studies.

All the scenarios have been studied by considering maximum dispatch from all the existing/planned WPPs in the Jhimpir and Gharo Clusters.

- For the base case of summer 2019, capacity constraint was observed in 500kV network emanating from Jamshoro and upwards in case of some critical outages of 500kV circuits. Due to this capacity constraint, partial curtailment in the output of all WPPs under study was proposed to bring the loading on the 500kV network within limit. Hence output of Lootah WPP is curtailed to 7MW in case of some contingency events. For the future scenario of 2022, this issue of capacity constraint is resolved due to the following major reinforcements:
    - 660kV HVDC from Matiari to Lahore
    - 660kV HVDC from Port Qasim to Faisalabad West
- With the proposed reinforcements highlighted earlier and the curtailment process for the base year of 2019 under special circumstances, the load flow results for peak and Off Peak scenarios establish that the proposed scheme of interconnection of Lootah WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in terms of absorbing all the output of Lootah WPP and other proposed WPPs under normal as well as the contingency conditions.
- Maximum and minimum short circuit levels for three-phase faults and single-phase faults have been evaluated. The maximum SC levels have been evaluated for the year 2022 and minimum short circuit level for the year 2019 for the most stringent conditions. The fault levels of Lootah 132 kV are 16.38 kA and 12.22 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Lootah Farm Substation as per NTDC requirements for 132 kV. The fault levels for Lootah 22 kV are 22.54 kA and 24.03 kA for 3-phase and single-phase faults respectively for year 2022.

  Therefore the short circuit rating for 22 kV switchgear is recommended as 31.5 kA. It has been found that the proposed scheme provides maximum SC strength for the evacuation of Lootah WPP power to the grid.

  The switchgear ratings for Lootah WPP substation are as follows:

132 kV:

Short circuit rating = 40 kA (3 sec.)

Continuous rating = 2500 A

22 kV:

Short circuit rating = 31.5 kA (3 sec.)

Continuous rating = 2500 A

- Transient Stability analysis has been carried out for Lootah WPP based on their selection of Type-3 WTGs, with connectivity of proposed scheme. Different disturbances have been simulated to apply stresses from the system faults on the wind farm and vice versa and it was found that Lootah WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Lootah WPP side did not cause any stress on the main grid or the power plants nearby and in the HESCO area such that the whole system remained stable under all events.
- The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault clearing due to stuck-breaker (breaker failure) reason. The simulations have proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.
- The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and unbalance are within the permissible limits of IEC and other International Standards.
- There are no technical constraints whatsoever in the way of bringing in the 50 MW of Lootah Wind Power Plant at the proposed site and scheduled time of commissioning, in any respect of steady state (load flow) or short circuit or dynamic performance (stability) or power quality issues related to this plant.

Report Contents

1. Introduction

1.1 Background

There exists a huge wind corridor in coastal Sindh, starting from Gharo-Ketti Bandar up to Jhimpir and upward, that has been identified by AEDB with an actual potential of about 50,000 MW. There are many entrepreneurs coming forward to tap this huge natural resource of power.

Study of 10 WPPs was recently carried out by NTDCL Planning Department after cancellation of LOIs of NBT-II and NBT-III. New Jhimpir-2 220/132 kV substation was proposed to evacuate power from these WPPs. For further evacuation of power from Jhimpir area, an integrated study was required depicting optimal utilization of resources. Hence a study of 15 new WPPs was carried out in integration with the already planned / existing WPPs. Lootah Wind Energy limited is amongst those entrepreneurs who have come forward with a Wind Power Plant within this cluster at Jhimpir.

The proposed wind farm shall have the installed capacity of about 50 MW of electricity. The project is being developed in the private sector and the electricity generated from this project would be supplied to power grid of NTDC. The services of Power Planners International have been engaged to perform the impact studies of penetration of this wind power in the national grid to evolve the most feasible interconnection scheme for this plant.

1.2 Objectives

The overall objectives of this study are:

1. Impact of Lootah Wind Power Plant on the System
2. Impact of the System on Lootah Wind Power Plant

These impacts are to be studied for different operating conditions of Plant as well as the System. The operating condition of the plant may vary from its 100 % output to 0 % i.e. no output at all. The system conditions would be peak load, off-peak load for the spot year of study i.e. 2019. A future scenario of 2022 is also studied.

The impacts are required to be studied for steady state as well as the dynamic and disturbed conditions of the system. The specific objectives are:

1. To develop a feasible scheme of interconnections of Lootah Wind Power Plant (WPP) with HESCO/NTDC network at 132 kV for which right of way (ROW) and space at the terminal substations would be required to be made available.
2. To check the load-ability of lines and transformers to be within their rated limits satisfying the clauses OC 4.8, OC 4.9, and OC 4.10 of NEPRA Grid Code regarding the criteria of operation of frequency, voltage and stability under normal and contingency conditions for peak and off-peak load conditions of grid as well as the plant.
3. To check the voltage profile of the bus bars of the neighboring interconnected network under different operating conditions
4. To check the reactive power limitations of the wind turbines and the neighboring generators of the system; and evaluate the size of switched shunt capacitor banks at Medium Voltage level of substation of collector system of Lootah Wind Farm to regulate the voltage under steady state and contingency conditions to fulfill the Grid Code criteria of ± 0.95 Power Factor at the point of common coupling (interface point) interconnecting Wind Farm and the Grid i.e. 132 kV gantries of outgoing circuits.
5. To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations at 220 kV and 132 kV voltage levels to be within the rating of equipment of these substations, and also determine the short circuit ratings of the proposed equipment of the Medium Voltage substation of collector system of Lootah Wind Farm and the NTDC/HESCO substations of 132 kV connecting with the Lootah Wind Farm.
6. To check the minimum short circuit strength of the system to handle large variation of generation of wind turbine

7. To check if the interconnection with the grid withstands transient stability criteria of post fault recovery with good damping satisfying the NEPRA Grid Code.
8. Transient stability to see the dynamic performance of Lootah WPP in response to Grid disturbances and vice versa the dynamic impact of disturbances in Lootah WPP on the Grid.
9. To check the ability of the wind turbine generators of Lootah WPP to remain connected following major disturbances and grid disruptions i.e. the Low Voltage Ride Through (LVRT) capability to satisfy the Grid Code requirement of LVRT for 180 ms.
10. Analysis of power quality issues such as flicker, voltage-unbalance, harmonics and resonance of the system.

1.3 Planning Criteria

The planning criteria required to be fulfilled by the proposed interconnection as enunciated in NEPRA Grid Code including Addendum No.1 for WPPs are as follows:

Voltage	± 5 %, Normal Operating Condition
	± 10 %, Contingency Conditions
Frequency	50 Hz, Continuous, ± 1% variation steady state
	49.4 - 50.5 Hz, Under Contingency

Short Circuit:

132 kV Substation Equipment Rating 40kA

Dynamic/Transient and Low Voltage Ride through (LVRT):

The WTGs should remain connected during voltage dip upto 30 % level, under fault conditions by ride through capability for the following sequence of disturbance

1. Total normal fault clearing time from the instant of initiation of fault current to the complete interruption of current, including the relay time and breaker interruption time to isolate the faulted element, is equal to 100 ms (5 cycles) for the systems of 132 kV and above.

2. In case of failure of primary protection (stuck breaker case), the total fault clearing time from the instant of initiation of fault current to the complete interruption of current to isolate the faulted element, including the primary protection plus the backup protection to operate and isolate the fault, is equal to 180 ms (9 cycles) for 132 kV and higher voltage levels.

3. LVRT of 100 ms for normal fault clearing and 180 ms for the case of failure of primary protection (stuck breaker case).

Reactive Power and Power factor:

Reactive Power Control to maintain the power factor within the range of 0.95 lagging to 0.95 leading, over full range of plant operation, according to Dispatch Instructions/manual voltage adjustment requirements.

Power Quality Requirements:

As per IEC61400-21standards

1.4 Operating Criteria

The operating requirements to be fulfilled by the proposed Lootah WPP as enunciated in NEPRA Grid Code for WPPs (Addendum No.1) are as follows:

Black Start and Islanded Operation:

Exempted

Active Power and Frequency Control:

Exempted from precise frequency control responsibility

Synchronization / De-Synchronization:

(i) The Wind Power Plant will manage for

  (a) Smooth Synchronization

  (b) Smooth De-Synchronization

(ii) The above operations, achieved through appropriate equipment, will be without jerk(s), felt on the grid system

Power Generation Capability Forecasting Requirement:

(i) Power Generation Capability Forecasting, of average power on hourly basis, will be managed by the Wind Power Plant as required from conventional power plants, except provisions of clause (ii) & (iii) below.

(ii) The forecasting, as required in (i), will be estimated by Wind Power Plant through

(a) Expected availability of plant during the period of forecast.

(b) Predicted value of wind speed at site based upon analysis of historic wind data available.

(iii) The forecasting, as required in (i), will be on the basis of total Wind Power Plant and break-up for each WTG will not be required.

(iv) The forecasted values will not be a binding upon the wind power plant as actual wind speeds may differ significantly from predicted values over short durations.

1.5 Input Data

The input data of HESCO / NTDC has been used in this study as per letter No. GMPP/CEMP/TRP-380/2728-30 dated 24-06-2016. The load forecast and the generation expansion plan of NTDC provided vide this letter has been used as shown in Appendix 2.

The input data regarding Lootah Wind Farm has been provided by the client who has indicated to use 2 MW Gamesa-G114 Type-3 WTG. The main parameters of the WTGs have been attached in Appendix-2.

2. Description of Problem & Study Approach

2.1 Description of the Problem

In Pakistan, there is big wind power generation potential in the Southern parts of Sindh province, which is untapped as yet. However now with the establishment of Alternative Energy Development Board, this sector of power generation has taken an unprecedented stride and many entrepreneurs have come forward to build small and big Wind farms in this area.

The peculiar nature of wind power turbine is such that its output fluctuates in terms of MW and MVAR, being dependent on the wind speed and its direction. So long as the capacity of wind farm is less significant compared to the size of the power grid it is connected, these fluctuations are absorbable without compromising the power quality. But as the penetration of wind power in the power grid increases, the capability of the power grid may not be as strong as may be required to absorb constant variations of MW, MVAR and hence rapid deviation in voltage and frequency from the system's normal operating set point.

The existing power plants nearest to the vast wind farm areas of Jhimpir in the existing power grid are Kotri and Jamshoro Power Plants. Next to them is Hub with 1200 MW and Lakhra with 150 MW installed capacities respectively. Apparently this amount of generation in Southern grid seems strong enough to absorb the penetration of wind power. But there are other variables that necessitate detailed studies like strengths of nodes of connectivity, loading capacity of the transmission lines to evacuate power from Wind Farm area and dynamic response of wind turbine generators and neighboring conventional synchronous generators.

The dynamic response of power plants in the neighborhood may not be uniform; as some of them are gas turbines and some are steam turbines i.e. Kotri has gas turbines whereas Jamshoro, Lakhra and Hub have steam turbines. Normally gas turbines are faster than the steam turbines to respond to changes in the system. The dynamic studies will determine how they respond to dynamic behavior of Lootah WPP.

The above-mentioned thermal power plants do not run at their full capacity all along the whole year. During high water months when cheaper hydel power is abundantly available in the Northern grid of NTDC, many generating units of these plants are shut down for the sake of economic dispatch. Therefore in high hydel season, which is low thermal season by default, the southern power grid would get weaker in terms of system strength, especially during off-peak hours. The dynamics of this season is different than that of high thermal season.

There are different models of different sizes and make available in the market viz. GE, Vestas, Nordex, Gamesa, Siemens, Goldwind and Vensys etc. The dynamics of each model may be different with respect to grid's dynamics. Lootah Wind Energy is considering using 2 MW Gamesa G-114 Type-3 WTGs which are Doubly Fed Induction Generators.

2.2 Approach to the problem

We will apply the following approaches to the problem:

- According to the COD of Lootah WPP as provided by the Client Lootah Energy (Pvt) Limited, we have decided to perform our analysis for the scenario of August/September 2019 to judge the maximum impact of the plant for High Wind Season after the COD of the plant.
- The base case for the year 2019 comprising all 500kV, 220kV and 132 kV, and 66kV system would be prepared envisaging the load forecast, the generation additions and transmission expansions for each year particularly in the Southern parts of the country. The case would include all the proposed and existing Wind Power Plants which have been developed or are going to be developed on a fast track basis and are expected to be commissioned by 2019 as per the latest schedule of AEDB.
- Interconnection scheme without any physical constraints, like right of way or availability of space in the terminal substations, would be identified.

- Perform technical system studies for peak load conditions of high wind seasons' power dispatches, to confirm technical feasibility of the interconnections.
- The proposed interconnection scheme will be subjected to steady state analysis (load flow), short circuit and transient stability to test the robustness of the scheme under normal and contingency conditions by checking steady state and transient/dynamic behavior under all events.
- Determine the relevant equipment for the proposed technically feasible scheme of interconnection
- Perform sensitivity studies considering adjacent wind farms to check their impact on HESCO/NTDC Grid. This sensitivity check can be performed for the ultimate planned number of Wind Power Plants in the neighborhood of Lootah Wind PP.

3. Analysis of Network Prior to Lootah WPP Interconnection

3.1 Description of the Network

The electrical grid, which is relevant for interconnection of Lootah Wind PP, is the 500, 220 and 132 kV network that stretches through South of Hyderabad and Jamshoro up to coastal areas of Southern Sindh. The sketch of this network for the spot year 2019 after the addition of reinforcements in the area is shown in Appendix-4.

In this sketch, all the existing and proposed WPPs in the Jhimpir and Gharo clusters are modeled. Newly proposed 220/132kV substation of Jhimpir-2 is shown connected in loop In-out of the 220 kV Jamshoro – KDA double circuit and Jhimpir-1 – Gharo-New 220 kV single circuit. On 25th January 2017 a site visit was carried out to develop technically correct as well as least cost scheme for evacuation of power from these WPPs. Based on the location of the WPPs, two loops (each having 8 WPPs) were proposed at Jhimpir-2 grid station. The list of WPPs in each loop is provided below:

First Loop:

- Lakeside (50 MW)
- Nasda (50 MW)
- Trans-Atlantic (50 MW)
- Uni-Energy (50 MW)
- Iran Pak (50 MW)
- Artistic (50 MW)
- Act-2 (50 MW)
- Cacho (50 MW)

Second Loop:

- Indus (50 MW)
- Gul Ahmed (50 MW)
- Metro-2 (60 MW)
- Zulaikha (50 MW)
- Din Energy (50 MW)
- Noor (50 MW)

- Shafi Energy (50 MW)
- DHA-City (50 MW)

The details of the other 6 newly proposed WPPs is provided below:

- Master Green (50 MW) connected via loop In-out of the proposed Nooriabad – Jamshoro Old 132kV single circuit
- 14 MW Burj WPP connected via loop In-Out of 132 kV Thatta – FWEL-I single circuit
- Norinco-2 (50 MW), Sino Well (50 MW) and Tricom (50 MW) connected via loop In-out of the 132kV Jhimpir-1 – T.M.Khan 132kV single circuit
- Lootah Energy (50 MW) connected via loop In-out of the upcoming Jhimpir-1 – Tricon-A 132kV single circuit

We have carried out the studies of the case "without" Lootah WPP but including all the other planned and existing WPPs which have COD by 2019 to ascertain if there are any constraints in the system prior to Lootah WPP's commissioning.

3.1.1 Load Forecast

The load forecast of NTDC attached in Appendix-2 has been used for the preparation of all the study scenarios.

3.1.2 Generation and Transmission Expansion Plan

There is a sizable addition of generation in the Southern part of the country. The latest generation and transmission expansion plan provided by NTDCL has been used and is attached in Appendix-2.

3.2 Load Flow Analysis

Load flow analysis has been carried out for the NTDC / HESCO network including all the existing and planned wind power plants at Jhimpir and Gharo clusters but without including Lootah WPP to see if the network was adequate for dispersal of wind power without it. The case has been studied for the system conditions of August/September 2019. Jhimpir-2 220/132 kV substation would also be completed before the commissioning of the said WPPs. In order to ensure proper economic dispatch in the southern area for this High Wind High Water Season, it was essential to have a reasonable energy mix with contributions from both thermal and wind power plants. We kept the dispatch of the nearby power plants such as Thatta, Nooriabad and Kotri-Site at its maximum. Kotri GTPS was operated at 50% capacity. Output from all the existing/ under construction/ planned Wind Plants was kept at maximum. The results are shown plotted in Exhibit 3.0 in Appendix-3 which indicates that no circuit is loaded more than its rated power carrying capacity and the voltage profile at all the bus bars of 132 kV, 220 kV and 500 kV is within the permissible range. All power plants are running at lagging power factor within their rated range.

The N-1 contingency check has also been applied and the results are attached in Appendix-3 as below:

Exhibit 3.1	Tricon-A to Jhimpir-1 132 kV Single Circuit Out
Exhibit 3.2	Tricon-C to Jhimpir-1 132 kV Single Circuit Out
Exhibit 3.3	Tricon-B to Tricon-A 132 kV Single Circuit Out
Exhibit 3.4	TGF-2 to Jhimpir-1 132 kV Single Circuit Out
Exhibit 3.5	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 3.6	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 3.7	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit 3.8	Kotri GTPS to Jamshoro Old 132 kV Single Circuit Out
Exhibit 3.9	Jhimpir-New to TM Khan Road 220 kV Single Circuit Out
Exhibit 3.10	Jhimpir-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.11	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 3.12	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 3.13	Jamshoro 500/220 kV Single Transformer Out
Exhibit 3.14	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 3.14a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 3.15	Jamshoro to Dadu 500 kV Single Circuit Out

power, and has no limitations in terms of power transfer capacity under normal as well as N-1 contingency, prior to connection of Lootah WPP. We will check the adequacy of network after adding Lootah WPP in Chapter 6.

4. Development of Interconnection Scheme

4.1 Interconnection of Lootah 50 MW WPP

To connect the wind farms to the main grid of NTDC / HESCO, one may think of connecting each Farm with any nearby available 132 kV substation by laying a direct 132 kV circuit from the gantry of each Farm's substation. But it is important to first see if the nearby substation has enough short circuit strength to connect to a Wind farm having characteristics of time-varying output because flicker and harmonics' resonance are a function of short circuit MVA of that node where this variation would be occurring.

In case there is a potential of developing of several Wind Farms in the same area, then a better interface or common coupling point may be a collector substation where each Wind Farm is connected and then this collector substation is connected to suitable node or nodes of the main national grid system. From suitable node or nodes we mean the nodes (bus bars) having relatively higher short circuit levels to mitigate the impact of time-variant generation from WTG.

In case of Lootah WPP, the nearest substation is the collector substation of Jhimpir-1 220/132 kV which is proposed for evacuation of power from already planned 10 WPPs and will be operational before the commissioning of the said power plant.

4.2 Proposed Interconnection Scheme

The scheme of interconnection of newly proposed WPPs proposes the following reinforcements in place at Jhimpir cluster.

- 220 kV D/C transmission line approx. 5km long on twin bundled Greeley conductor looping In/out of second circuit of existing Jamshoro – KDA-33 D/C transmission line at the proposed Jhimpir-2 220/132 kV substation
- Addition of 4^{th} 220/132 kV transformer at the newly proposed Jhimpir-2 220/132 kV substation.

- 132kV double circuit transmission line approx. 135 km long on twin bundled Greeley conductor for connecting 8 WPPs in the first loop to Jhimpir-2 220/132 newly proposed substation.
- 132kV double circuit transmission line approx. 168 km long on twin bundled Greeley conductor for connecting 8 WPPs in the second loop to Jhimpir-2 220/132 newly proposed substation.
- In this Integrated study, the interconnection of Lootah WPP includes 132 kV D/C transmission line approx. 6 km long, on Greeley conductor for looping in/out on the 132kV single circuit from upcoming Jhimpir-1 – Tricon-A grid station.

The connection scheme of Lootah WPP for the scenario of August/September 2019 as shown in Appendix - 4 is located in Jhimpir district. Lootah Wind Power Plant would be connected by loop in-loop out configuration of the upcoming Jhimpir-1 and tricon-A 132kV single circuit. It should be noted that the length of circuits used for the simulations are confirmed from site visit and agreed with NTDC official. They may change slightly during the implementation of the project. In addition, the connectivity of Lootah WPP with neighboring wind power plants may change, depending upon the COD of the project.

5. Modeling of Lootah Wind Farm

5.1 Electrical Layout of Wind Farm

5.1.1 Lootah WPP Energy Selection

Lootah has selected Type-3 Gamesa WTGs which they are considering to install on their Wind Farm at Jamshoro. It is a Doubly Fed Induction Generator. Each WTG would step up from its terminal LV voltage of 0.7 kV to a medium voltage (MV) that will be 22 kV.

5.1.2 Electrical Layout

The WTGs would be connected to MV collector cables of 22 kV laid down in the Farm connecting each line (row) of the WTGs to the Farm substation. The layout is shown in **Sketch – 3** (Appendix-5), briefly described as follows;

Line – 1	WTGs 1-6	(6 x 2 = 12 MW)
Line – 2	WTGs 7-12	(6 x 2 = 12 MW)
Line – 3	WTGs 13-18	(6 x 2 = 12 MW)
Line – 4	WTGs 19-25	(7 x 2 = 14 MW)

The average length of cable between the two WTGs has to be enough to completely outdo the wake effect from the adjoining WTG based on thumb rule to leave 4xD (rotor diameter) between the WTGs to take care of wake effect. In actual micro-siting the distances between WTGs might be slightly different due to many other factors. We have taken about 400 meters distances between the WTGs.

The Farm Substation has been assumed to be located somewhere in the middle of the Farm.

The three collector circuits of 22 kV would thus be laid as shown in Sketch-3 and explained as follows;

Collector Line-1	from WTG-1 to Farm Substation
Collector Line-2	from WTG-7 to Farm Substation
Collector Line-3	from WTG-13 to Farm Substation
Collector Line-4	from WTG-19 to Farm Substation

Since each collector would carry a max of approximately 14 MW at normal rating, the 22 kV collector circuits loading capacity should be in the range of 16 MVA each, giving some margin for reactive power at 0.95 Power Factor and some losses in the circuits with certain overload capacity as well.

5.1.3 22 kV Collector Circuits

The MV voltage level selected by Lootah for interconnection of collector groups of WTGs in the Farm is 22 kV. Underground cables will be used with length of approx. 3 km. Further details regarding the type of cable is provided in Appendix - 2.

5.2 Wind Farm Substation 132/22 kV

A substation would be built in the middle of the Farm to collect all the power from the WTGs, spread out in the Farm, at medium voltage (MV) level of 22 kV and step-up this power to high voltage (HV) level of 132 kV so that the Farm's output may be evacuated to the main grid of NTDC. The single line diagrams of the substation are briefly shown in Sketch-1 and 2 in Appendix-5 for 22 kV and 132 kV respectively.

Keeping in view the data provided by the Client, the bus bar scheme for 132 kV level is double bus with a coupler i.e. double bus-single-breaker scheme. Keeping in view the NTDC/DISCOs practice, we propose to provide good reliability to a power plant as follows:

- Single bus scheme with a sectionalizer to enable to have two bus sections at 22 kV.
- Double-bus single-breaker scheme with a Bus Coupler at 132 kV

The schemes are shown in Sketch-1 and 2 respectively and described as follows.

5.2.1 Conceptual Design of 22 kV

The single line diagram SLD–1 in Appendix-5 shows the conceptual design of 22 kV (MV) bus bar of the Farm substation. It comprises of

- Two single bus-sections of 22 kV with a bus sectionalizer
- Four breaker bays to connect four collector double circuits of WTG Lines 1-4
- Two breaker bays to connect two transformers of 132/22 kV

- Two breaker bays for connecting two auxiliary transformers of 22/0.4 kV
- Two breaker bays to connect switched shunt capacitor banks

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity = 31.5 kA

Normal continuous current = 1250 A for line breakers

= 2500A for Bus Sectionalizer and Power TF

5.2.2 Conceptual Design of 132 kV

Single-line-diagram SLD–2 (Appendix–5) shows 132 kV bus bars of the Farm substation, which would comprise as follows:

- Double bus bars with a Bus Coupler
- Two breaker bays to connect two transformers 132/22 kV
- Two breaker bays to connect two circuits of 132 kV i.e. double circuit on single tower overhead line to connect to the grid system.

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity = 40 kA

Normal continuous current = 1250 A for line and TF breakers

= 2500 A for Bus Sectionalizer

The other equipment of the substation consists of:

- Two 132/22 kV, 31.5/40/50 MVA ONAN/ONAF1/ONAF2 OLTC transformers, 132±11×1%/22kV, to fulfill N-1 criteria of Grid Code
- Two station auxiliary transformers 22/0.4 kV
- Two switched shunt capacitor banks each of the size of 10 MVAR (5 x 2 MVAR) with contactors and PLC (Programmable Logic Controller).
- Energy meters would be installed on HV side (132 kV) of the 132/22kV transformers.

6. Load Flow Analysis

Load flow analysis has been carried out for the proposed scheme of interconnection of Lootah WPP with NTDC grid for the base scenario of September 2019.

6.1 Modeling of Wind Farm in Load Flow

Representation of all the individual machines in a large Wind Farm is inappropriate in most grid impact studies [1]. There is a provision in the model structure of PSS/E to allow single equivalent WTG machine model to represent multiple WTGs. However there are limitations. Disturbances within the local collector grid cannot be analyzed, and there is some potentially significant variation in the equivalent impedance for the connection to each machine. A single machine equivalent requires the approximation that the power output of all the machines will be the same at a given instant of time. For grid system impact studies, simulations are typically performed with the initial wind of sufficient speed to produce the rated output on all the machines. Under this condition, the assumption that all the machines are initially at the same (rated) output is not an approximation [2]. Otherwise this assumption presumes that the geographic dispersion is small enough that the wind over the farm is uniform. Though simulations of bulk system dynamics using a single machine equivalent are adequate for most planning studies, we have adopted a rather more detailed level of modeling by using an equivalent machine just for one group of WTGs connected to one collector feeder. Since we have four collector feeders connecting to four groups of WTGs, therefore there are four equivalent WTGs assumed for each collector group in this study report. The Farm Substation is represented by two bus bars as Lootah medium voltage bus named Lootah-MV 22 kV and Lootah 132 kV, with two inter-bus transformers of 31.5/40/50 MVA each. These transformers have an overload capacity of 50 MVA for a limited time to cover N-1 contingency criteria of Grid Code i.e. in case of outage of one transformer, the other can take up the full output of Farm i.e. 50 MVA.

6.2 Reactive Power Requirements

Lootah is considering using 2 MW Gamesa Type-3 WTGs, which are doubly fed induction generators, in their WPP. Its power factor is 0.95 lagging (capacitive/generating) and 0.95 leading (inductive/absorbing). The maximum reactive power output that can be available at the 0.7 kV terminal is 0.66 MVAR for each WTG. Part of this reactive power will be consumed by the 0.7/22 kV step-up (GSU) transformer and the rest may be consumed in the MV collector cables of the wind farm. However some reactive power might reach the MV bus bar of Farm substation. That means each WTG is self sufficient to meet VAR absorption requirement of its step-up transformer with some contribution of VARs to the Farm MV network.

The Grid Code Addendum No.1 requires to meet the criteria of ± 0.95 power factor at the point of interconnection with the NTDC/HESCO grid at 132 kV (point of common coupling). Therefore a Farm of 50 MW generating capacity is required to pump 16.4 MVAR to the grid at full output of 50 MW. The VAR generating capability of WTG at 0.95 PF will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers, collector cables and the HV/MV i.e. 132/22 kV transformers at the Farm substation. In order to meet the Grid Code criteria, we need to install switched shunt capacitor bank at 22 kV bus of the Farm substation of sufficient size capable of delivering approx. 16.4 MVAR at 132 kV bus after VAR loss across 132/22 kV transformers.

6.3 Load Flow Analysis for Peak Load Scenario of August/September 2019

Load flow analysis has been carried out for the NTDC / HESCO network to see the steady state impact of adding the generation of Lootah WPP on the network including the existing/under-construction/planned WPPs in the Jhimpir and Gharo Cluster. The network configuration is same for Jhimpir and Gharo clusters as indicated in Appendix-4 and discussed in Ch. 3.

The integrated case has been studied for the system conditions of summer 2019, the time line associated with the COD of Lootah

WPP. In order to ensure proper economic dispatch in the southern area for this High Wind High Water Season, it was essential to have a reasonable energy mix with contributions from both thermal and wind power plants. We kept the dispatch of the nearby power plants such as Thatta, Nooriabad and Kotri-Site at its maximum. Kotri GTPS was operated at 50% capacity. Output from all the existing/ under construction/ planned Wind Plants was kept at maximum.

Load flow simulations have been run for normal and contingency conditions. The results are shown plotted in Appendix-6.

6.3.1 Normal Case

Exhibit 6.1.0 shows the normal case under the system conditions of summer 2019. All the wind farms in Jhimpir and Gharo clusters with installed capacity of 50 MW or 49.5 MW have been assumed after deducting Farm losses and given some diversity in the maximum output of all the Wind Power Plants at one time. For Lootah WPP, 47.9 MW is assumed to be delivered at the point of delivery to grid at 132 kV.

All these loadings are within the rated limits of these circuits. The bus voltages on all the substations in Southern HESCO grid are within the normal limits of operation.

We see that all the WTGs are running at a power factor above its rated value of 0.90 not using full reactive power capability leaving enough margin to cover contingencies. The switched shunt capacitor bank of 20 MVAR at 22 kV bus bar is supplying 18.07 MVAR at (22.14 kV) voltage and, after VAR loss across 132/22 kV transformers, supplying about 15.72 MVAR (nearly 0.95 PF) at 132 kV bus i.e. fulfilling the Grid Code criteria at the point of interconnection. The voltage profile on all the bus bars of 132 kV of HESCO grid are well within the normal operating criteria of ± 5 % off the nominal.

6.3.2 Contingency cases and evolving of reliable scheme

The N-1 contingency cases have been run and the results have been shown plotted as under:

Exhibit 6.1.1 Lootah Energy 132/22 kV Single Transformer Out

Exhibit 6.1.2	Lootah Energy to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.1.3	Tricon-A to Lootah Energy 132kV Single Circuit Out
Exhibit 6.1.4	Tricon-C to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.1.5	TGF-2 to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.1.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.1.7	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 6.1.8	Jhimpir to Kotri-GTPS 132 kV Single Circuit Out
Exhibit 6.1.9	Kotri GTPS to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.1.10	Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit Out
Exhibit 6.1.11	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.1.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.1.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.1.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.1.15	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.1.15a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 6.1.16	Jamshoro to Dadu 500 kV Single Circuit Out
Exhibit 6.1.16a	Jamshoro to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW

The load flow results of the network in the close vicinity of Lootah WPP shown plotted in Exhibits 6.1.1 to 6.1.14 indicate that all the power flows on the lines are within the rated limits of this network.

For some critical outages of 500kV circuits shown in Exhibit 6.1.15 and 6.1.16, capacity constraint was observed in 500kV network emanating from Jamshoro and upwards. Due to this capacity constraint, partial curtailment in the output of all WPPs under study was proposed to bring the loading on the 500kV network within limit. Hence output of Lootah WPP is curtailed to 7MW in case of these contingency events. Results are shown in Exhibit 6.1.15(a) and 6.1.16(a). The details of the curtailment of WPPs are provided below:

Plant Name	Gross output	Curtailed Output
Lake Side	50 MW	7 MW
Nasda	50 MW	7 MW
Uni-Energy	50 MW	7 MW
Indus	50 MW	7 MW
Noor	50 MW	7 MW
Sino Well	50 MW	7 MW
Lootah	50 MW	7 MW
Shafi Energy	50 MW	7 MW
Lootah	50 MW	7 MW
Iran Pak	50 MW	7 MW
Metro-2	60 MW	9 MW
Norinco-2	50 MW	7 MW
DHA City	50 MW	7 MW
Tricom	50 MW	7 MW

Total Wind Capacity: 724 MW
Wind Capacity after curtailment: 113 MW

The results also show that under all events of outages the switched shunt capacitor banks at 22 kV bus regulates the voltage under all events. The reactive power being supplied by the 20 MVAR switched shunt capacitor banks as proposed by the client connected at 22 kV bus, maintains the supply of VARS to the grid under all contingencies adjusting its output according to the system requirement.

In addition, twin bundled Greeley conductor (368 MVA) is used for the interconnection of all the wind farms coming in the second loop at Jhimpir-2 220/132 kV collector substation. In the load flow simulation, however, the MVA capacity is assumed to be 404 MVA taking into account the increase in MVA capacity of the conductors at high wind speed during high wind season. This is true for all the conductors in the area, whether lynx or rail, a 10% increase in the thermal rating is assumed.

6.4 Load Flow Analysis for Off-Peak Load Scenario of August/September 2019

Load flow analysis has been carried out for the off-peak conditions of August/September 2019 for the NTDC / HESCO network to see the steady state impact of reduced loads and generations as a higher loading on the circuits is expected during the off-peak conditions.

Load flow simulations have been run for normal and contingency conditions. The results are shown plotted in Appendix-6.

Exhibit 6.2.0 shows the normal case under the off-peak system conditions of August/September 2019. All these loadings are within the rated limits of these circuits. The bus voltages on all the substations in Southern HESCO grid are within the normal limits of operation.

The N-1 contingency cases have been run and the results have been shown plotted as under:

Exhibit 6.2.1	Lootah Energy 132/22 kV Single Transformer Out
Exhibit 6.2.2	Lootah Energy to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.2.3	Tricon-A to Lootah Energy 132kV Single Circuit Out
Exhibit 6.2.4	Tricon-C to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.2.5	TGF-2 to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.2.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.2.7	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 6.2.8	Jhimpir to Kotri-GTPS 132 kV Single Circuit Out
Exhibit 6.2.9	Kotri GTPS to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.2.10	Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit Out
Exhibit 6.2.11	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.2.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.2.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.2.14	Jamshoro 500/220 kV Single Transformer Out

Exhibit 6.2.15	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.2.15a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 6.2.16	Jamshoro to Dadu 500 kV Single Circuit Out
Exhibit 6.2.16a	Jamshoro to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW

The load flow results of the network in the close vicinity of Lootah WPP shown plotted in Exhibits 6.2.1 to 6.2.14 indicate that all the power flows on the lines are within the rated limits of this network.

For some critical outages of 500kV circuits shown in Exhibit 6.2.15 and 6.2.16, capacity constraint was observed in 500kV network similar to the peak scenario discussed above. Hence curtailment of WPPs as discussed above was carried out in this off-peak scenario as well. Results after curtailment are shown in Exhibit 6.2.15(a) and 6.2.16(a).

6.5 Load Flow Analysis for Future Scenario of 2022

Load flow analysis has been carried out for the peak conditions for future scenario of 2022 for the NTDC / HESCO network. All the future reinforcements that were proposed till 2022 are modeled in the case.

Load flow simulations have been run for normal and contingency conditions. The results are shown plotted in Appendix-6.

Exhibit 6.3.0 shows the normal case under the peak system conditions of future year 2022. All these loadings are within the rated limits of these circuits. The bus voltages on all the substations in Southern HESCO grid are within the normal limits of operation.

The N-1 contingency cases have been run and the results have been shown plotted as under:

Exhibit 6.3.1	Lootah Energy 132/22 kV Single Transformer Out
Exhibit 6.3.2	Lootah Energy to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.3.3	Tricon-A to Lootah Energy 132kV Single Circuit Out

Exhibit 6.3.4	Tricon-C to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.3.5	TGF-2 to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.3.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.3.7	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 6.3.8	Jhimpir to Kotri-GTPS 132 kV Single Circuit Out
Exhibit 6.3.9	Kotri GTPS to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.3.10	Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit Out
Exhibit 6.3.11	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.3.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.3.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.3.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.3.15	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.3.16	Jamshoro to Dadu 500 kV Single Circuit Out

The results show that power flows on intact 132 kV circuits remain within their rated limits. For this future scenario of 2022, the issue of capacity constraint that was observed in the base case of 2019 is resolved due to the following major reinforcements in the system:

- 660kV HVDC from Matiari to Lahore
- 660kV HVDC from Port Qasim to Faisalabad West

6.6 Conclusion of Load Flow Results

With the proposed reinforcements and the curtailment process for the base year of 2019 under special circumstances, the load flow results of the proposed scheme of interconnection of Lootah WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in terms of absorbing all the output of Lootah WPP under normal as well as the contingency conditions for all the scenarios studied.

Lootah Wind Power would be connected by loop in-loop out configuration of the newly proposed Jhimpir-1 to Tricon-A 132kV single circuit. Greeley conductor with the capacity of 184 MVA per circuit has been used for the interconnection of Lootah WPP.

References:

1- WECC Wind Generator Modeling Group; *Generic Type-3 Wind Turbine-Generator Model for Grid Studies; Version 1.1*, September 14, 2006, p. 2.2

2- *Ibid.* p.3.1

7. Short Circuit Analysis

7.1 Methodology and Assumptions

The methodology of IEC 909 has been applied in all short circuit analyses in this report for which provision is available in the PSS/E software used for these studies. For calculations of maximum fault levels the bus voltage has been assumed as 1.1 PU i.e. 10 % above the nominal as per IEC909. For calculations of minimum fault levels the bus voltage has been assumed as 0.9 PU i.e. 10 below the nominal. That covers the entire ± 10 % range of the ratings of the equipment.

7.1.1 Assumptions for maximum and minimum short circuit levels

7.1.1.1 Assumptions-Maximum short circuit levels

For evaluation of maximum short circuit levels we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the future year of 2022 to assess the maximum impact of Lootah WPP.

The maximum fault currents have been calculated with the following assumptions under IEC909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence

Desired voltage magnitude at bus bars set equal to 1.10 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition

However tabular results of some significant bus bars of 220 kV and 132 kV in the electrical vicinity of Lootah WPP have also been produced and placed in Appendix-7.

7.1.1.2 Assumptions-Minimum Short Circuit Levels

The minimum fault currents are important for the evaluation of power quality issues such as flicker, unbalance, sudden voltage dip and harmonics.

To assess the minimum short circuit levels we have considered conditions of 2019 to simulate the minimum short circuit strength of southern grid. For Lootah WPP we have assumed dispatch of 25% of its capacity for the minimum short circuit calculations i.e. just one collector group with partial output of approx. 12 MW is on bar.

For minimum fault currents we have applied the following assumptions under IEC 909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence

Desired voltage magnitude at bus bars set equal to 0.9 P.U. i.e. 10 % lower than nominal, which is the minimum permissible voltage under contingency condition.

7.2 Fault Currents Calculations

7.2.1 Maximum Short Circuit Levels for the Year 2022

The short circuit levels have been calculated and plotted on the bus bars of 500 kV, 220 kV and 132 kV of substations lying in the electrical vicinity of our area of interest i.e. Jhimpir, T.M.Khan Road, Jamshoro and Gharo area, and are shown plotted in the Exhibit 7.2 for the scenario of 2022 and attached in Appendix-7. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-7 for the 500 kV, 220 kV and 132 kV bus bars of our interest i.e. the substations connecting in the three branches of 132 kV running South of Hyderabad up to Southern Sind coast line. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 7.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations which normally are 25 kA or 31.5 kA for older substations and 40 kA for new substations.

The fault levels of Lootah 132 kV are 16.38 kA and 12.23 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Lootah Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Lootah 22 kV are 22.54 kA and 24.03 kA for 3-phase and single-phase faults respectively for 2022. Therefore the short circuit rating recommended for 22 kV switchgear is recommended as 31.5 kA.

Table-7.1

Maximum Short Circuit Levels with Lootah WPP – 2022

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Lootah-MV 22 kV	22.54	24.04
Lootah 132 kV	16.38	12.23
Tricon A 132 kV	15.48	11.38
Tricon B 132 kV	15.80	10.44
Tricon C 132 kV	16.11	10.75
Nooriabad 132kV	11.93	13.16
Kotri GTPS 132kV	19.73	19.01
Jamshoro Old 132kV	23.84	22.88
Jamshoro New 132kV	25.25	24.90
T.M. Khan 132 kV	14.80	14.24
Jhimpir-1 132 kV	30.36	26.67
Jhimpir-2 132 kV	24.21	22.22
Jhimpir 132 kV	11.45	10.49
Thatta 132 kV	6.62	6.50
Halla RD 132 kV	22.36	21.44
Gharo-New 132 kV	10.37	9.81

Jhimpir-2 220 kV	29.86	21.96
Jhimpir-1 220 kV	23.18	18.06
Gharo-New 220 kV	10.17	8.0
T.M. Khan Road 220 kV	22.56	18.46
Halla RD 220 kV	29.68	22.90

7.2.2 Minimum short circuit levels

The minimum fault levels have been calculated for minimum dispatch of power in the grid system. The plotted results of short circuit analysis are attached as Exhibit 7.1. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the faulted bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-7 for the 132 kV bus bars of our interest.

The total minimum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 7.2.

Table-7.2

Minimum Short Circuit Levels with Lootah WPP 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Lootah-MV 22 kV	17.39	19.32
Lootah 132 kV	11.25	10.01
Tricon A 132 kV	10.52	9.37
Tricon B 132 kV	10.69	9.95
Tricon C 132 kV	10.88	10.19
Nooriabad 132kV	7.88	8.40
Kotri GTPS 132kV	13.25	12.28
Jamshoro Old 132kV	15.93	15.61

Jamshoro New 132kV	16.89	16.90
T.M. Khan 132 kV	10.92	10.62
Jhimpir-1 132 kV	18.25	18.95
Jhimpir-2 132 kV	17.01	16.32
Jhimpir 132 kV	7.31	6.87
Thatta 132 kV	4.74	4.63
Halla RD 132 kV	15.59	15.20
Gharo-New 132 kV	7.44	7.53
Jhimpir-2 220 kV	19.01	15.69
Jhimpir-1 220 kV	14.89	13.39
Gharo-New 220 kV	7.42	6.31
T.M. Khan Road 220 kV	14.89	12.91
Halla RD 220 kV	18.13	14.88

7.3 Conclusions of Short Circuit Analysis

As a whole for the peak scenario of 2022, the fault levels at all the 132 kV bus bars are well below the short circuit rating of the equipment at these substations.

The fault levels of Lootah 132 kV are 16.38 kA and 12.22 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Lootah Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Lootah 22 kV are 22.54 kA and 24.03 kA for 3-phase and single-phase faults respectively for 2022. Therefore the short circuit rating recommended for 22 kV switchgear is 31.5 kA.

Similarly for minimum short circuit case for the year 2019, the fault levels are also well below the short circuit rating of the equipment at these substations.

The short circuit strength is very important for Power Quality issues like flicker, harmonics and voltage unbalance. Exhibit 7.1.1 and 7.1.2 show the results of minimum fault levels in MVA to be used in Power Quality analysis carried out in Ch.9.

The fault levels indicate that there are no constraints in terms of short circuit ratings of the equipment of the adjoining substations and there is improvement in minimum fault levels. The proposed interconnection scheme holds well on the basis of short circuit analysis as well.

8. Transient Stability Analysis

The objective of transient stability study is to see:

1. Dynamic impact of Lootah Wind Power Plant on the System
2. Dynamic impact of the System on Lootah Wind Power Plant

8.1 Assumptions & Methodology

8.1.1 Type-3 WTG Dynamic Model

Lootah is considering using Doubly Fed Induction Generator which is designated as Type-3 WTG in their Wind Power Plant. We have used the generic Type-3 wind turbine-generator model, which has been developed and has been made available by Siemens–PTI to their users of PSS/E software. Only the main parameters have been incorporated in this model, whereas other details and minute control parameters have been based on assumptions in the controllers of generic model of Siemens-PTI software PSS/E.

8.2 Dynamic Impact of System Disturbances

8.2.1

Fault Type: 3-Phase			
Fault Location: Lootah 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Lootah to Jhimpir-1 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Lootah 132 kV 2. Lootah MV 22 kV 3. Tricon-A 132 kV 4. Tricon-C 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220kV	The voltages of all the bus bars recover after fault clearance	8.1.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.1.2

• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.1.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.8
• **MW Line Flow** • **MVAR Line Flow**	Tricon-C to Jhimpir-1 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.1.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.1.11

8.2.2

Fault Type: 1-Phase			
Fault Location: Lootah 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Lootah to Jhimpir-1 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Lootah 132 kV 2. Lootah MV 22 kV 3. Tricon-A 132 kV	The voltages of all the bus bars	8.2.1

	4. Tricon-C 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220kV	recover after fault clearance	
Frequency	Lootah 132 kV	Recovers after fault clearance	8.2.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.2.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.8
• **MW Line Flow** • **MVAR Line Flow**	Tricon-C to Jhimpir-1 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.2.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.2.11

8.2.3

Fault Type: 3-Phase
Fault Location: Lootah MV 22 kV bus bar
Fault Duration: 9 cycles (180 ms)
Line Tripping: Lootah 132/22 kV Single Transformer

Variable	Bus/Line	Response	Figure No.
Voltage	1. Lootah 132 kV 2. Lootah MV 22 kV 3. Tricon-A 132 kV 4. Tricon-C 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220kV	The voltages of all the bus bars recover after fault clearance	8.3.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.3.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.3.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.8
• **MW Line Flow** • **MVAR Line Flow**	Lootah 132/22 kV Single Transformer	Attains steady state value after damping of oscillations	8.3.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.3.11

8.2.4

Fault Type: 3-Phase			
Fault Location: Lootah MV 22 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: One Collector Group of 12 MW			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Lootah 132 kV 2. Lootah MV 22 kV 3. Tricon-A 132 kV 4. Tricon-C 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220kV	The voltages of all the bus bars recover after fault clearance	8.4.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.4.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.4.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.8
• **MW Line Flow** • **MVAR Line Flow**	Lootah 132/22 kV Single Transformer	Attains steady state value after damping of oscillations	8.4.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV	Damps down quickly and	8.4.11

	4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	attain a steady state value	

8.2.5

Fault Type: 3-Phase			
Fault Location: Tricon-A 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Tricon-A to Lootah 132kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Tricon-A 132 kV 2. Lootah 132 kV 3. Lootah MV 22 kV 4. Tricon-C 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220kV	The voltages of all the bus bars recover after fault clearance	8.5.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.5.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.5.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.8
• **MW Line Flow** • **MVAR Line Flow**	Lootah to Jhimpir-1 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.5.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.10

Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.5.11

8.2.6

Fault Type: 1-Phase			
Fault Location: Tricon-A 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Tricon-A to Lootah 132kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Tricon-A 132 kV 2. Lootah 132 kV 3. Lootah MV 22 kV 4. Tricon-C 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220kV	The voltages of all the bus bars recover after fault clearance	8.6.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.6.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.6.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.8

• **MW Line Flow** • **MVAR Line Flow**	Lootah to Jhimpir-1 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.6.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.6.11

8.2.7

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-1 to Tricon-C 132kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1132 kV 2. Lootah 132 kV 3. Tricon-A 132 kV 4. Tricon-C 132 kV 5. Jhimpir-1 220 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.7.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.7.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.6

• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.7.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.8
• **MW Line Flow** • **MVAR Line Flow**	Lootah to Jhimpir-1 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.7.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.7.11

8.2.8

Fault Type: 1-Phase

Fault Location: Jhimpir-1 132 kV bus bar

Fault Duration: 9 cycles (180 ms)

Line Tripping: Jhimpir-1 to Lootah 132kV Single Circuit

Variable	Bus/Line	Response	Figure No.
Voltage	1. Jhimpir-1132 kV 2. Lootah 132 kV 3. Tricon-A 132 kV 4. Tricon-C 132 kV 5. Jhimpir-1 220 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.8.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.8.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.4

• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.8.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.8
• **MW Line Flow** • **MVAR Line Flow**	Lootah to Jhimpir-1 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.8.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.8.11

8.2.9

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 220 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 220 kV 2. T.M.Khan Road 220 kV 3. Jhimpir-2 220 kV 4. Jamshoro 220 kV 5. Gharo-New 220 kV 6. Lootah 132 kV	The voltages of all the bus bars recover after fault clearance	8.9.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.9.2

• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.9.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit	Attains steady state value after damping of oscillations	8.9.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.9.11

8.2.10

Fault Type: 1-Phase			
Fault Location: Jhimpir-1 220 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 220 kV 2. T.M.Khan Road 220 kV 3. Jhimpir-2 220 kV	The voltages of all the bus bars	8.10.1

	4. Jamshoro 220 kV 5. Gharo-New 220 kV 6. Lootah 132 kV	recover after fault clearance	
Frequency	Lootah 132 kV	Recovers after fault clearance	8.10.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.10.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit	Attains steady state value after damping of oscillations	8.10.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.10.11

8.2.11

Fault Type: 3-Phase			
Fault Location: Jhimpir-2 220 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-2 to KDA-33 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**

Voltage	1. Jhimpir-2 220 kV 2. Jhimpir-1 220 kV 3. T.M.Khan Road 220 kV 4. Jamshoro 220 kV 5. Gharo-New 220 kV 6. Lootah 132 kV	The voltages of all the bus bars recover after fault clearance	8.11.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.11.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.11.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.11.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.11.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.11.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.11.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.11.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to KDA-33 220 kV Single Circuit	Attains steady state value after damping of oscillations	8.11.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.11.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.11.11

8.2.12

Fault Type: 1-Phase

Fault Location: Jhimpir-2 220 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-1 to KDA-33 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-2 220 kV 2. Jhimpir-1 220 kV 3. T.M.Khan Road 220 kV 4. Jamshoro 220 kV 5. Gharo-New 220 kV 6. Lootah 132 kV	The voltages of all the bus bars recover after fault clearance	8.12.1
Frequency	Lootah 132 kV	Recovers after fault clearance	8.12.2
• **Plant MW Output** • **Plant MVAR Output**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.12.3
• **Speed** • **Pmechanical**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.12.4
• **Torque** • **Pitch Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.12.5
• **Paero** • **Shaft Twist Angle**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.12.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Lootah Collector Group-1 0.7 kV	Recovers	8.12.7
• **Pitch control** • **Pitch compensation**	Lootah Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.12.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to KDA-33 220 kV Single Circuit	Attains steady state value after damping of oscillations	8.12.9
• **MW Output** • **MVAR Output**	Tricon-A Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.12.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hub 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.12.11

8.5 Conclusion of Stability Study

The transient stability analysis performed as discussed above indicates that the NTDC system connecting to Lootah WPP through the proposed scheme of interconnection is strong enough to absorb the worst disturbances on either side i.e. on Lootah WPP side or the Grid side.

There are no constraints of connecting Lootah WPP with the NTDC grid in terms of transients or dynamic behavior of system under the disturbed conditions either on the Farm side or on the Grid side.

9- Power Quality

The issues of power quality are of particular importance to wind turbines that may cause flicker and distortions in the power supply due to harmonics and unbalance. These issues are more significant for weak systems of low short circuit strength. Therefore we have investigated these issues for the case of minimum short circuit of 2019 for the proposed scheme of interconnection. The same case has been re-evaluated with per unit MVA values and plotted for 3-phase faults in Exhibits 7.1.1 and 7.1.2 in Appendix-7

9.1 Flicker

We have used IEC61400-21 for the calculations of flicker levels for steady-state continuous operation and for switching conditions [1].

9.1.1 Continuous Operation

The probability of 99th percentile flicker emission from a single wind turbine during continuous operation for short time $P_{st\Sigma}$ and longer time flicker levels $P_{lt\Sigma}$ are assumed same and calculated by the following formula

$$P_{st\Sigma} = P_{lt\Sigma} = \frac{1}{S_k} \cdot \sqrt{\sum_{i=1}^{N_{wt}} (c_i(\psi_k, v_a) \cdot S_{n,i})^2}$$

where

$c(\psi_k, v_a)$ is the flicker coefficient of the wind turbine for the given network impedance phase angle, ψ_k at the PCC, and for the given annual average wind speed, v_a at hub-height of the wind turbine at the site;

S_n is the rated apparent power of the wind turbine;

S_k is the short-circuit apparent power at the PCC.

N_{wt} is the number of wind turbines connected to the PCC.

PCC is the point of common coupling of WTGs that is MV bus of Lootah Farm substation.

For minimum short circuit case we have assumed the same case as discussed in paragraph 7.1.1.2 of Chapter 7 in which output of Lootah Wind farm reduced as low as 25 % of its rated capacity. Therefore taking one collector group as one equivalent generator of 6x2 = 12 MW we have calculated as follows;

S_n= 2.22 MVA at 0.90 PF (For 1 WTG)

N_{WT} = 6

S_k for MV bus = 660 MVA

The value of c (ψ_k) at 10 minute average speed (v_a) is supplied by the manufacturer after filed measurements of $P_{St,\ fic}$ for different operating conditions using the following formula.

$$c(\psi_k) = P_{\mathrm{st,fic}} \cdot \frac{S_{\mathrm{k,fic}}}{S_n}$$

where

S_n is the rated apparent power of the wind turbine;

$S_{\mathrm{k,fic}}$ is the short-circuit apparent power of the fictitious grid.

The value of c (ψ_k) may not be greater than 1, therefore for the present analysis we may assume it as 1 for the worst case.

Putting this data in the above Equation, we find

$P_{St\Sigma}$ =$P_{lt\Sigma}$= 0.008239= 0.8239 %

Whereas the acceptable value is 4 % as mentioned in Ref. [2]. Therefore we are much less than the maximum permissible level and the WTGs at Lootah Wind farm would not cause any flicker problem during steady state operation even in the weakest system conditions of minimum short circuit level.

9.1.2 Switching Operation

The most common switching operations would be as follows;

a. Wind turbine start-up at cut-in speed
b. Wind turbine start-up at rated wind speed
c. The worst case of switching between the WTGs

The flicker emission from the wind farm of many machines can be calculated by the following equation as per IEC61400-21 (Section 8.3.2)

$$P_{\mathrm{st}\Sigma} = \frac{18}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{10,i} \cdot \left(k_{f,i}(\psi_k) \cdot S_{n,i} \right)^{3.2} \right)^{0.31}$$

$$P_{\mathrm{lt}\Sigma} = \frac{8}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{120,i} \cdot \left(k_{f,i}(\psi_k) \cdot S_{n,i} \right)^{3.2} \right)^{0.31}$$

where

$N_{10,i}$ and $N_{120,i}$	are the number of switching operations of the individual wind turbine within a 10 min and 2 h period respectively;
$k_{f,i}(\psi_k)$	is the flicker step factor of the individual wind turbine;
$S_{n,i}$	is the rated power of the individual wind turbine.

The values of N_{10} and N_{120} are usually provided by the manufacturers based on field measurements, but if these are not available then IEC61400-21 proposes in section 7.6.3 to use as follows;

For switching conditions of (a) and (b)

$N_{10} = 10$

$N_{120} = 120$

For switching conditions of (c)

$N_{10} = 1$

$N_{120} = 12$

The value of flicker step factor $k_{f,i}$ (ψk) is also provided by the manufacturer after the field and factory measurements; but for the present analysis we assume it to be equal to 1.

Substituting the numbers in the above equations, we find for switching conditions of (a) and (b) as follows;

$P_{st\Sigma} = 0.191663$

$P_{lt\Sigma} = 0.184035$

For switching conditions of (c) these values would be less as the frequency of occurrence assumed i.e. N_{10} and N_{120} are 10 times less.

Engineering Recommendation P28 (Electricity Association, 1989) specifies an absolute maximum of P_{St} on a network from all sources to be 1.0 with a 2 hour P_{St} value of 0.6. However, extreme caution is advised if these limits are approached as the risk of complaints increases when the limits are reached, therefore, an assessment method proposed in the same document is based on P_{St} not exceeding 0.5. British Standard (1995) is less stringent specifying that over a one week period P_{lt} must be less than 1 for 95 % of the time. Gardner (1996) describes P_{St} limits from a number of utilities in the range of 0.25 to 0.5 [2].

The values evaluated above are less than the values recommended in the references of above standards.

9.2 Voltage Unbalance

9.2.1 Voltage Step-Change

The voltage step change would occur when a WTG will be energized, assuming just one WTG in the collector for the minimum No. of units in the collector being energized.

The limit on the voltage change is based on the impedance of the circuit between the point of connection and the MV transformer bus bar together with the apparent power of the wind turbine generators. The following equation needs to be satisfied [2];

$$\Delta V = \sum S_{WKA} [(1/S_{KE}) - (1/S_{KSS})] \leq 1/33 \text{ or } 3\ \%$$

Where

S_{WKA} = MVA rating of the WTG

S_{KE} = Short circuit MVA at connection point

S_{KSS} = Short circuit MVA at MV bus of the wind farm substation

For the minimum short circuit case, we have calculated minimum fault levels in MVA as shown in Exhibit 7.1.2

S_{WKA} = 2.22 MVA for the equivalent WTG of a collector group for the minimum case

S_{KE1} for one WTG in collector group = 320 MVA (Exhibit 7.1.2)

S_{KSS} = 650 MVA (Exhibit 7.1.2)

Substituting these values we get

$$\Delta V = 0.002751282 = 0.27513\ \%$$

Which is much less than the limit of 3 %

9.2.2 Voltage Fluctuation

For the limits of voltage fluctuation, we need to satisfy the following equation [2].

$$\sqrt{\sum (P_{WKA} / S_{KE})^2} \leq 1/25 \text{ or } 4\ \%$$

Where

P_{WKA} = MW rating of the WTG

S_{KE} = Short circuit MVA at connection point

Punching all the numbers in this equation, we get

Voltage Fluctuation = 0.00556= 0.556 %

Which is less than the maximum permissible specified as 4 %.

10- Conclusions & Recommendations

- Interconnection Study has been carried out for 50 MW Lootah WPP which is proposed to be connected by loop in-loop out configuration of the Up-coming Jhimpir-1 – Tricon-A 132kV single circuit. The scheme of interconnection of newly proposed WPPs proposes the following reinforcements in place at Jhimpir cluster.
    - 220 kV D/C transmission line approx. 5km long on twin bundled Greeley conductor looping In/out of second circuit of existing Jamshoro – KDA-33 D/C transmission line at the proposed Jhimpir-2 220/132 kV substation
    - Addition of 4th 220/132 kV transformer at the newly proposed Jhimpir-2 220/132 kV substation.
    - 132kV double circuit transmission line approx. 135 km long on twin bundled Greeley conductor for connecting 8 WPPs in the first loop to Jhimpir-2 220/132 newly proposed substation.
    - 132kV double circuit transmission line approx. 168 km long on twin bundled Greeley conductor for connecting 8 WPPs in the second loop to Jhimpir-2 220/132 newly proposed substation.
    - In this Integrated study, the interconnection of Lootah WPP includes 132 kV D/C transmission line approx. 6 km long, on Greeley conductor for looping in/out on the 132kV single circuit from Jhimpir-1 to Tricon-A
- The existing grid system of HESCO and NTDC in the vicinity of Lootah WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Lootah WPP and no bottlenecks or constraints have been found in the grid system.
- Wind Farm of Lootah has been modeled considering Type-3 WTGs. They are Doubly Fed Induction Generators which are designated as Type-3 WTG. The terminal voltage is 0.7 kV. The medium voltage level of wind farm has been selected as 22 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Farm substation.

- The design of scheme of 132/22 kV substation of Lootah Wind Farm has been provided by the Client and is attached in Appendix – 2.
- Load flow analysis has been carried out for peak and Off Peak scenarios of August/September 2019 considering the COD targeted by Lootah WPP and a future scenario of 2022, for the dispersal of power from Lootah WPP into NTDC system using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme has been evolved by performing the load flow studies testing the steady state performance for normal as well as N-1 contingency conditions fulfilling the Grid Code criteria of Wind Power Plants. The reactive power requirement at point of common coupling to meet PF of ± 0.95, voltage and line loading criteria are fulfilled by these studies. All the scenarios have been studied by considering maximum dispatch from all the existing/planned WPPs in the Jhimpir and Gharo Clusters.
- For the base case of summer 2019, capacity constraint was observed in 500kV network emanating from Jamshoro and upwards in case of some critical outages of 500kV circuits. Due to this capacity constraint, partial curtailment in the output of all WPPs under study was proposed to bring the loading on the 500kV network within limit. Hence output of Lootah WPP is curtailed to 7MW in case of some contingency events. For the future scenario of 2022, this issue of capacity constraint is resolved due to the following major reinforcements:
    - 660kV HVDC from Matiari to Lahore
    - 660kV HVDC from Port Qasim to Faisalabad West
- With the proposed reinforcements highlighted earlier and the curtailment process for the base year of 2019 under special circumstances, the load flow results for peak and Off Peak scenarios establish that the proposed scheme of interconnection of Lootah WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in terms of absorbing all the output of Lootah WPP and other proposed WPPs under normal as well as the contingency conditions.

- Maximum and minimum short circuit levels for three-phase faults and single-phase faults have been evaluated. The maximum SC levels have been evaluated for the year 2022 and minimum short circuit level for the year 2019 for the most stringent conditions. The fault levels of Lootah 132 kV are 16.38 kA and 12.22 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Lootah Farm Substation as per NTDC requirements for 132 kV. The fault levels for Lootah 22 kV are 22.54 kA and 24.03 kA for 3-phase and single-phase faults respectively for year 2022.

  Therefore the short circuit rating for 22 kV switchgear is recommended as 31.5 kA. It has been found that the proposed scheme provides maximum SC strength for the evacuation of Lootah WPP power to the grid.

  The switchgear ratings for Lootah WPP substation are as follows:

  132 kV:

  Short circuit rating = 40 kA (3 sec.)

  Continuous rating = 2500 A

  22 kV:

  Short circuit rating = 31.5 kA (3 sec.)

  Continuous rating = 2500 A

- Transient Stability analysis has been carried out for Lootah WPP based on their selection of Type-3 WTGs, with connectivity of proposed scheme. Different disturbances have been simulated to apply stresses from the system faults on the wind farm and vice versa and it was found that Lootah WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Lootah WPP side did not cause any stress on the main grid or the power plants nearby and in the HESCO area such that the whole system remained stable under all events.
- The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault clearing due to stuck-breaker (breaker failure) reason. The simulations have

proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.

- The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and unbalance are within the permissible limits of IEC and other International Standards.
- There are no technical constraints whatsoever in the way of bringing in the 50 MW of Lootah Wind Power Plant at the proposed site and scheduled time of commissioning, in any respect of steady state (load flow) or short circuit or dynamic performance (stability) or power quality issues related to this plant.

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LOOTAH ENERGY (PVT.) LIMITED

Final Report
August 2017

Initial Environmental Examination (IEE)
50MW LOOTAH ENERGY (PVT.) LIMITED WIND FARM (PHASE-I)

EMC Pakistan
Private Limited

Lootah Energy (Pvt.) Limited

Initial Environmental Examination (IEE) Study
50 MW LOOTAH ENERGY (PVT) LIMITED WIND FARM (Phase-I)

Final Report
August 2017
Ref: IEE-04/08/17

EMC PAKISTAN PVT. LTD.
503, Anum Estate, Opp. Duty Free Shop, Main Shahrah-e-Faisal, Karachi.
Phones(+) 9221- 34311466, 34382860, Fax: (+) 9221-34311467.
E-mail: mail@emc.com.pk, nadeem@emc.com.pk
Website: www.emc.com.pk

EXECUTIVE SUMMARY

The Initial Environmental Examination (IEE) Study for "50 MW Lootah Energy (Pvt.) Limited Wind Farm (Phase-I) Project" has been conducted by EMC Pakistan Pvt. Ltd. The IEE has been prepared in compliance with the requirement under section 17 of Sindh Environmental Protection Act, 2014 and SEPA IEE/EIA Regulations 2014 for scheduled development projects.

The proposed project is a 50 MW Wind Farm in Jhimpir in Thatta District. The project site is about 5,000 acres, acquired by the proponent for this project. 50 MW Lootah Energy-Phase I Project has an installed capacity of 50MW. The Wind Turbine Generators (WTGs) for the project will be selected after Wind Study and Technical feasibility study. Twenty-five (25) WTGs are proposed to be installed at the wind farm. Lootah Wind Power Plant would be connected by loop in-loop out configuration of upcoming Jhimpir-1 – Tricon-A 132kV S/C 132kV single circuit. Project is estimated to be completed in 18 months with a cost of about 80-85 million US$ for Phase-I (50MW).

Table Ex.1 : Project at Glance

S. No.	Particulars	Description
1.	Project Site	Jhimpir, District Thatta, Province of Sindh, Pakistan
2.	Project Capacity	50 MW
3.	Total number of Wind Turbines	25

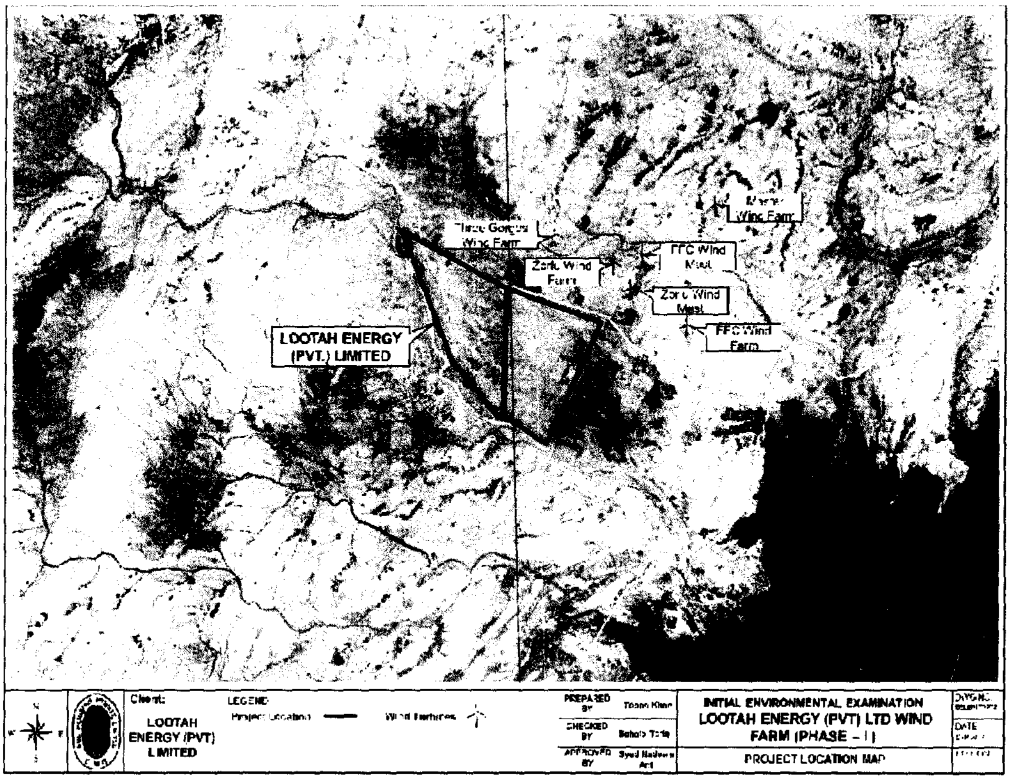


Figure Ex.1: Project Area as shown with polygons. Nearby Wind Farms also visible

Sindh Environmental Protection Act, 2014, empowers the Sindh Environmental Protection Agency (SEPA) as the principal authority for environmental protection in Sindh. It has also established the requirement of environmental assessment of any project in place prior to commencement of work.

According to Sindh Environmental Protection Agency (IEE/EIA) Regulations, 2014, a project falling in any category listed in Schedule I shall file an IEE with the Sindh Environmental Protection Agency (SEPA). **Wind project** is placed in Schedule I: B(7), thus requiring an IEE.

The main objectives of the 50MW Lootah Energy-Phase I Project are to:

- Respond to the national need to produce power from renewable energy sources that are alternative to thermal (Oil/Gas/Coal-fired) and hydro power production systems;
- Establish a wind power generation facility in accordance with GOP's policy and guidelines on development and generation of alternative or renewable energy, being implemented through the Alternative Energy Development Board (AEDB);
- Utilize the potential of wind energy generation identified by the AEDB at the Jhimpir Wind Corridor to reduce the emission of greenhouse gases in Pakistan through clean energy technologies, and
- Utilize the hitherto unexploited wind energy potential which is the resource that will help bridging the significant gap in supply and demand of energy, being faced in Pakistan.

Review of Guidelines for classification of polluted and unpolluted sites with respect to their airshed, watershed, soil, sensitivity of ecosystem including fauna, flora, wildlife, aquatic life, historical and archaeological sites and protected areas, along with assessment of impact by using the "Checklist of actions affecting environment and significance of their impact" has been used in this IEE Study for assessment of impact of different activities for establishment of wind power Project. The review process finds that:

- The impacts from Wind Farm Project construction, operation of machinery & equipment and the resulting air and noise emissions, and wastewater discharges during siting, construction and operation of the Project would be of smaller magnitude and temporary and would confine at the project site or microenvironment and the macro environment will not be impacted.
- Estimates on net savings in terms of air pollutants clearly suggest that operation of the 50MW Wind Power Project would be economically viable and environment friendly.
- Noise from the WTGs at the Project site will have a higher level at the top of the WTGs where the blades sweep air pocket and will decrease with distance and height. The noise level at the community areas at about 1 km will be well within acceptable limits of the World Bank/IFC Guidelines and the limits imposed by Sindh Environmental Quality Standards (SEQS).
- The expected level of air emissions are unlikely to have any significant impact either on its microenvironment that includes the proposed site for the Project, or on its macro environment.

Screening of potential environmental impacts at the different stages viz. siting, construction and operation, leads to the conclusion that:

- The site is already designated for Wind Power Projects and many wind farms are in operation, constructed or planned near the Project site.
- Visual effect, noise effect, flicker effect induced by operation of the wind turbines may have some impact on the community areas, located with 500 m from the WTG installation. The induced impact by operation of the wind turbines on the microenvironment will be monitored through environmental management plan, environmental monitoring plan and mitigated, if necessary, by adoption of suitable measures at the site.
- There are no cultural heritage, recognized archaeological sites, endangered species of flora and fauna, wildlife reserve, or potential tourism sites in the micro and immediate macro environment. Mitigation measures will nevertheless be taken. Keenjhar Lake, a Ramsar site, is located far at a distance of over 7 km from the project site.
- The proposed 50MW Wind Power Project, when commissioned, would become integral part of microenvironment of the already developed wind corridor.

This IEE Study finds that the value-addition characteristics of Lootah Energy-Phase I Project would respond to the principles of sustainable development that aim at "socially equitable and economically viable development to improve the quality of life for all citizens of the Earth, without altering the balance in the ecosystem".

It is therefore concluded that if the field activities, including the implementation of all mitigation measures, are carried out in line with recommendations suggested in the report, the impacts from project's construction and operations will not be adverse so as to deteriorate the environmental quality of the project area and a more detailed report will not be required in the form of an EIA. Additionally careful implementation of the EMP will ensure that environmental impacts are managed and minimized and the project proponent meets all statutory requirements.

There are two essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. The Proponent shall ensure that:

- All mitigation, compensation and enhancement measures proposed in this IEE report are implemented in full, as described in the document;
- The Environmental Management and Monitoring Plan will be implemented in letter and spirit.

Screening of potential impact suggests that the Construction & Operation of 50 MW Lootah Energy (Pvt.) Limited Wind Farm (Phase-I) Project will, on adoption of the suggested mitigation measures, be an environmentally acceptable proposition and will provide clean and renewable energy. It is recommended that the IEE be approved with the condition that recommendations given in the IEE and NOC will be duly followed by the proponent.

Table of Contents

ANNEXURES

Abbreviations

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
GoP	Government of Pakistan
GoS	Government of Sindh
IEE	Initial Environmental Examination
IMC	Independent Monitoring Consultant
SEQS	Sindh Environmental Quality Standards
NOC	No Objection Certificate
NTDC	National Transmission and Dispatch Company
PGA	Peak Ground Acceleration
PMD	Pakistan Meteorological Department
SEPA	Sindh Environmental Protection Agency
TDS	Total dissolved solids
TSS	Total Suspended Solids
WB	World Bank
WHO	World Health Organization

Chapter 1 INTRODUCTION

This report presents the findings of the Initial Environmental Examination (IEE) Study conducted by EMC Pakistan Pvt. Ltd for "50 MW Lootah Energy (Pvt.) Limited Wind Farm (Phase-I) Project" located at Jhimpir in Thatta District, proposed to established by Lootah Energy (Pvt.) Limited.

The proposed project is a 50 MW Wind Farm in Jhimpir, District Thatta. The project site is about 5,000 acres, acquired by the proponent for this project. The Project will have installed capacity of 50MW and will comprise of 25 WTGs.

The report presents the assessment of environmental and social impacts of the proposed project. This document has been prepared in compliance with the mandatory requirements of **Section 17 of Sindh Environmental Protection Act, 2014**. Compliance with the Provisions of SEPA 2014, Section 17 requires that:

"No proponent of a project will commence construction or operation unless he has filed with the Agency an environmental impact assessment, and has obtained from the Agency approval in respect there of".

EMC Pakistan Pvt. Ltd has been commissioned by the Project Proponent to conduct the Initial Environmental Examination (IEE) Study of the proposed project for local regulatory approval from the Environmental Protection Agency of Sindh Province & to meet the requirements of the specified reference framework as follow:

- Applicable national laws and regulations in Pakistan;
- Sindh Environmental Protection Act, 2014;
- Sindh EPA Review of IEE/EIA regulations, 2014;
- Other applicable laws, regulations and guidelines for environmental & social safeguard.

Not only to meet the regulatory requirements, the purpose of this IEE is also to assess the project's environmental and social viability through various environmental and social components and to prepare Environmental Management Plan (EMP) for mitigation of potential adverse impacts along with chalking out of environmental monitoring plan. This report presents baseline data collected for air, water, noise including land, ecology and socio-economic components of environment, identification, prediction and evaluation of impacts and preparation of environmental management plan for mitigation of adverse impacts that may arise due to the proposed project.

1.1. Background and Justification of the Project

Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, and produces no greenhouse gas emissions during operation. Its land use is, however, significant. The government of Pakistan decided to develop wind power energy sources due to problems supplying energy to the southern coastal regions of Sindh and Balochistan. Jhimpir-Gharo Wind Corridor (Figure 1.1) has coverage of about 9,700 sq. km in Sindh and having a gross wind power potential of 43,000 MW. Keeping in view the area utilization constrains etc. the exploitable electric power potential of this area in Sindh is about 11,000 MW. Therefore to exploit the untapped potential of this resource of renewable energy, Project proponent has undertaken this project of 50 MW capacity.

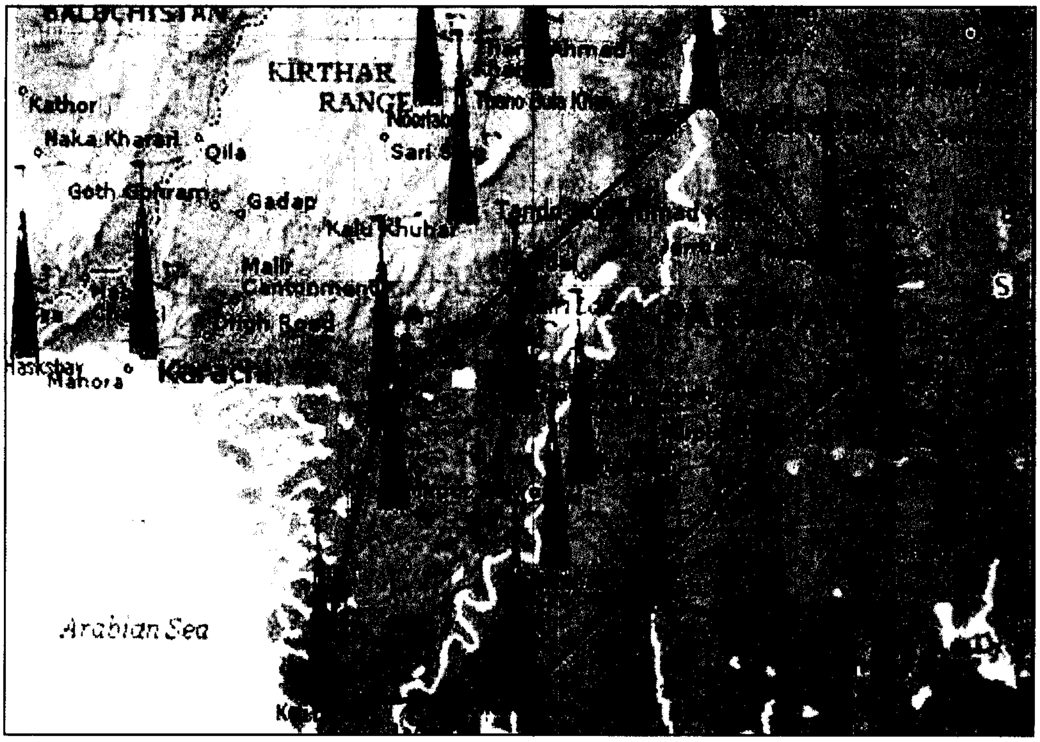
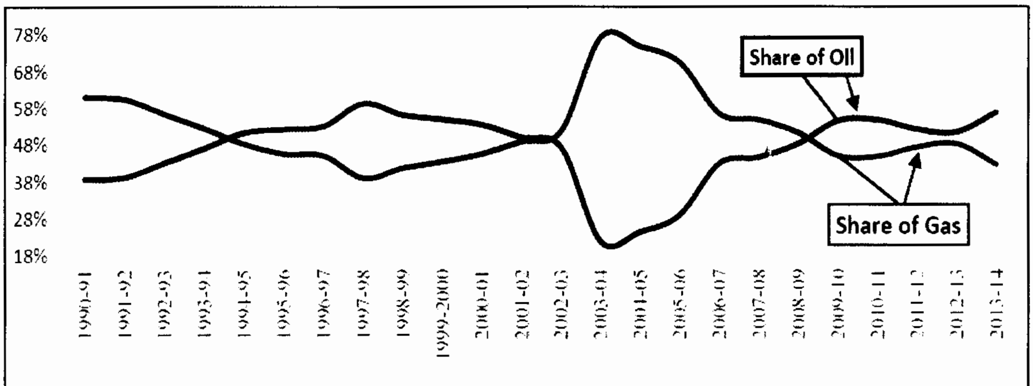


Figure 1.1: Jhimpir - Gharo Wind Corridor (*Source: Pakistan Meteorological Department, PMD*)

1.1.1 Energy Overview

Electricity, although the secondary source of energy, has become indispensable not only for household but for all other spheres like industry, transport etc. Power shortages have become the most influential economic challenge not only causing social disruption but also hitting the real GDP growth rate. In NEPRA State of Industry Report 2013, NEPRA estimated, "the power sector is responsible for 2 to 3 percent reduction in the annual GDP of the country." However, the exact cost including direct and indirect cost of power shortage and its directional relationship with growth is still unfolding for developing economies especially for Pakistan. In this era of modernization, there is continuous increase in consumption of electricity within household as innovation has introduced more electrical-usage appliances to household. With respect to industry, the behavior is little bit different as due to power shortage the large manufacturers have got their own captive power plants to generate electricity and thus became Independent Power Producers (IPPs) under the Power Policy 2002. Nishat, Gul Ahmed, Orient, etc. are some of the examples. All IPPs under the 1994 policy were thermal power plants often using furnace oil as a fuel. Thus the share of oil in thermal power generation remained high which also created a heavy dependence on oil prices and imports.



Source: Energy Year Book, HDIP

Figure 1.2: Share of Oil and Gas in Thermal Power Generation

At present, the country is facing chronic load shedding/blackout problems due to shortage of about 5 GW power supply. The natural gas demand grows beyond the supply and large users, mainly industries, power plants, cement industries and transport sector (CNG stations) are curtailed the gas supply, especially during winter months to ensure supplies to domestic, commercial and small industries or fertilizer. The energy crisis in the country has forced hundreds of industries to shut down operations, affecting industrial production and the livelihoods of thousands of families. It has been a major drag on the economy and a serious impediment to growth with an estimated cost of 10% of the GDP over the past 5 years. Pakistan's energy crisis, if not tackled at both operating and strategic level in the immediate future, might become a national security threat.

Table 1.1 shows the projections of power supply and demand in the NTDC's systems indicating that the gap between supply and demand is likely to persist over next few years. The gap represents about one-third of the total demand in National Transmission and Dispatch Company (NTDC) system resulting in as much as 12 hours of load shedding in urban areas and at times more than 18 hours of load shedding in rural areas. Any slippage in the addition of new generation capacity or fuel availability will further widen the gap between supply and demand.

Chronic power shortages in Pakistan are the most serious constraints to the country's economic growth and job creation. The energy crisis continues to drag down the country's economic performance and spark social instability. Increasing an unpredictable load shedding is estimated to constrain annual gross domestic product (GDP) growth by at least 2%. Hardest hit are the small- and medium-sized enterprises that employ the most number of people but cannot afford back-up electricity generators and fuel. In addition to the economic impact, the shortage has environmental and social consequences as well. Other than complaints of general discomfort, students have complained of effects of the load shedding on their studies. It has resulted in deterioration of health care services. The environmental impact of the shortage has not been studied but potential impacts include increased use of firewood, kerosene, biomass and their effects on deforestation and air quality. As there are no regulatory control over the emission from these small generators, widespread use of generators in the cities results in emissions of nitrogen oxides, particulate matter and sulfur dioxide (from diesel generators) from generator exhaust and hence contributing to the urban air pollution. These generators are also a major source of noise.

Table 1.1: Projected Supply and Demand in NTDC Systems

Financial Year ending 30th June	Installed Capacity (MW)	Planned Gen. Capability as per NTDC (MW)	NTDC Projected Demand during peak hours (MW)	Surplus/ (Deficit) (MW)
NTDC				
2017	24643	20106	23816	(3710)
2018	32812	24640	25140	(500)
2019	34018	26663	26439	224
2020	38740	29059	27725	1334
2021	41950	33776	29082	4694
Source: NEPRA's State of Industry Report, 2016				

Pakistan has remained an energy deficient country, dependent upon imports, mostly oil and oil products. Pakistan has had more success in finding natural gas than oil, and as a result, gas over took oil as the largest source of primary energy supplies, as shown in Figure 1.3.

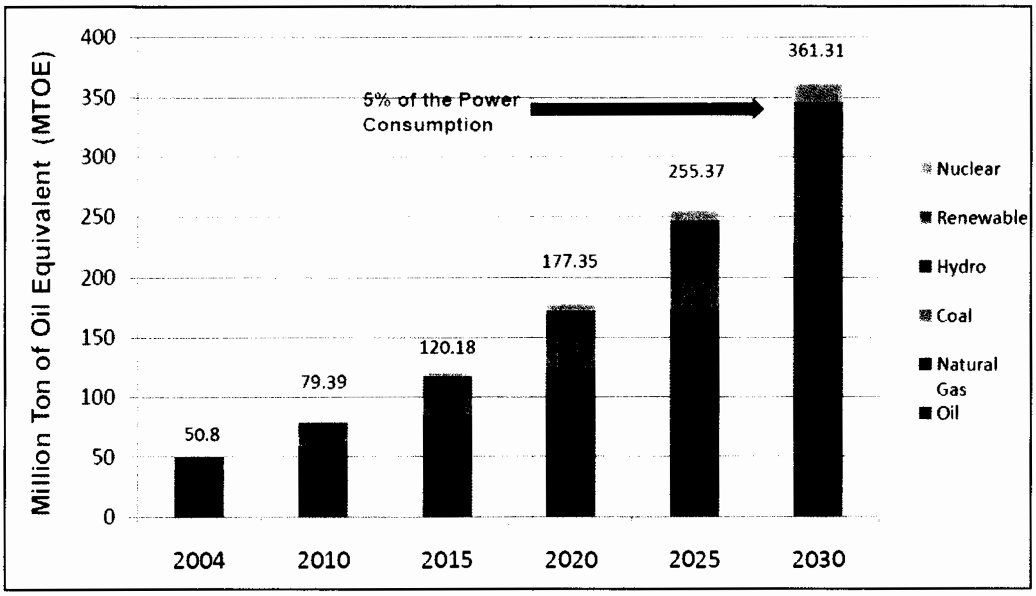


Figure 1.3: Energy Mix Plan Projections (source: Vision 2030-PC, GOP)

The Government considers Thar coal development as a flagship project and believes in it as a means to Energy Security. In addition to Thar Coal resources, the government has taken measures to diversify its energy mix. In this regard, the government has given due attention to fast track the development of Alternative / Renewable Energy resources in the country.

According to AEDB[1], six (6) wind energy projects of cumulative 308.2 MW have achieved COD so far. Nine (9) wind power projects of cumulative 477 MW have achieved financial close and are under construction. Moreover, fourteen (14) projects of 663 MW are at various stages of financial close and feasibility approval.

[1] Alternative Energy Development Board (AEDB). Retrieved from http://www.aedb.org/index.php/ae-technologies/wind-power/wind-current-status

1.1.2 Benefits of Wind Farm Development

A large wind farm may consist of tens of individual wind turbines which are connected to the electric power transmission network. Offshore wind power facilities can harness better wind speeds that are available over the sea almost throughout the year, compared to those installed on land or onshore. Small onshore wind facilities are used to provide electricity to isolated locations and utility companies increasingly buy back surplus electricity produced by small domestic wind turbines.

Although a variable source of power, the intermittency of wind seldom creates problems when using wind power to supply up to 20% of total electricity demand. But as the proportion rises, increased costs are involved since the grid needs to be balanced. Then there is need for upgrading the grid. Power management becomes an important component of the power production system and techniques such as excess capacity, storage, dispatchable backup supply (usually natural gas), exporting and importing power to neighboring areas or reducing demand when wind production is low, have to be developed to mitigate the situation.

Good wind resources are not a constraint to wind power development at this time because Pakistan has abundant favorable wind resources in the vast area of the designated Wind Corridor. The necessary conditions for successful operation of an average wind farm are moderately constraining land use and environmental restriction assumptions, and a 10-mile proximity to existing transmission line assumption.

Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, and produces no greenhouse gas emissions during operation. Its land use is, however, significant. The Table 1.3 shows that requirement of land area per unit of energy produced from different sources is highest for wind power. Project proponent has taken account of the topography of the land and the Project has proposed to 25 WTGs for wind power generation.

Table 1.2: Sq kms per terawatt-hour of energy per year	
Wind	72.1
Hydro	54.0
Solar	36.9
Natural Gas	18.6
Coal	9.7
Geothermal	7.5
Nuclear	2.4
(Source: The Nature Conservancy)	

During operation, the overall cost per unit of energy produced for wind power is similar to the cost for new coal and natural gas installations. The construction of wind farms is not universally welcomed due to the "not in my backyard" affect shared by other coal or gas fired power stations, but negative effects on the environment from wind power are generally much less problematic than those of any other power source.

Above all, Lootah Energy-Phase I Wind Farm will promote the sustainable growth of local economy, improve the living standard of local residents, facilitate the development of local power industry, and meet the demand of sustainable development in the country.

1.2. Project Proponent

Lootah Energy (Pvt.) Limited is the Proponent of the Project. The company aims to establish Wind Farms in Jhimpir, District Thatta, Sindh.

1.3. Brief Description of Project

50MW Lootah Energy (Pvt.) Limited Wind Farm (Phase-I) is a 50 MW Wind Farm in Jhimpir in Thatta District. The project site is about 5,000 acres, acquired by the proponent for this project. Project area allocation map is attached as **Annex-IV**. The Project has an installation capacity of 50MW of 25 wind turbine generators (WTGs).

The brief overview of project is summarized in Table 1.4 below;

Table 1.4: Project at Glance

S. No.	Particulars	Description
1.	Project Site	Jhimpir, District Thatta, Province of Sindh, Pakistan
2.	Project Capacity	50 MW
3.	Total number of Wind Turbine	25

1.3.1 Objectives of the Project

The main objectives of the Project are to:

- Respond to the national need to produce power from renewable energy sources that are alternative to thermal and hydro power production systems;
- Establish a wind power generation facility in accordance with GOP's policy and guidelines on development and generation of alternative or renewable energy.
- Utilize the potential of wind capacity identified by the AEDB at the Jhimpir and Thatta-Thana Bola Khan-Hyderabad Wind Corridors and ground the transferred technology of wind power generation to reduce the emission of greenhouse gases including CO_2 in Pakistan through net energy gain, and
- Utilize the hitherto unexploited wind energy potential which is the resource that will help bridging the significant gap in supply and demand of energy being faced in Pakistan.

1.3.2 Location of the Project

The site is located at around 110 km from Karachi. The site is easily accessible through Karachi-Hyderabad Motorway (M9) and Thatta – Thano Bula Khan access road. Keenjhar Lake is located at over 7 km towards southwest of wind farm site.

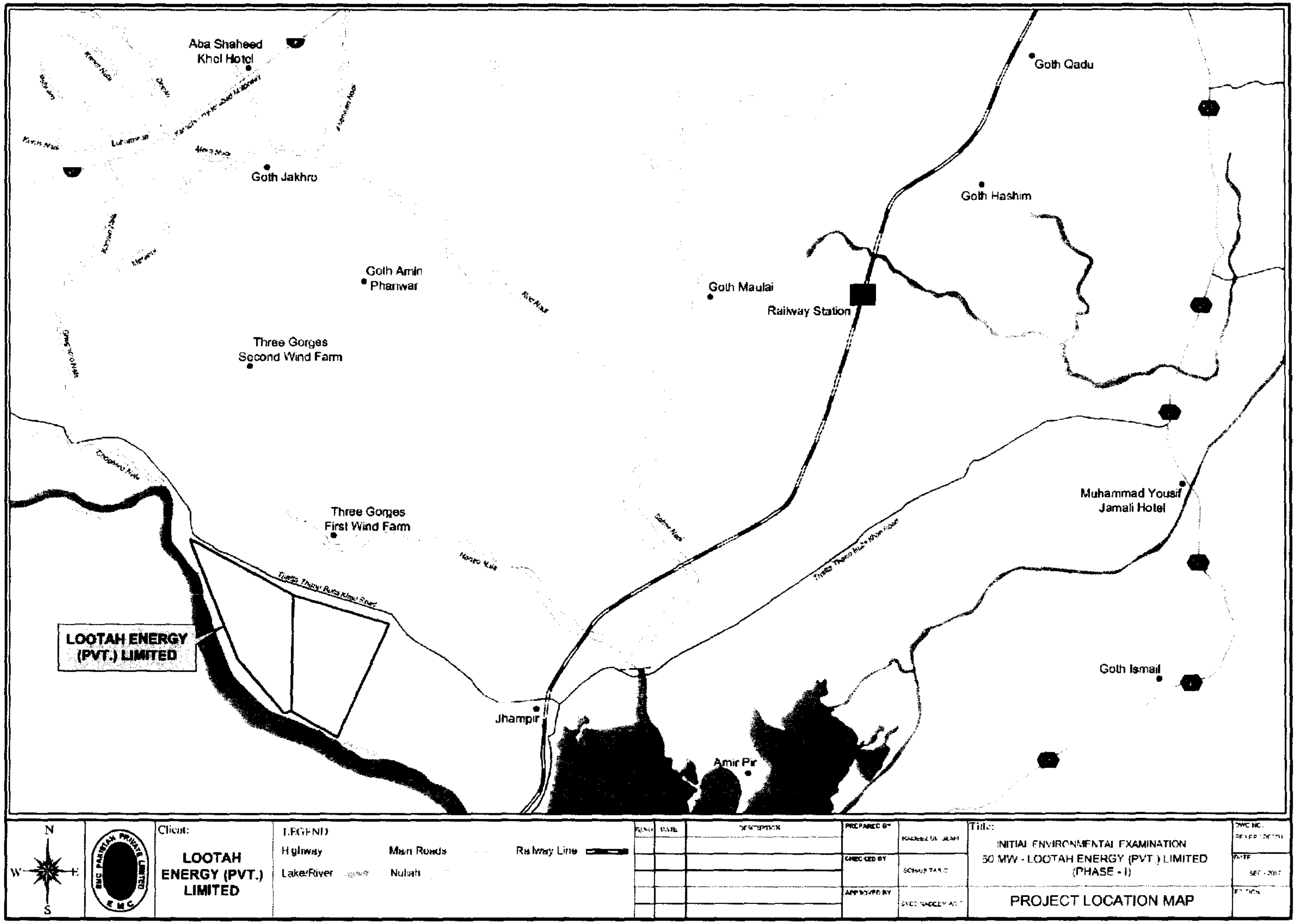


Figure 1.4: Map showing the Proposed Project Area. Neighboring Wind Farms, Jhampir town and Keenjhar lake are also visible

1.4. Initial Environmental Examination (IEE)

The IEE study aims to assess the environmental and social impacts likely to result from the activities proposed under the context of 50MW Lootah Energy Wind Farm Project and propose suitable and practicable mitigation measures for the identified social and environmental impacts. The study will be undertaken to fulfill the legislative requirements stipulated in Sindh Environmental Protection Act (SEPA), 2014 and rules and regulations framed there under.

The IEE shall cover following key aspects during its course of execution:

- Collection of baseline data for physical, biological and socio-economic components for assessment of potential impacts of project activity
- To assess all the major and minor environmental and socio-economic aspects due to project activities in the area in accordance with the national and international environmental legislations, especially the Sindh Environmental Protection Act (SEPA) 2014 and IEE/EIA review regulations.
- To propose appropriate mitigation and monitoring measures that can be included into the design of the project to minimize or prevent any potential adverse effects identified by the assessment.
- To develop a detailed Environmental Management Plan (EMP) for the sustainable implementation mechanism of mitigation measures identified during the study.

1.4.1 Categorization of the Project

The Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations, 2014, define Schedules (I & II) of projects falling under the requirement of IEE or EIA. This IEE Study has, for environmental classification of the Project into Category A or B, taken account of the requirements of the Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2014 which define Schedules (I & II) as follows:

Schedule I: A project falls in Schedule I if it is likely to have adverse environmental impacts, but of lesser degree or significance than those for category 'A' and all the mitigation measures to handle the impact is manageable. Such types of projects need IEE report including EMP.

Schedule II: Projects are categorized in Schedule II if they generate significant adverse environmental impacts that require a comprehensive management plan, or if the project is located within or passes through: a) Areas declared by the Government of Pakistan as environmentally sensitive (National Parks/Sanctuaries/Game Reserve), b) Areas of international significance (e.g. protected wetland as designated by the RAMSAR Convention), or c) Areas designated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as cultural heritage sites. They require an EIA.

According to Sindh Environmental Protection Agency Regulation, 2014, a project falling in any category listed in Schedule I shall file an IEE with the Sindh Environmental Protection Agency (SEPA). **Wind project** are placed in Schedule I: B (7), thus requiring an IEE.

1.5. Adopted Methodology for IEE Study

Various steps were undertaken in order to conduct, prepare and present this IEE report. Brief details on those steps are given below while description is documented in the subsequent sections of this report.

1.5.1 Understanding of the Proposed Operation

This step required collection of information from the proponent on the proposed project and understanding the activities to identify potential impacts from them.

1.5.2 Review of Legislation and Guidelines

National legislation and environmental guidelines were reviewed to set environmental standards that the proponent of the proposed project will be required to adhere to, during the different stages of the project.

1.5.3 Secondary Data Collection

All available published and unpublished information pertaining to the background environment was obtained and reviewed. It included previous environmental studies and environmental baselines conducted by EMC Pakistan Pvt. Ltd. and associated consultants in the past, in the project area and/or its surroundings. All data sources were carefully reviewed to collect project area's related information with regard to physical, biological and socio-economic environment.

1.5.4 Field Data Collection

Detailed environmental baseline survey was conducted to collect primary data on the Project corridor to help identify sensitive receptors. The primary data were examined and compared with secondary data available from earlier environmental studies in the region. The scope of survey included collection of information on following key aspects:

1. To confirm baseline data including Biophysical of the Project Area including the following items with their seasonal variability:
   - Climate and Rainfall
   - Air Quality
   - Noise Quality
   - Wind project details
   - Soil
   - Geology
   - Hydrology
   - Vegetation
   - Fauna
   - Geomorphology
2. To confirm baseline data including Socio Economic Environment of the Project Area including the following items with their seasonal variability
   - Administrative Division
   - Nearby settlement
   - Socio-Economic Activities

- Land use
- Existing Infrastructure and Social Services

1.5.5 Identification of Aspects

Identification of environmental aspects and their significance is fundamentally important for determination of severity of incidence of impacts at different stages of the project. This step is aimed at obtaining an inventory of the aspects. The aspects identified during this step cover all activities in order to determine those which have or can have significant impact on the environment.

1.5.6 Impact Assessment & EMP

Environmental experts at EMC analyzed and assessed the anticipated impacts that are likely to arise due to the identified aspects. Each of the potential impacts identified during the consultation session was evaluated using the environmental, socioeconomic, and project information collected. Air quality monitoring was undertaken to oversee the impact of gaseous emissions. In general, the impact assessment discussion covers the following aspects:

- Present baseline conditions
- Potential change in environmental parameters due to project
- Prediction of potential impacts
- Evaluation of the potential impacts
- Defining of mitigation measures to reduce impacts to as low as practicable
- Monitoring of residual impacts.

An environmental management plan (EMP) was developed to oversee the environmental performance of the project and adoption of proposed mitigation measures. A monitoring plan has also been incorporated in the EMP to monitor impact of all activities and performance of mitigation measures and to identify the residual impact if any, and also the positive/negative changes in the physical, and socioeconomic environment.

1.5.7 Documentation & Review

This is the final step of the IEE study. The data generated during and for the study are compiled and examined by experts of the respective field. Sections of this report were prepared as the study progressed, by EMC office staff in consultation with experts. The report was finally reviewed by Team Leader, who analyzed the information, assessed the potential environmental impacts in the light of national and international guidelines, and examined the alternatives in the light of observations on the field, before organizing the Report in the present form.

1.5.8 Report Structure

This report locates the IEE process in the context of the current EIA/IEE legislation, describes in broad terms the important aspects of the proposed development, and the biophysical and social environments in which it will exist, and identifies possible issues relating to these environments that will be assessed in the IEE study. The structure of the report is as follows:

Section 1 Introduction

Section 2 Describes the proposed project and its associated activities;

Section 3 Contains an overview of applicable national regulatory requirements as well as international conventions, guidelines which are relevant to construction of the reverse osmosis plant and conservation of environment.

Section 4 Describes baseline of project area, which includes existing environmental conditions.

Section 5 Describes assessment of potential impacts of project along with appropriate mitigation measures for reducing these impacts.

Section 6 Defines the Environmental Management Plan including a comprehensive monitoring plan during the various phases of the Project

Section 7 The final section presents the conclusion of the IEE study.

The IEE report has been structured on the standard format, prescribed by the Federal EPA. The main text of the report is supported by a series of Annexures which provide auxiliary information including: Respective sections of applicable Provincial Environmental Laws and Standards which form part of the environmental study.

1.6. IEE Study Team

EMC commissioned the following team for the IEE Study;

Table 1.3: IEE team members

S. No.	Name of Expert	Position in IEE Team
1.	Mr. Syed Nadeem Arif	Director / Team Leader
2.	Mr. Saquib Ejaz Hussain	Project Manager
3.	Dr. Syed Ali Ghalib	Ecological Expert
4.	Mr. Sohaib Tariq	Environmental Engineer
5.	Mr. Mustafa Warsi	Renewable Energy Engineer
6.	Mr. Shahbaz Ahmed	Environmentalist

Chapter 2 DESCRIPTION OF PROJECT

This section describes the description of the project including the technical specifications, methodology for undertaking the project works and the necessary procedures to be followed per applicable national / international guidelines and standards.

The design in the feasibility study stage mainly involves engineering geology, wind resources, WTG (wind turbine generator) type selection and electric power generation estimate, electrical engineering, civil works, environmental protection and water & soil conservation, design budget estimate, financial evaluation and social effect analysis, etc.

2.1. Outline of the Project

The proposed project is the establishment a 50 MW Lootay Energy (Pvt.) Limited Wind Farm (Phase-I) in Jhimpir in Thatta District. The project site is about 5,000 acres acquired by the proponent for this project. The project has an installation capacity of 50MW; 25 WTGs will be installed. Options for WTGs are currently under scrutiny and will be ascertained after the conclusion of Wind study and Technical feasibility report. The project is estimated to be completed in about 18 months and would cost around 80-85 million US$.

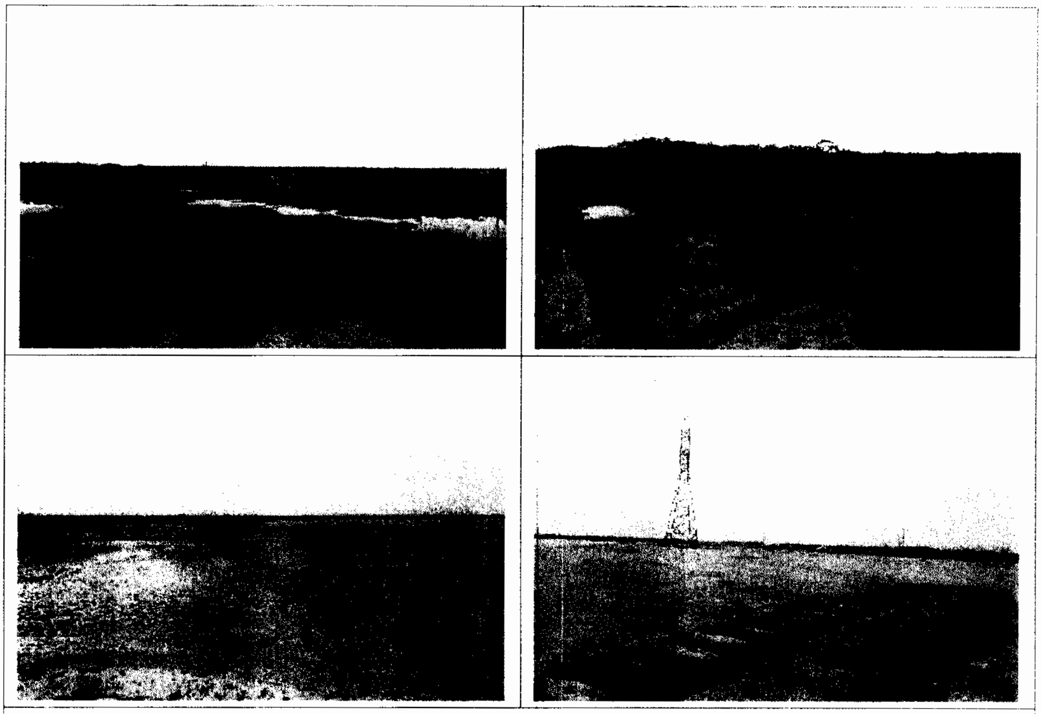
The project components include:

- Wind resource use assessment for macro-siting the Wind Farm in the Jhimpir Wind Corridor.
- Acquisition of data from Karachi Meteorological Station.
- Geological/Geotechnical investigation.
- Finalizing the layout plan for siting the selected wind turbines.
- Construction of access road linking the wind turbines and for transportation of other equipment.
- Installation of selected wind turbines
- Installation of corresponding number of step-up transformers mounted at the foot of each turbine tower.
- Construction of underground electrical collection system leading to the project substation.
- Construction of operations and control buildings.
- O&M of Wind Farm and decommissioning.

2.2. Location of the Project

Wind farm is located at Jhimpir in Sindh Province of Pakistan, about 110 km northeast from Karachi and over 11 km from the town of Nooriabad. The elevation of the project area is 50m~73m. The project area can be reached through M9 Super Highway from Karachi to Nooriabad. The location map is proposed Project is presented in Figure 2.1.

Table 2.1: WTGs Location Coordinates		
S. No	**Latitude**	**Longitude**
01	25°03'20.56" N	67°57'37.85" E
02	25°03'23.51" N	67°57'27.65" E
03	25°03'26.44" N	67°57'17.41" E
04	25°03'29.39" N	67°57'07.21" E
05	25°03'32.32" N	67°56'57.00" E
06	25°03'35.27" N	67°56'46.77" E
07	25°03'38.20" N	67°56'36.55" E
08	25°03'41.17" N	67°56'26.32" E
09	25°03'44.08" N	67°56'16.14" E
10	25°03'47.02" N	67°56'05.93" E
11	25°03'49.96" N	67°55'55.71" E
12	25°03'52.90" N	67°55'45.50" E
13	25°03'55.84" N	67°55'35.29" E
14	25°03'58.78" N	67°55'25.07" E
15	25°04'01.71" N	67°55'14.86" E
16	25°04'06.45" N	67°55'05.49" E
17	25°04'11.03" N	67°54'55.99" E
18	25°04'15.57" N	67°54'46.49" E
19	25°04'20.09" N	67°54'36.99" E
20	25°04'24.09" N	67°54'27.20" E
21	25°04'27.34" N	67°54'17.06" E
22	25°04'31.09" N	67°54'07.29" E
23	25°04'35.84" N	67°53'57.90" E
24	25°04'40.58" N	67°53'48.54" E
25	25°04'45.34" N	67°53'39.17" E



Views of Proposed Project Site

2.3. Road Access

The Project site is easily accessible throughout the year. The major road track form Karachi to Nooriabad is through Karachi-Hyderabad Motorway (M9) and another access to the Project site is through Jhimpir. When travelling through Karachi-Hyderabad Motorway, the access from Nooriabad to the Project Site is a Double track with metaled road named "Thatta-Thano Bula Road" which provides primary access to the site. However, the terrain is relatively flat with minimal human and grazing activity and therefore, long and heavy vehicles can easily move through the project area. There are number of neighboring wind farms in the surrounding area of Jhimpir. Internal semi-paved roads may be established within the project site for smooth movement of vehicular and equipment traffic. The total distance from Karachi to the site is around 110 km.

The satellite view of road track from Karachi to the Project site through Karachi-Hyderabad Motorway (M9) is shown in Figure 2.3.

Figure 2.2: Ariel View of Complete Track from Karachi (Through Karachi-Hyderabad Motorway M9 and Thatta-Thano Bula Khan Road)

There are number of neighboring wind farms developing in Jhimpir region of various capacities ranging from 05 MW to 150 MW.

Figure 2.3: Intersection of Roads and other planned Wind Farms in the vicinity

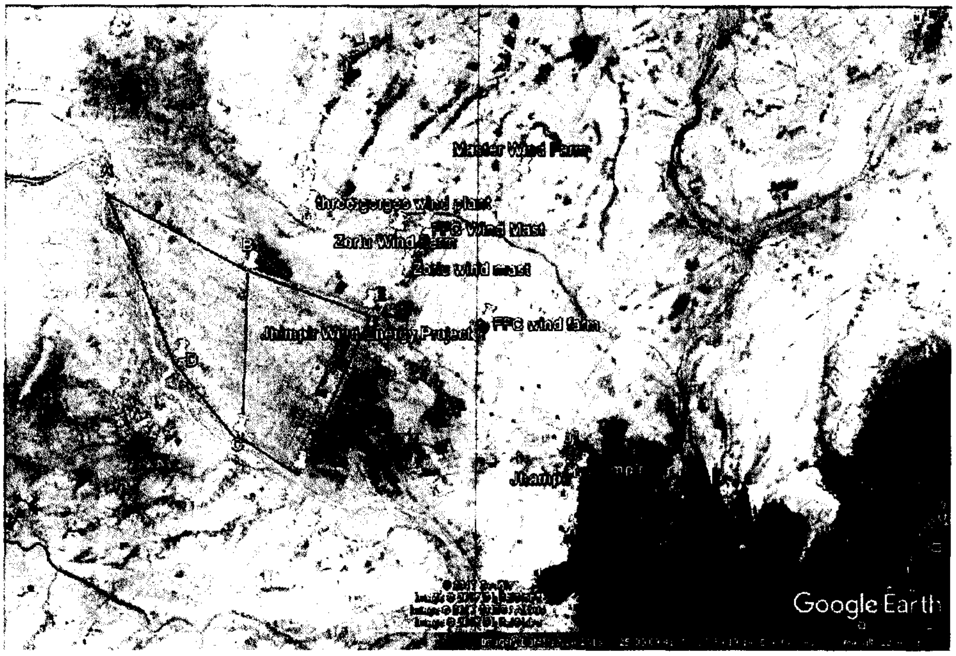


Figure 2.4b: Operational Wind Farms near proposed Phase-I WTGs strip

2.4. Location of Grid

The Lootah Energy 50 MW Wind Power Plant is planned to be built in Jhimpir. The electrical network in vicinity of the site of the proposed wind power plant comprises of LV (11 kV), MV (33 kV) and HV (132 kV and 220 kV), single and double circuit overhead transmission lines. For projects with installed capacity >10 MW, connection must be made with HV lines.

Hyderabad Electrical Supply Company's (HESCO) newly built 132/220 kV Grid Station in cooperation with the USAID is in Jhimpir Wind Corridor. Distance of grid station from the proposed wind farm is about twelve (12) kilometers. MV transmission lines passes through the project area. Old Jhimpir Grid Station or Jhimpir-1 is also near the proposed Wind Farm.

Lootah Wind Power Plant would be connected by loop in-loop out configuration of upcoming Jhimpir-1 – Tricon-A 132kV S/C 132kV single circuit[2]. The length of circuits used for the simulations are confirmed from site visit and have been agreed with NTDC official. They may change slightly during the implementation of the project. In addition, the connectivity of Lootah wind power project with neighboring wind power plants may change, depending upon the COD of the project. Wind Farm of Lootah has been modeled considering Type-3 WTGs. They are Doubly Fed Induction Generators which are designated as Type-3 WTG. The terminal voltage is 0.7 kV. The medium voltage level of wind farm has been selected as 22 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Wind Farm substation.

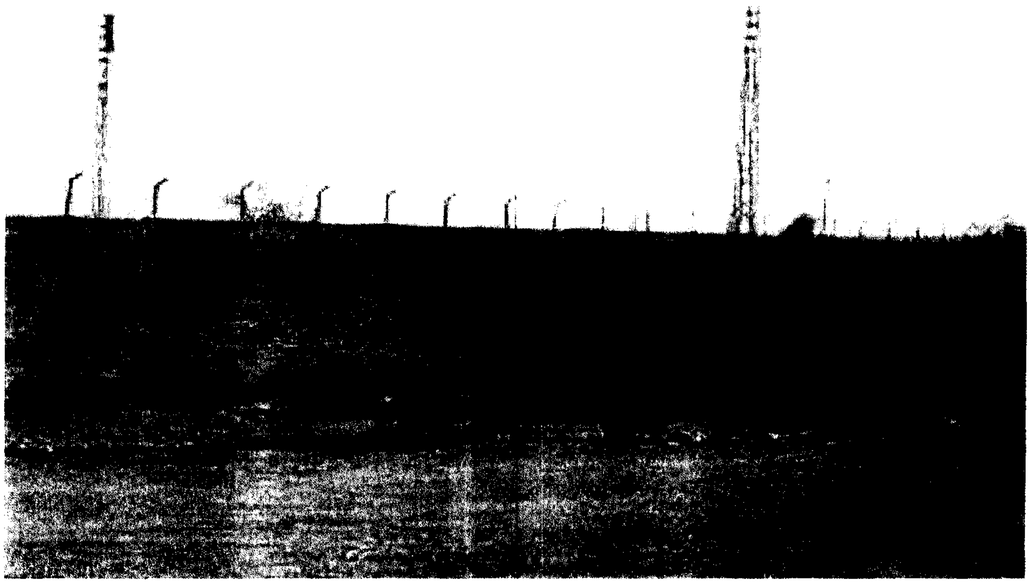


Figure 2.5: Old Jhimpir Grid Station (Jhimpir-1)

2.5. Wind Turbine Details

Subject to finalization of the EPC contract, it is anticipated that the Project shall use a total of 25 WTGs. However, the exact configuration will be determined upon finalization of the EPC. The information provided below is therefore subject to any changes required by the actual EPC.

Alternatives for Micro-sitting of WTGs

Analysis has been carried out for three different options for Micro sitting of the wind turbines. It is done keeping into the consideration;

- To get best energy yield

[2] Electric Grid Studies for 50MW Wind Power Plant by Lootah Energy (Pvt.) Ltd at Jhimpir by Power Planners International, April 2017.

- Best utilization of land
- Keeping future expansion of project in subsequent phases

Results of the analysis are being evaluated at this stage of the project. Final selection and finalization of WTGs will be made in due course since the Mode of Tariff for the project is presently not very clear. Currently, the project has at least two WTG manufacturers option, and three WTG size options. It will be finalized before the application for Tariff is made.

Initially, it had been planned to install Phase-I 50MW WTGs in a single row. However, it was found to be not an economical option as the whole piece of 5000 acre of land was utilized.

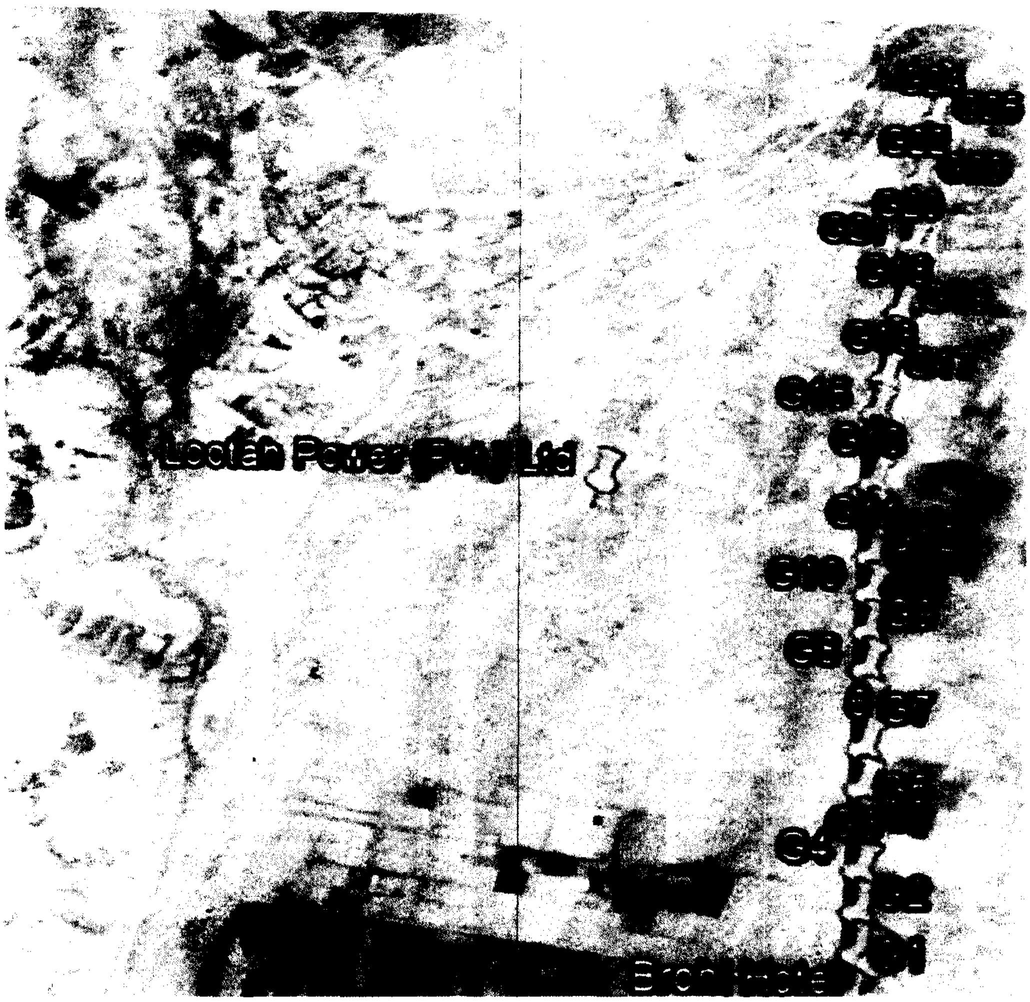


Figure 2.6a: Site 1 for proposed Micro sitting of WTGs

The site 2 for the respective micro sitting plan is depicted in figure 2.6b;

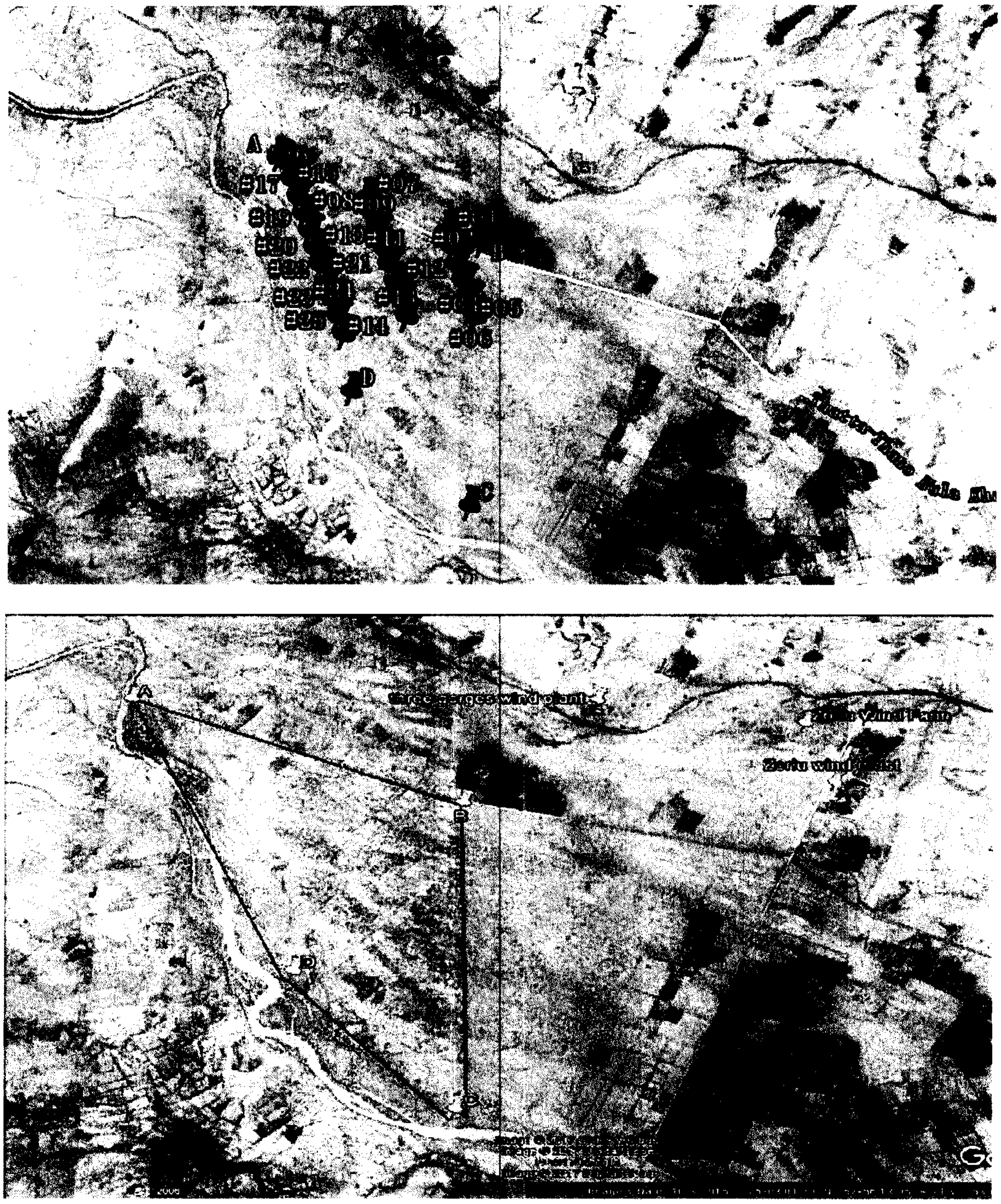


Figure 2.6b: Site 2 and the proposed respective Micro sitting of WTGs

Site 3 and the proposed micro sitting on it is shown in figure below;

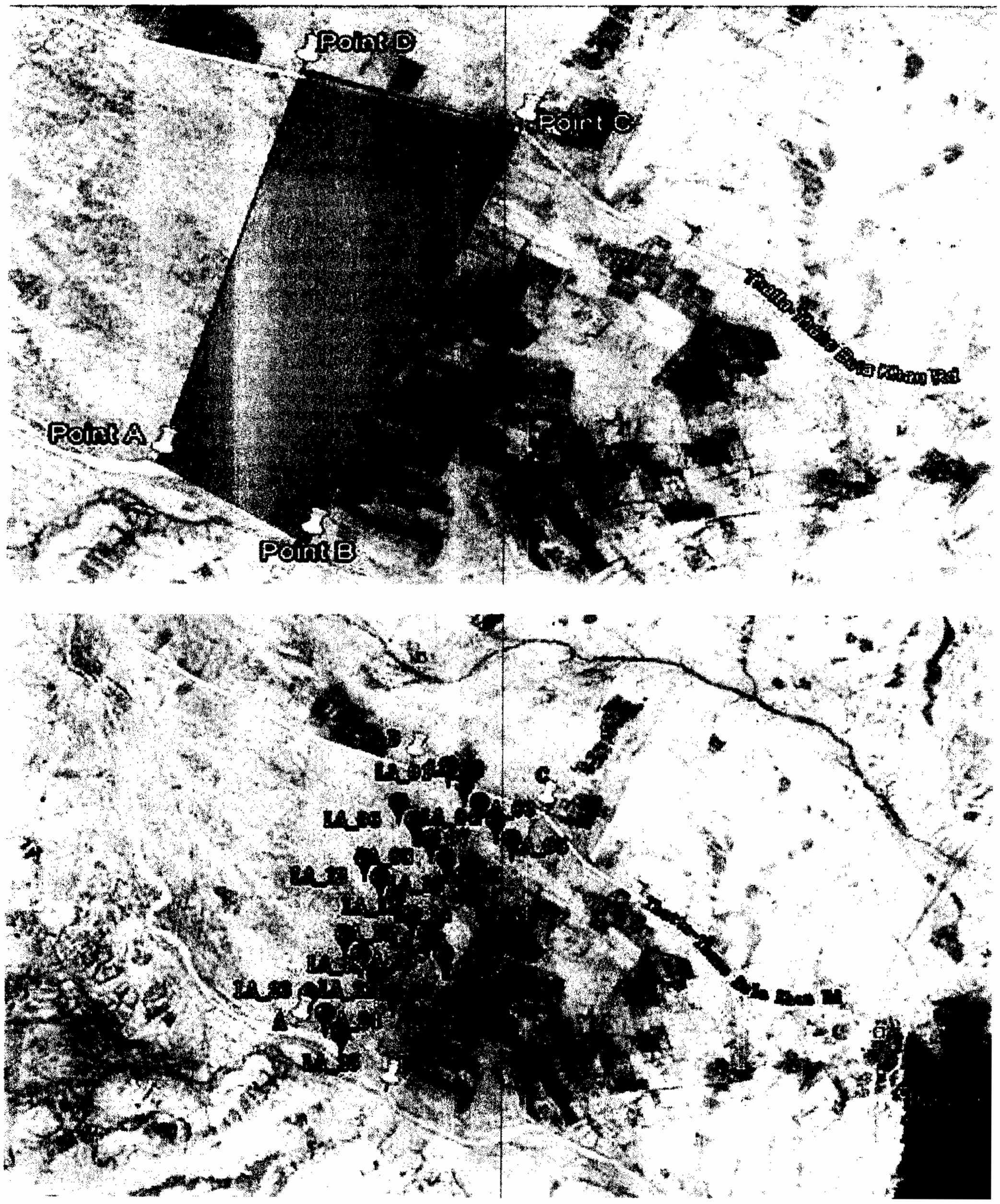


Figure 2.6c: Site 3 and the proposed respective Micro sitting of WTGs

Comparing the 3 micro sitting options, it is concluded that the best economical usage of the Land was found to be on Site 2, which forms the Western Part of Lootah Energy plot and it is suitable to install up to 100MW there, keeping into consideration the future expansion as well.

2.6. Construction Method Statement

2.6.1 Construction for Main Works

2.6.1.1. Foundation of WTG

Construction Sequence

Construction sequence of the wind turbine foundation: positioning and setting out →mechanical excavation of foundation → manual cleaning and trimming → acceptance of foundation trench → bedding cushion concrete placement → setting out → foundation reinforcement fixing → installation of embedded pipes, parts and bolts → installation of formworks → foundation concrete placement →formworks removal → acceptance →backfill.

Geotechnical Investigation for Lootah Wind Power Project in Jhimpir area was carried out in May, 2017. Four (04) boreholes were drilled up to the maximum drilled depth of 30.0 meters. Soil and rock samples were also collected during the field investigation. Laboratory testing of soil and rock samples has been carried out in lab and includes natural moisture content, specific gravity, water absorption, wet and dry density, unconfined compressive strength test etc. Chemical characteristics of soil have also been assessed through determination of total dissolved solids, sulphate content, chloride content and pH.

Keeping in view the results from field, and laboratory tests and the expected loads being transferred to the founding stratum, allowable bearing pressures for shallow foundations at depth of 1.5 meters is recommended. Exposure to chloride and sulphate salts is 'negligible' for rock; therefore, Ordinary Portland Cement (OPC) should be used for underground concreting. Since, the area of the project site is large, the investigation was only for the preliminary feasibility stage study. Detailed geotechnical investigation is recommended carried out after the location for WTG are finalized. The detailed Geotechnical report is attached as **Annex-IV**.

Foundation Construction

Excavation and backfill of foundation pit

1) According to coordinate control points at construction site, the foundation axis and excavation line of the foundation pit will be determined; then excavation will begin when no error is found through check.

2) Earth is excavated mainly by machinery and supplemented by manual cooperation. Slope excavation will be conducted according to the requirements of construction drawings; the foundation bottom elevation will be controlled well in excavation; over-excavation is forbidden; excavated soil and stone will be piled according to requirement of water and soil conservation. After foundation excavation of WTG reaches specified elevation and trench is proven qualified by the Engineer and professional geologist, then it is allowed to go to next procedure.

3) Earth backfill: after foundation construction is completed and concrete strength meets requirement of specification and design passes acceptance for concealed works, earth backfill will be conducted in time. Earth will be backfilled through auto transportation, layer-wise manual backfilling and mechanical compaction. In addition, sundries in foundation must be cleaned prior to backfilling.

4) Foundation earthing of WTG will be conducted concurrently with excavation of foundation pit and acceptance of concealed works will be carried out prior to backfilling of the foundation pit.

5) After excavation of the foundation pit is completed, it will be protected prior to placement of bedding cushion concrete.

Placement of bedding cushion concrete

C20 concrete is applied for WTG foundation cushion of the Project; after foundation pit is excavated to proper position and qualified through acceptance, concrete placement of foundation layer will be carried out in time to provide protection for foundation pit; sundries will be cleaned, block surface will be leveled, little water will be sprinkled, compaction and leveling will be conducted prior to concrete placement of the foundation.

Installation of foundation ring and support bracket

1) WTG tower is connected to support bracket with pre-embedded foundation bolts. Foundation ring is directly buried in concrete of foundation and will be subject to fixing of support bracket with foundation bolts in construction.
2) Prior to reinforcement fixing, foundation centerline will be set out on cushion at first, densified control network will be built around foundation to mark out location of foundation centerline, sideline and foundation ring; after it is checked without error, installation of support bracket of foundation ring and reinforcement fixing will begin.
3) Owing to relatively strict requirement put forth for flange installation of foundation ring, the installation will follow these procedures: four 400 × 400 × 20mm steel plates will be embedded in concrete cushion; lower end of support bracket of foundation ring will be connected with embedded foundation slab, and its upper end with adjusting bolt; foundation ring and support bracket will be subject to connection of adjusting bolt which can help adjust smoothness of foundation ring so that elevation of foundation ring can be controlled in accuracy.
4) Reinforcement fixing will begin after installation of foundation ring is accepted as qualified. Bolt support bracket will not be connected with steel bar, formwork, formwork support system, and scaffolds should be in an independent system so as to prevent bolts from influence caused by vibration and deformation of framework in concrete placement.
5) After installation works of support bracket of foundation bolt and foundation ring are completed, overall acceptance and check will be conducted, including acceptance of control axis and foundation centerline and dimension acceptance for embedded parts of foundation. Reinforcement fixing and formwork sealing will begin after mounting bracket of foundation ring is accepted as qualified.

Steel bar works

1) Reinforcement fixing will begin after installation of foundation ring is accepted as qualified. Support bracket of foundation ring will not be connected with steel bars.
2) Main stressed steel bars at parts of foundation like bottom, top, upper pillar etc. are subject to steel bar of common length without overlapping. Connection between steel bars is 100% subject to fixing instead of welding.
3) If structural steel for support bracket of foundation ring and embedded cable conduit are met in arrangement of steel bars, spacing between steel bars will be adjusted to avoid them, while steel bar shall not be cut off to cause damage to stress structure.
4) After reinforcement fixing and installation of foundation ring is completed, foundation ring will be checked and adjusting bolts will be used to adjust error existing in centerline, elevation, smoothness etc. of foundation ring; when each indication is in line with requirement of design and specification, support bracket and foundation ring will be reinforced, adjusting bolts will be fixed through spot welding to assure accuracy for position of foundation ring.

Formworks

Enough strength and rigidity is necessary for formworks, mould and nodes of different members to meet requirement for dimension error; inner surfaces of formworks and moulds shall be kept clean.

Concrete placement of foundation

1) Concrete will be subject to the placement method of centralized mixing through site mixing plant, transportation by mixer trucks, delivered by concrete pumps and vibration by inserted vibrators. During concrete placement, special personnel must be arranged to monitor the displacement of formworks, foundation rings, and bolts and embedded pipes to find any problem and solve them.
2) Construction joint shall not occur in concrete placement and main body concrete shall be placed at a time.
3) Design drawings and supplier's equipment drawings shall be carefully studied and thoroughly understand prior to concrete placement of the foundation, construction will begin only after it is fully understood; absolute accuracy of holes of reserved foundation bolts and integrity of mass concrete foundation must be assured.
4) Much attention must be paid to internal placement for support bracket of foundation bolts in concrete placement. Concrete placement between ends of star steel bars at inner side of support bracket will be carried out through tremie so as to assure that the foundation tower will not displace but kept at center position.
5) Steel bars and anchor bolts must be cleaned prior to placement so as to assure cohesion between concrete and steel bars.
6) Measures shall be taken in concrete placement to assure layer-wise placement from top to bottom; concrete will be controlled to go up evenly to prevent support bracket of bolt from side pressure caused by different heights of concrete.

7) In order to assure that the final installation of foundation ring is correct, measuring instrument shall be used in concrete pouring to strengthen measurement so as to keep smoothness of foundation ring on the support bracket as it is.
8) Construction will be subject to layered placement and vibration, meanwhile good combination between upper and lower layers of concrete must be assured prior to initial setting so that no construction joint will occur.
9) Weather condition shall be learned before concrete construction; rainy day is not suitable for concrete placement and construction in winter will be avoided as much as possible.

Control measures for temperature difference of foundation concrete

1) Prior to concrete placement, calculation for temperature difference between inside and outside of concrete will be carried out according to the annual temperature in determined placement period, cement, aggregate to be used etc. so as to confirm whether the difference between the maximum central temperature of concrete and surface temperature is more than 25°C in that situation; if it is not more than the specified value of 25°C, control measure for temperature difference may not be taken, if it is more than 25°C, control measure for temperature difference must be taken.
2) Temperature monitoring inside concrete

16 temperature measuring points will be set inside concrete, and 2 air temperature measuring points will be set outside concrete, as well as 2 temperature measuring points for thermal insulation materials and 1 temperature measuring point for curing water; 21 working measuring points are arranged in total. The additional 10 stand-by measuring points will be set. Site temperature monitoring data will be automatically collected by data collector and analyzed; temperature of each measuring point and temperature difference between the central and surface measuring points at each measuring position will be printed and output once every two hours; it will be used as basis for study on adjustment of temperature measures to prevent concrete from temperature crack.

Curing of foundation concrete

Concrete curing is to keep it under certain temperature and humidity; special personnel will be arranged to measure concrete temperature regularly during curing so as to assure that temperature difference between inside and outside of concrete will not be more than 25°C and temperature crack will not occur in concrete. Foundation concrete will be covered in time after placement; backfill will be timely carried out at the formwork after it is disassembled so as to reinforce curing of thermal insulation and moisture preservation; concrete will be subject to curing of moisture preservation through spraying after placement.

Crack resistance measures of foundation

1) Slag cement with low heat of hydration will be applied, cement consumption in single cube and cement ash ratio will be reduced, and water reducing agent will be added to reduce heat of hydration in concrete.
2) Concrete will be subject to curing of thermal insulation and moisture preservation immediately after placement so as to make its temperature reduce slowly; concrete

surface will be subject to thermal insulation through covering of straw bag with plastic membrane on its top; special personnel will be arranged for curing and the curing period will not be less than 14 days.

3) Time for formwork removal of concrete will be extended; for underground foundation, earth backfill will be conducted immediately after the formwork is removed so as to maintain the situation of thermal insulation and moisture preservation.
4) Mass concrete shall not be placed in season especially hot or cold as possible.
5) Soil content of aggregate shall be controlled well with sediment content for sand not more than 2% and that for gravel not more than 1%.

Foundation sealing

Foundation sealing will be carried out in line with technical requirement provided by the Supplier of WTGs.

2.6.1.2. Installation of WTGs

Owing to the difference existing in installation method of WTGs from different manufacturers or of different models, it is largely identical but with minor differences. Therefore, the following installation method description of common WTGs is made for reference. This method features short preparation time, fast lifting and flexible application.

Installation sequence of WTGs: construction preparation –tower lifting– nacelle lifting – blade assembly – blade lifting – installation of control cabinet – cable installation – electrical connection – connection of hydraulic pipelines.

Construction Preparation

Construction plan shall be made before installation of WTGs; the plan shall be consistent with safety production regulations of the country and the manufacturer.

The following works shall be completed before lifting:

1) Road at WTG installation site shall be flat and smooth and be assured to provide safe access for various kinds of construction vehicles.
2) WTG installation site shall meet lifting requirement and have enough place for storage of parts.
3) Reliable safety measures shall be taken for temporary power supply at construction site.
4) Safety facilities like warning board, fence etc. shall be set at construction site if necessary.
5) Common medical articles shall be prepared at installation site.
6) Before lifting, the personnel must check parts of crane and choose lifting tools correctly.
7) Before lifting, WTG equipment shall be checked carefully to avoid dropping of parts.
8) Dedicated person must be arranged to command at the lifting site. The commander must have a certificate for lifting command and conduct specified command gestures and signals.

9) Crane operator shall be responsible for the whole lifting process. Before lifting, the rigger and crane operator shall be familiar to lifting scheme. The commander shall make the crane operator know his/her works completely.
10) When heavy fog, thunderstorm, insufficient lighting is encountered and the commander cannot see each work position clearly or the crane operator cannot see the commander, lifting must be halted.
11) Only a single person is allowed to climb or work at the same section of ladder within the tower.

Selection of lifting equipment

WTG lifting is the key and important step for construction of wind farm project; generally, the heavy-tonnage crawler crane lifting equipment is applied and supplemented by autocrane; crane is used mainly to complete installation of three main components, i.e. nacelle, tower and blades.

Control parameters for selection of huge WTGs crane are hub height and weight of the largest component. Three cranes of 600t, 200t and 75t are usually applied to perform WTG lifting.

Requirements of lifting site

The installation will be subject to joint operation of two cranes; in order to assure that crane boom will not get contacted with tower in lifting, enough space is required for crane; working space for WTGs shall not be less than 50m × 50m. Enough places are required for storage of parts, fittings or small crane at side of access road. Width of construction road in the farm shall not be less than 6m so as to assure crawler crane can pass smoothly. Figure 2.6 shows WTG lifting plan.

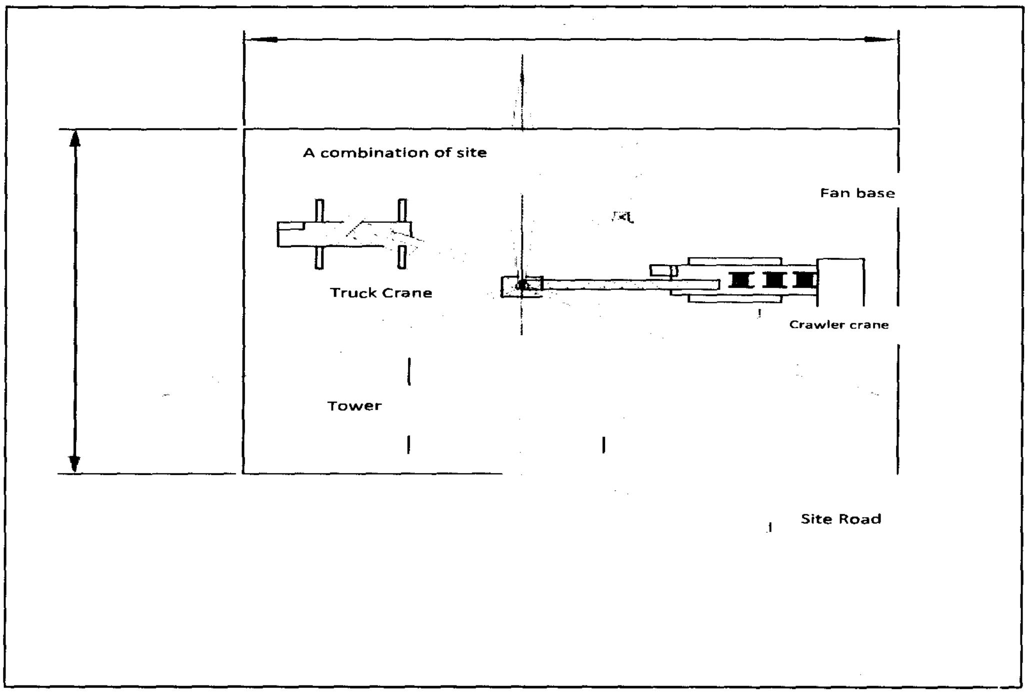


Figure 2.7: Schematic plan for WTG lifting operation

Installation of WTG Tower

In this stage, the WTG tower shall be tubular one composed of three parts, and flange plate shall be used for connecting every two parts. These tubular towers shall be transported by sections, and hoisting shall be carried out after the parts in the tower are installed at the site. When stockpiling tower at the site, the tower shall be put onto hardwood and prevented from rolling, and the stockpile area shall be plane and free from slope as possible. Tower and its parts must be inspected at the site to confirm whether they are damaged during transportation, and in order to avoid corrosion, any surface damage shall be repaired immediately and any dirt shall be cleaned.

Base shall be inspected prior to installation, the evenness of base shall be calibrated with leveling instrument, and the allowable error of tower shall be consistent with specification of the manufacturer.

The dust on foundation ring flange and residua of concrete pouring shall be cleaned before installing tower. Especially for flange position, there must be no corrosion. Abrasive paper may be used for polishing if necessary.

Lifting procedures for bottom section of tower

1) Prior to lifting of the bottom section of tower is finished, installation of support and body of tower foundation control cabinet must be completed.
2) Prior to lifting, leveling instrument will be used to check elevation and levelness of foundation ring; sundries like dust, rust, and scrap iron in bolt hole of foundation ring shall be cleaned, as well as lower and upper flanges of foundation ring; sealant shall be applied on upper flange surface of foundation ring.
3) Bolts, nuts and gaskets for connection of the bottom section of tower and foundation ring will be made ready and put in foundation ring;
4) Threads of all bolts shall be applied with special lubricant.
5) Main and auxiliary cranes shall be arranged in place according to requirement of installation scheme, and lifting tools shall be made prepared. Lifting tool of main crane will be connected with upper flange of tower (evenly-distributed connection at four positions), lifting tool of auxiliary crane with one position at lower flange of tower; head of lifting tool will be hung at the main hook of main and auxiliary crane with safety pin fastened.
6) Two pulling ropes will be bound through bolt hole at lower flange of lower section of tower to adjust tower direction.
7) Main and auxiliary cranes will be lifted at the same time; when the tower is lifted away from ground, main crane continues hoisting, auxiliary crane will be used to adjust distance of end of the tower from the ground;
8) When the tower is lifted to a vertical position by main crane, lifting tools of auxiliary crane will be disassembled to make the tower down with bottom accurately in a line with flange surface of foundation ring, pulling rope will be used to adjust direction of the tower; correct position of tower entrance will be found; the tower will be turned to make it in line with bolt hole of foundation ring; then the tower will be put down, when lower section of

Installation of WTG Tower

In this stage, the WTG tower shall be tubular one composed of three parts, and flange plate shall be used for connecting every two parts. These tubular towers shall be transported by sections, and hoisting shall be carried out after the parts in the tower are installed at the site. When stockpiling tower at the site, the tower shall be put onto hardwood and prevented from rolling, and the stockpile area shall be plane and free from slope as possible. Tower and its parts must be inspected at the site to confirm whether they are damaged during transportation, and in order to avoid corrosion, any surface damage shall be repaired immediately and any dirt shall be cleaned.

Base shall be inspected prior to installation, the evenness of base shall be calibrated with leveling instrument, and the allowable error of tower shall be consistent with specification of the manufacturer.

The dust on foundation ring flange and residua of concrete pouring shall be cleaned before installing tower. Especially for flange position, there must be no corrosion. Abrasive paper may be used for polishing if necessary.

Lifting procedures for bottom section of tower

1) Prior to lifting of the bottom section of tower is finished, installation of support and body of tower foundation control cabinet must be completed.
2) Prior to lifting, leveling instrument will be used to check elevation and levelness of foundation ring; sundries like dust, rust, and scrap iron in bolt hole of foundation ring shall be cleaned, as well as lower and upper flanges of foundation ring; sealant shall be applied on upper flange surface of foundation ring.
3) Bolts, nuts and gaskets for connection of the bottom section of tower and foundation ring will be made ready and put in foundation ring;
4) Threads of all bolts shall be applied with special lubricant.
5) Main and auxiliary cranes shall be arranged in place according to requirement of installation scheme, and lifting tools shall be made prepared. Lifting tool of main crane will be connected with upper flange of tower (evenly-distributed connection at four positions), lifting tool of auxiliary crane with one position at lower flange of tower; head of lifting tool will be hung at the main hook of main and auxiliary crane with safety pin fastened.
6) Two pulling ropes will be bound through bolt hole at lower flange of lower section of tower to adjust tower direction.
7) Main and auxiliary cranes will be lifted at the same time; when the tower is lifted away from ground, main crane continues hoisting, auxiliary crane will be used to adjust distance of end of the tower from the ground;
8) When the tower is lifted to a vertical position by main crane, lifting tools of auxiliary crane will be disassembled to make the tower down with bottom accurately in a line with flange surface of foundation ring, pulling rope will be used to adjust direction of the tower; correct position of tower entrance will be found; the tower will be turned to make it in line with bolt hole of foundation ring; then the tower will be put down, when lower section of

the tower is 3 ~ 5mm from flange surface of foundation ring, hole pin can be used to fasten.

9) Bolts will be pre-tightened by electric or hydraulic spanner;
10) Then, lifting tools of main crane will be disassembled;
11) Connecting bolts for the tower and foundation ring will be tightened and the tightening torque for bolts must be consistent with requirement;
12) Earth wire connection;
13) Installation of lighting wires in the tower

Lifting of middle and top sections of tower

Lifting of middle and top sections of tower is the same with that for bottom section of tower. Before lifting, upper flange surface and bolt hole of installed tower will be cleaned and bolts for flange connection will be made ready. When mane crane lifts the tower to a vertical position, lower flange surface and bolt hole of tower will be cleaned. Correct position and hole position and reliable connection will be assured in butt joint of tower.

Installation of WTGs and Nacelles

WTG installation will be subject to components lifting; good weather will be chosen for installation which is not allowed in rainy day or day with wind speed more than 12m/s. According to lifting capacity of crawler crane, the nacelle can be lifted by crawler crane directly to tower top and fastened; subgrade boxes shall be laid for the supporting parts of crawler crane to increase ground contact area so that hoisting load can be dispersed and ground settlement can be prevented. When the nacelle is lifted by crane to top of upper flange of tower, pulling rope will be used to adjust direction of the nacelle to make position correct; yaw slide block is used to lead nacelle to required position. When clearance is about 10mm, vertical axis of the nacelle will be adjusted perpendicular to wind direction; tooling will be used to locate the nacelle so as to install fixing bolts; then the nacelle will be put down in place and all bolts will be tightened, ropes will be loosened; bolts will be tightened to specified torque through diagonal method for two times; yaw brake will be installed and hydraulic oil pipe will be connected.

Installation of WTG Blades

Rotor blades will be installed to the hub on the ground according to technical requirements on installation; then lifting can begin. Hub and blades are assembled on the ground and blades will be supported by supports to keep level. Following assembly, special fixtures are used to clamp the hub; meanwhile, two blades will be tied with rope and top of the other one blade is placed on special movable trolley. Prior to rotor blades are installed, cleaning equipment will be used to clean blade flange and hub flange. When the hub is lifted up slowly by crawler crane, blades swing will be controlled by manual pulling of rope on the ground till blades are hoisted to the installation height; then, installation workers will get in the nacelle to finish assembly and connection.

Safety Measures after Lifting

In general, WTGs shall not be subject to commissioning and grid connection immediately following installation. Therefore, measures shall be taken in accordance with requirement of WTGs supplier to assure that performance of WTGs is in good condition in commissioning.

The main issues are as follows:

1) WTGs shall be locked before it is put into operation;
2) Parts of WTGs will be checked regularly for rust which shall be removed if found;
3) Before it is put into operation, stator, rotor and control equipment of WTGs will be checked regularly to determine whether they are affected with damp; if they are affected, measures like heating and dehumidification will be taken to solve such problem;
4) Before it is put into operation, both oil and water circulating systems of WTGs will be started regularly;
5) Inside of control equipment, tower and WTGs will be checked to see whether there is trace of small animals; if there is, prevention measures like blocking and killing will be taken to solve the problem.

Safety Monitoring

Three WTGs of the wind farm shall be selected for safety monitoring which mainly monitors the foundation settlement and incline after WTGs erection and during operation period. Specific monitoring method and practice is as follows: four observation posts shall be arranged on each WTGs foundation along two orthogonal longitudinal directions. Each observation post requires C30 concrete of about 0.207m3. Three reference piers shall be provided about 30m to the WTGs. Each reference pier requires C30 concrete of about 0.675m3. The observation shall adopt gradienter. Observation shall be first made upon completion of the foundation. After application of all loads, observation shall be made again; at least two observations are required during the operating period; observation shall be made in the case of special event such as earthquake or strong wind.

Fire Protection Design for Ventilation and Air Conditioning System

(1) Independent air exhaust system is provided for oil depot, with fans and motors of explosion-proof type.
(2) The oil depot is provided with an emergency ventilation system (combined with normal ventilation system), which will be closed in case of fire. After the confirmation of fire extinguishment, the post-emergency ventilation will be made by the fire control center or through local air exhaust fans.
(3) In case of fire, the operation of ventilation and air conditioning system of relevant parts should be stopped.
(4) For the oil depot, its emergency ventilation system is combined with normal ventilation system and the air exhaust fans are fire-control high-temperature smoke exhaust fans. In case of fire, the ventilation system is closed. After the confirmation of fire extinguishment, the post-emergency smoke exhaust will be made by the fire control center or through local smoke exhaust fans.

2.6.1.3. *Firefighting*

Fire protection of this project is designed according to principles of "Putting Prevention First and Combining Prevention & Fire Fighting". Aiming at actual conditions of the project, advanced fire-protection technology shall be actively applied so as to assure safety, convenience and economic feasibility. Contents of fire protection design are mainly the fire-protection design of monitoring center of the wind farm. Meanwhile, design requirements on fire protection for construction are raised.

Through external highway, fire engines can reach the areas where the central control center, WTGs and box-type transformers are built and installed. Fire-protection passages around administration building and service building shall be available. The net width of these passages shall be wider than 4m and the passages shall form looped ones. The passage ways shall be free from overhead barriers and meet relevant specification requirements. Portable and wheeled ammonium phosphate powder extinguishers shall be provided in the control building, garage and operation rooms. In addition, operation building and main transformers shall be equipped with portable and wheeled carbon dioxide fire extinguishers.

Eight sets of outdoor underground fire hydrants (SA100/65-1.0) are provided, and water-supply pipes for outdoor fire protection are arranged in rings.

Fire hazard of the largest building (control building) of this wind farm is of Class IV, the fire protection rating is of Class II and its volume is smaller than 10000m3. In accordance with Code for Fire Protection Design of Building (GB50016-2006), no indoor fire hydrant system is provided to the control building. Water consumption of the outdoor fire hydrants is 20L/s. Based on one fire duration of 2h, water consumption (180m3) is required by the hydrant system for fire extinguishing.

Within the wind farm, one fire water and domestic water tank with effective volume of 180m3 and fire pump house (accommodating both fire pumps and living pumps) will be built. In the pump house, two fire pumps (parameters: Q=25L/s, H=0.5MPa, N=22kW) are provided and these two pumps are mutual standby. Fire water is transported from the outside of the wind farm. Fire water supply system is driven by fire pumps to deliver water from the fire water tank. Normally, water pressure of the firefighting system is kept by the frequency converter set.

Passages around 132kV collector sub-station should be free and clear. The fire passages utilize services road, both net width and clearance of roads are greater than 4.0m. All those satisfy requirements on fire-fighting facilities.

2.6.2 Water Drainage System

Separate flow of rainwater and wastewater is employed for water drainage system of the project.

2.6.2.1 *Rainwater drainage system*

Building roof rainwater is drained outside. Outdoor rainwater is drained out of the site along the road slope under gravity.

2.6.2.2 Wastewater drainage system

The indoor domestic sewage is drained to outdoor sewage pipe network under gravity and kitchen wastewater is drained to outdoor sewage pipe network after being treated by oil separation tank. One $4m^3$ septic tank, one $4.5m^3$ wastewater adjustment pool, one set of wastewater treatment equipment with a capacity of $0.50m^3/h$ and one wastewater catch basin with a capacity of $50m^3$ are set outside. Wastewater is treated and drained to the $50m^3$ wastewater catch basin before being used for site greening or discharged out of the site.

2.6.2.3 Pipe Materials and Connection

PE water supply pipes are used as outdoor water supply pipes, with fusion connection. PVC-U double-wall corrugated water drainage pipes are used as outdoor wastewater pipes, with rubber ring socket connection; steel-plastic composite pipes are used as indoor water supply pipes, with special accessory connection. PVC-U water drainage pipes are used as indoor domestic wastewater pipes, with adhesives connection; and steel-plastic transition joint or special flange joint must be used for connecting PE water supply pipes, metal pipelines, valves and equipment.

2.6.2.4 Labor Safety and Industrial Health

Design of labor safety and industrial health is carried out in principles of Safety First and Prevention at Priority as well as follows the safety regulations of that safety facilities of newly-built, rebuilt and extended project shall be designed, constructed and put into operation & production simultaneously with those of main works. In accordance with relevant regulations of laws, factors such as high voltage, flammables, explosives, fire, electromagnetic radiation, noise, corrosion and mechanical injury, etc which directly endangers personnel safety and health shall be identified. Comprehensive prevention and treatment measures satisfying specification requirements and project reality shall be raised to assure the project after putting into operation satisfies requirements on labor safety and industrial health as well as assure safety & health of personnel in the wind farm and safety of structures and equipment themselves.

Concerning main dangers possible occurring during construction, requirements on safety management shall be put forward to the Employer, the Contractor and the Engineer in term of management so as to provide the Employer with reference for tendering management, completion acceptance and management of safety operation of the farm; assure safety of construction personnel lives and properties; minimize property loss, environmental damage and social affects.

Chapter 3 POLICY, STATUTORY & INSTITUTIONAL FRAMEWORK

This section describes the current legal responsibilities of the proponent in the context of the environment and sustainable development, and the institutions that exist in the country that may influence the environmental management of the proposed Project.

Project Proponent will comprehensively follow the relevant requirements of the policy documents and legislative framework as well as recommendations as described in the national and international guidelines in relevance to the proposed project. Provisions of many of these guidelines have been incorporated in the mitigation measures and the Environmental Management & Monitoring Plan (EMMP) which have been formulated for the better management of environmental and social impacts.

3.1 Policy Framework

The Pakistan National Conservation Strategy (NCS), which was approved by the Federal Cabinet in March 1992, is the principal policy document for environmental issues in the country. The NCS signifies the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant to the proposed project are biodiversity conservation, restoration of rangelands, pollution prevention and abatement, and the preservation of cultural heritage.

Pakistan is a signatory to the Convention on Biological Diversity, and is thereby obligated to develop a national strategy for the conservation of biodiversity. The Government of Pakistan constituted a Biodiversity Working Group, under the auspices of the Ministry of Environment, to develop a Biodiversity Action Plan for the country, which was completed after an extensive consultative exercise. The plan, which has been designed to complement the NCS and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country. The Pakistan Environmental Protection Council (PEPC) has approved the action plan and steering committees at the federal and provincial levels have been formed to implement it.

Mid-term Review of NCS: Key Findings: An overview of the key environmental issues facing Pakistan is as follows:

- Per capita water availability in Pakistan has been decreasing at an alarming rate. In 1951, the per capita availability was 5300 cubic meter which has now decreased to 1105 cubic meter just touching water scarcity level of 1000 cubic meter.
- Almost all fresh water resources are severely polluted due to discharge of untreated industrial and municipal wastes. Pollution of coastal waters due to waste discharges and oil spills coupled with reduced freshwater flows is resulting in declining fish yields.

- About 55 percent of population has access to a relatively safe drinking water source. Potable water quality, assessed against WHO standards, fails to meet all the specified criteria, confirming evidence of extremely high pollutant loads.
- Approximately 35 percent of population has access to adequate sanitation facilities.
- Air pollution is on the rise, especially in urban areas. Recent surveys conducted by Pakistan Environmental Protection Agency revealed presence of very high levels of suspended particulate matter (about 6 times higher than the World Health Organization's guidelines). 'Smog' also seriously affects almost entire Punjab during December and January every year.
- Noise pollution has become a serious issue in major urban centers.
- Of about 54,850 tons of solid waste generated daily in urban areas, less than 60 per cent is collected. No city in Pakistan has proper waste collection and disposal system for municipal, hazardous or healthcare wastes.
- The deforestation rate has been estimated at 0.2-0.5 percent per annum. Forest cover, which was 4.8 percent of total land area in 1992, could hardly be increased substantially despite all efforts.
- Degradation and encroachment of natural forests, rangelands and freshwater and marine ecosystems are resulting in loss of biodiversity. At least four mammal species, including tiger, swamp deer, lion and Indian one-horned rhinoceros, are known to have become extinct from Pakistan while at least 10 ecosystems of particular value for the species richness and uniqueness of their floral and faunal communities are considered to be critically threatened.
- Desertification affects over 43 million hectares of land annually.
- Pakistan is a highly energy in-efficient country. It uses approximately same amount of energy to generate 1 dollar of GNP as the USA.

The situation just mentioned is the result of a number of constraining factors including high population growth rate, prevailing poverty, unplanned urban and industrial expansion, insufficient emphasis on environmental protection in the government policies, lack of public awareness and education and above all the ailing economy which has caused deficiencies in institutional capacity and resources for effective environmental management.

The mid-term review of the NCS led the Government of Pakistan (GOP) and United Nations Development Program (UNDP) to jointly initiate an umbrella support program called the National Environmental Action Plan-Support Program (NEAP-SP) that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-SP is environmental sustainability and poverty reduction in the context of economic growth. The primary objective of NEAP is to initiate actions and programs for achieving a state of environment that safeguards public health, promotes sustainable livelihood, and enhances the quality of life of the people in Pakistan. The NEAP identifies four primary areas, (1) Clean air (2) Clean water (3) Management of solid waste (4) Ecosystem management. The plan also presents five additional areas of concern (i) Management of fresh water resources (ii) Marine pollution (iii) Toxic and hazardous substances handling and disposal (iv) Energy conservation and management (v) Compliance with international treaties and protocol.

Studies conducted by GOP and Donor Agencies in Pakistan have identified a number of environmental concerns with regard to energy, water and air pollution, waste management, irrigated agriculture, and biodiversity. These studies suggest an overall degradation in the quality and impoverishment of renewable natural resources such as water, forests and other flora as well as key biological habitats. The GOP, private sector and civil society have, with few exceptions, not responded positively to meet the challenges from these concerns.

The Mid-Term Development Framework: 2005-2010 (MTDF 2005-10) of the Planning Commission has been developed in line with the National Environment Action Plan (NEAP) objectives, and the same focuses on four core areas i.e., clean air, clean water; solid waste management, and Ecosystem management. The Plan has been prepared keeping in mind Pakistan's experience with such initiatives in the last decade; the current capacity to undertake planning, implementation and oversight and the identified needs for improvement in such capacity. The MTDF clearly specifies issues in environment which need to be addressed.

3.1.1 National Environmental Policy, 2005

The National Environmental Policy, 2005 aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life for the citizens through sustainable development. It provides an overarching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also gives direction for addressing the cross sectorial issues as well as the underlying causes of environmental degradation and meeting international obligations.

The National Environmental Policy, 2005 while recognizing the goals and objectives of the National Conservation Strategy, National Environmental Action Plan and other existing environment related national policies, strategies and action plans, provide broad guidelines to the Federal Government, Provincial Governments, Federally Administrated Territories and Local Governments for addressing environmental concerns and ensuring effective management of their environmental resources.

The National Environmental Policy, 2005 is agreed for compliance by the proposed project.

3.1.2 Policy for Development of Renewable Energy for Power Generation, GOP 2006

In December 2006 the Government of Pakistan published the first national package of measures aimed at promoting renewable sources of energy. The provisions apply to hydropower plants with a capacity of up to 50MW, solar thermal, photovoltaic and wind energy. Over the short term, i.e. to mid-2008, technologies that are already in commercial use internationally are to be trialed through the mechanism of attractive power purchase contracts and partial risk coverage. In the medium term, i.e. to 2030, it is hoped to have installed at least 9700 MW of capacity for renewable electricity in this way.

Salient Features of Policy

The Policy invites investment from the private sector for following categories of projects:

1a. Independent power projects of IPPs (for sale of power to the grid only)

1b. Captive cum grid spill over power projects (i.e. for self-use and sale to utility)

1c. Captive power projects (i.e. for self or dedicated use)

1d. Isolated grid power projects (i.e. small, stand-alone)

1. Except for Category (a) above, these projects will not require any LOI, LOS, or IA from the Government.
2. Electricity purchase by NTDC/CPPA from qualifying renewable resources at one location and receive an equivalent amount for own use elsewhere on the grid at the investor's own cost of generation plus transmission charges (wheeling)
3. Net metering and billing allowed enabling a producer to sell surplus electricity at one time and receive electricity from the grid at another time and settle accounts on net basis. This will directly benefit the economics of small scale, dispersed generation and optimize capacity utilization of installed systems.
4. De-licensing and deregulation of small scale power production through renewable resources (up to 5 MW for hydro and 1 MW for net metered sales) to reduce the transaction costs for such investments. This will be particularly beneficial from micro, mini and small hydro as well as solar-based electricity production.
5. Simplified and transparent principles of tariff determination
6. Insulating the investor from resource variability risk, which is allocated to the power purchaser
7. Facilitating project proponents in obtaining carbon credits for avoided greenhouse gas emissions, Helping improve financial returns and reducing per unit costs for the purchaser

These guidelines are in line with the Government's open door policy for inviting private investment into the country.

Policy Goals and Development Strategy

Specific goals of Renewable Energy (RE) Policy are to:

1. Increase the deployment of renewable energy technologies (RETs) in Pakistan so that RE provides a higher targeted proportion of the national energy supply mix, a minimum of 9,700 MW by 2030 as per the Medium Term Development Framework (MTDF), and helps ensure universal access to electricity in all regions of the country.
2. Provide additional power supplies to help meet increasing national demand.
3. Introduce investment-friendly incentives, and facilitate renewable energy markets to attract private sector interest in RE projects, help nurture the nascent industry, and

gradually lower RE costs and prices through competition in an increasingly deregulated power sector.

4. Devise measures to support the private sector in mobilizing financing and enabling public sector investment in promotional, demonstrative, and trend setting RE projects.
5. Optimize impact of RE deployment in underdeveloped areas by integrating energy solutions with provision of other social infrastructure, e.g., educational and medical facilities, clean water supply and sanitation, roads and telecommunications, etc., so as to promote greater social welfare, productivity, trade, and economic well-being amongst deprived communities.
6. Help in broad institutional, technical, and operational capacity building relevant to the renewable energy sector.
7. Facilitate the establishment of a domestic RET manufacturing base in the country that can help lower costs, improve service, create employment, and enhance local technical skills.

3.1.3 The Biodiversity Action Plan

The Biodiversity Action Plan, 2000 has been the most significant direct step towards addressing the issue of loss of biodiversity. It details the current status, trends, direct & indirect causes of loss of biodiversity; its principles, goals and aims; proposals for an action plan including planning & policies, legislation, identification and monitoring, in situ & ex situ conservation, sustainable use, research and training, public education and awareness, Environmental Impact Assessment, information extraction and financial resources etc.

The Wild Birds and Animals Protection Act 1912[3], the West Pakistan Wildlife Protection Ordinance 1959, the Wildlife Protection Rules 1972, provide for the protection of flora and fauna in the territory, including vegetation and protected forests. This IEE study has addressed different aspects of conservation, including wildlife, and forest.

By the perusal of above captioned legislation, it is evident that the Wild Bird and Animal life will not be disturbed due to operation of 50 MW Lootah Energy Wind Farm Project.

3.2 Administrative Framework

Environmental issues are governed by three levels of the government viz. Federal, Provincial and Local Government. The Ministry of Environment and Local Government is the Ministry at the Federal level, which oversees the affairs of the environment in the country. The Government of Sindh (GOS) has designated its Ministry of Environment and Alternative Energy, to administer matters related to the environment in Sindh. The Sindh EPA is directly under the Ministry of Environment, Climate Change and Coastal Development, Government of Sindh.

3.2.1 Institutional Setup for Environmental Management

The highest environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided over by the Chief Executive of the country. Other bodies

[3] The Wild Birds and Animals Protection Act 1912 (Act No.VIII of 1912 dated 18.09.1912)

include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and Environmental Tribunals. The roles, responsibilities and authorities of PEPC and the EPA's are defined in the PEPA 1997.

The PEPC has been formed by the Federal Government. Its members include the President of Pakistan, or someone appointed by the President, as the Chairperson; the Minister of the Ministry of Environment, Local Government and Rural Development as the vice-Chairperson; Governors of the Provinces; Ministers in charge of the subject of environment in the Provinces; Secretary to the Federal Government in charge of the Ministry of Environment, Local Government and Rural Development; Director General Federal EPA; heads of other federal and provincial departments; environmentalists and community representatives including scientists. The functions and powers of the Council include formulation of national environmental policy, enforcement of PEPA 1997, approval of the NEQS, incorporation of environmental considerations into national development plans and policies and provide guidelines for the protection and conservation of biodiversity in general and for the conservation of renewable and nonrenewable resources.

The Federal government has also formed the Federal EPA, which is headed by a Director General and has wide-ranging functions given in PEPA 1997. These include the preparation and coordination of national environmental policy for approval by the PEPC, administering and implementing the PEPA 1997 and preparation, revision or establishment of NEQS.

The Provincial Environmental Protection Agencies are formed by the respective Provincial Governments. A Director General who exercises powers delegated to him by the Provincial Government heads each Provincial EPA. IEEs and EIAs are submitted to provincial EPAs for approval.

The proposed project would be located in Sindh Province. Hence this IEE Report will be sent to the EPA Sindh for review and issuance of No Objection Certificate (NOC). Coordination of the environmental monitoring activity continues as a provincial subject and is assigned to Provincial EPAs; in this case EPA Sindh has been duly authorized to enforce environmental compliance.

3.3 Statutory Framework

The constitution of Pakistan contains provision for environmental protection and resource conservation. The constitution mentions environmental pollution and the ecology as a subject in the concurrent legislative list, meaning that both the provincial and federal government may initiate and make legislation for the purpose. Article 9 of the Constitution defines the right to life as a "fundamental right" in these words "No person shall be deprived of life or liberty save in accordance with law". The Supreme Court of Pakistan in its judgment in the case Shehla Zia and others vs WAPDA (1994) declared that the right to a clean environment is part of the fundamental constitutional right to life.

Several laws exist for the protection of the environment. Some of these laws are Federal and the rest Provincial in character. The promulgation of the Environmental Protection Ordinance 1983 was the first codifying legislation on the issue of environmental protection. This was indeed a consolidated enactment to plug the gaps and remove defects/deficiencies in the legislation. The promulgation of this ordinance was followed, in 1984, by the establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy. Provincial environmental protection agencies were also established at about the same time. The National Environmental Quality Standards were established in 1993.

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject.

However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. The main consequences of this change are as follows: i) The Ministry of Environment at the federal level has been abolished. Its functions related to the national environmental management haves been transferred to the provinces. The international obligations in the context of environment will be managed by various ministries and departments of the federal government, ii) The Pakistan Environmental Protection Act 1997 (PEPA 1997) is technically no longer applicable to the provinces. The provinces are required to enact their own legislation for environmental protection.

3.3.1 Sindh Environmental Protection Act, 2014

Legislative assembly of Sindh province of Pakistan passed the bill on 24th February 2014 to enact Sindh Environmental Protection Act 2014. The Act envisages protection, improvement, conservation and rehabilitation of environment of Sindh with the help of legal action against polluters and green awakening of communities.

It equally lays emphasis for the preservation of the natural resources of Sindh and to adopt ways and means for restoring the balance in its eco-system by avoiding all types of environmental hazards.

Environmental Protection Council (EPC): It has been formed consisting of Chief Minister as Chairman with Minister in charge of Environment Protection Department, Addl. Chief Secretary, Planning & Development Department, Government of Sindh and Secretaries of Environment, Finance, Public Health Engineering, Irrigation, Health, Agriculture, Local Government, Industries, Livestock & Fisheries Forest & Wildlife, Energy, Education Departments Government of Sindh and Divisional Commissioners of Sindh. Non-official members are also included (i.e. representatives of Chamber of Commerce & Industry and from medical or legal professions etc.) along with DG, EPA & two Members of Provincial Assembly also form part of EPC.

The functions and powers of EPC include coordination & supervision of provisions of Act, approving provincial environmental & sustainable development policies & SEQS, provide guidance for protection & conservation, consider annual Sindh Environmental Report, deal with interprovincial and federal provincial issues, provide guidance for bio safety and assist Federal Government in implementation of various provisions of UN Convention on laws on Seas (UNCLOS).

Sindh Environmental Protection Agency (SEPA): SEPA would be headed by Director General (DG) with the aim to exercise the powers and perform the functions assigned to it under the provisions of this Act and the rules and regulations made there under. The Agency shall have technical and legal staff and may form advisory committees.

The Agency shall administer and implement the provisions of this Act and rules and regulations. It shall also prepare environmental policies, take measures for implementation of environmental policies, prepare Sindh Environment Report and prepare or revise Sindh Environmental Quality Standards. SEPA shall also establish systems and procedures for surveys, surveillance, monitoring, measurement, examination, investigation research, inspection and audit to prevent and control pollution and to estimate the costs of cleaning up pollution and rehabilitating the environment and sustainable development. SEPA would also take measures for protection of environment such as to promote research; issues licenses for dealing with hazardous substances, certify laboratories, identify need for or initiate legislation, specify safeguards etc. SEPA would also encourage public awareness and education regarding environmental issues.

SEPA would have powers to enter or inspect under a search warrant issued by Environmental Protection Tribunal or a Court search at any time, any land or building etc. where there are reasonable grounds to believe that an offence under this Act has been or is being or likely to be committed. SEPA may also take samples, arrange for testing or confiscate any article in discharge of their duties.

This act has also provided for Sindh Sustainable Fund derived from various sources such as voluntary contributions or fees generated etc. This fund is utilized for protection, conservation or improvement of environment. It is appendices in this report as **Annex I.**

Salient Features

Section-11: No person shall discharge or emit or allow the discharge or emission of any effluent waste, pollutant, noise or adverse environmental effects in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards.

Section-12 & 13: No person shall import hazardous waste into Sindh province and handle hazardous substances except under licenses etc.

Section 14: No person shall undertake any action which adversely affects environment or which lead to pollute or impairment of or damage to biodiversity, ecosystem, aesthetics or any damage to environment etc.

Section 15: This section deals with regulation of motor vehicles banning emission of air or noise pollutants being emitted from them in excess of allowable standards.

Section 17: This section states that no proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment and has obtained from Agency approval in respect thereof. SEPA shall review the IEE & EIA and accord approval subject to such terms and conditions as it may prescribe or require. The agency shall communicate within four (04) months its approval or otherwise from the date EIA is filed failing which the EIA shall deemed to have been approved.

Section 21: Where agency is satisfied that the discharge or emission has occurred in violation of any provision of this act or rules etc. then it may, after giving an opportunity to person responsible, by order direct such person to take such measures within specified period. The agency under this section has been empowered to immediately stop, prevent or minimize emission, disposal etc. for remedying adverse environmental effects.

Section 22: The person who fails to comply with section 11, 17, 18 and 21 shall be punishable with a fine which may extend to five million rupees, to the damage caused to environment and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues. And, where a person convicted under sub-sections 1&2 had been previously convicted for any contravention of this Act, the Environmental Protection Tribunal (EPT) may, in addition to punishment, award imprisonment for a term that may extend up to three years, or order confiscation or closure of facility etc.

Section 23: Where any violation of this Act has been committed by any of employee of any corporate body, then, that employee shall be considered to be guilty of environmental pollution.

Section 25: This section allows for establishment of Environmental Protection Tribunals.

3.3.2 Sindh EPA (Review of IEE/EIA) Regulations 2014

The Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2014 define Schedules (I & II) of projects falling under the requirement of IEE or EIA. This IEE Study has, for environmental classification of the Project into Category A or B, taken account of the requirements of the Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2014 which define Schedules (I & II) as follows:

Schedule I: A project falls in Schedule I if it is likely to have adverse environmental impacts, but of lesser degree or significance than those for category 'A' and all the mitigation measures to handle the impact is manageable. Such types of projects need IEE report including EMP.

Schedule II: Projects are categorized in Schedule II if they generate significant adverse environmental impacts that require a comprehensive management plan, or if the project is located within or passes through: a) Areas declared by the Government of Pakistan as environmentally sensitive (National Parks/Sanctuaries/Game Reserve), b) Areas of international significance (e.g. protected wetland as designated by the RAMSAR Convention), or c) Areas designated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as cultural heritage sites. They require an EIA.

According to Sindh Environmental Protection Agency Regulation, 2014, a project falling in any category listed in Schedule I shall file an IEE with the Sindh Environmental Protection Agency (SEPA). **Wind project** are placed in Schedule I: B(7), thus requiring an IEE.

Filing: Regulation 9 requires submission of ten hardcopies and two electronic copies accompanied by an application form (schedule-V), copy of receipt of payment of review fee, NOC from relevant departments (where applicable) and environmental checklist (if project falls in schedule III).

Preliminary scrutiny: Regulation 10 states that within 15 days of report submission the agency shall review the report and inform the proponent for submission of any additional information.

Review: The agency shall review the IEE report within 60 days after issuing confirmation of completeness as per Regulation 9. It shall also conduct an experts committee meeting or solicit views from concerned advisory committee.

Validity: Regulation 18 defines the validity period of approval of an IEE or EIA to be three years from date of construction and construction must start within three years of report approval. A three year extension at a time may be granted upon the agency's discretion with or without the submission of a fresh IEE or EIA.

Monitoring: Sub-regulation 20 requires the submission of a report to agency on completion of construction of project and after issue of confirmation of compliance, the submission of annual report summarizing operational performance of the project with reference to conditions of approval and maintenance and mitigation measures adopted by the project.

The regulations are attached as **Annex-II**.

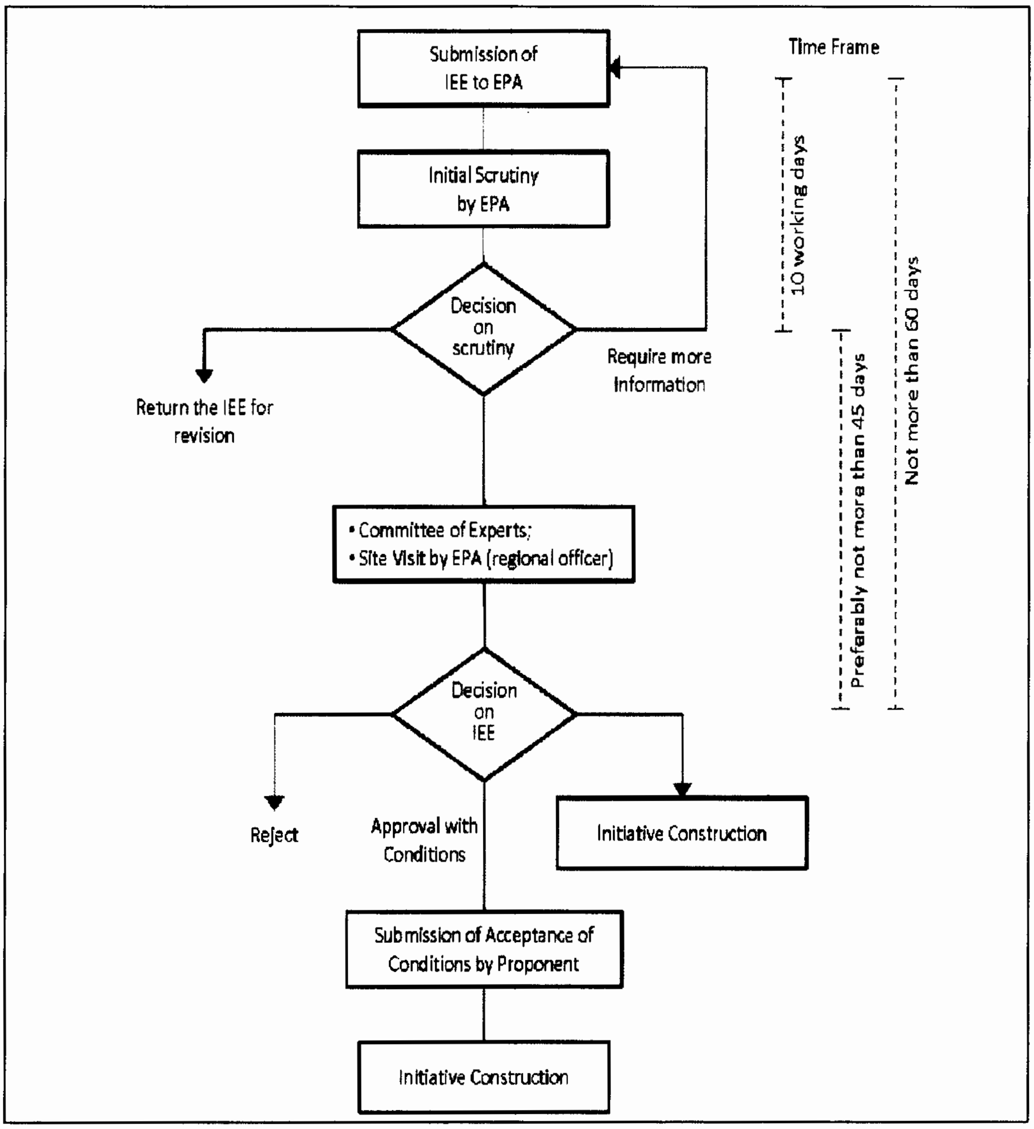


Figure 3.1: IEE Review and Approval Procedure

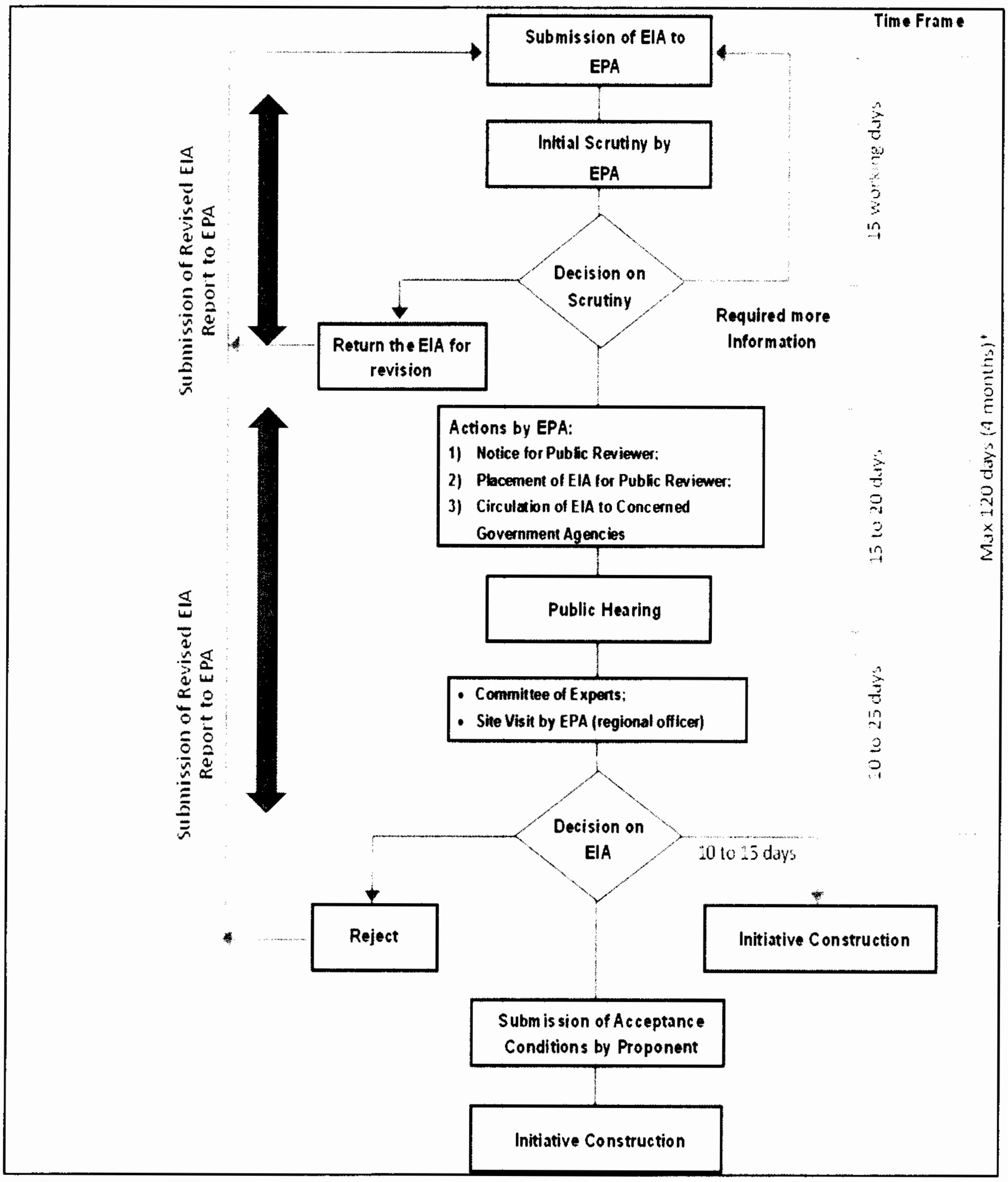


Figure 3.2b: IEE Review and Approval Procedure

3.3.3 Sindh Environmental Quality Standards (SEQS)

One of the functions of the Sindh EPA to issue SEQS for municipal and liquid industrial effluent, industrial gaseous emissions and motor vehicle exhaust and noise. The municipal and liquid industrial effluent standards cover 32 parameters. The standards for industrial gaseous emissions specify limits for 16 parameters, and the standards for motor vehicles prescribe maximum permissible limits for smoke, carbon monoxide and noise. Revised standards cover discharges limits of effluents into inland water, sewage treatment plant and the sea. The SEQS are primarily concentration based. Unfortunately, the limits on industrial effluents are neither industry specific nor do they have any relationship with the quantum of production. The SEQS prohibit dilution, but this can be easily circumvented. SEQS are attached in detail as **Annex-III**.

Project Proponent is committed to comply with the applicable SEQS in letter and spirit.

Table 3.1: Sindh Environmental Quality Standard for Ambient Air

Pollutant	Time-weighted average	Concentration in Ambient Air: Effective from 1st Jan 2009	Concentration in Ambient Air: Effective from 1st Jan 2012	Method of measurement
Sulfur Dioxide (SO_2)	Annual Average*	80µg/m³	80µgm³	Ultraviolet Fluorescence Method
	24 hours**	120µg/m³	120µgm³	
Oxides of Nitrogen as (NO)	Annual Average*	40µg/m³	40µgm³	Gas Phase Chemiluminescence
	24 hours**	40µgm³	40µgm³	
Oxides of Nitrogen as (NO_2)	Annual Average*	40µgm³	40µgm³	Gas Phase Chemiluminescence
	24 hours**	80µgm³	80µgm³	
O_3	1 hour	180µgm³	130µgm³	Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400µgm³	360µgm³	High volume Sampling, (Average flow rate not less than 1.1m³/minute)
	24 hours**	550µgm³	500µgm³	
Respirable Particulate Matter (PM10)	Annual Average*	200µgm³	120µgm³	B Ray absorption method
	24 hours**	250µgm³	150µgm³	
Respirable Particulate Matter (PM2.5)	Annual Average*	25µgm³	15µgm³	B Ray absorption method
	24 hours**	40µgm³	35µgm³	
	1 hour	25µgm³	15µgm³	
Lead (Pb)	Annual Average*	1.5µgm³	1µgm³	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2µgm³	1.5µgm³	
Carbon Monoxide (CO)	8hours**	5mg/m³	5mg/m³	Non Dispersive Infra Red (NDIR) method
	1hours	10mg/m³	10mg/m³	
***Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.**				
****24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.**				

Table 3.2: Sindh Environmental Quality Standard for Noise

S. No.	Category of Area / Zone	Effective from 1st January, 2015 — Limit it in dB(A) Leq*: Day Time	Effective from 1st January, 2015 — Limit it in dB(A) Leq*: Night Time	Effective from 1st January, 2016 — Limit it in dB(A) Leq*: Day Time	Effective from 1st January, 2016 — Limit it in dB(A) Leq*: Night Time
1	Residential area (A)	65	50	55	45
2	Commercial area (B)	70	60	65	55
3	Industrial area (C)	80	75	75	65
4	Silence Zone (D)	55	45	50	45
Note: 1	Day time hours: 6.00 a. m to 10.00 p. m				
2	Night time hours: 10.00 p. m to 6.00 a. m				
3	Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.				
4	Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.				
***dB(A)Leq**	Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.				

Table 3.3: Sindh Environmental Quality Standard for Municipal & Liquid Industrial Effluents					
S.#	Parameter	Into Inland Waters	Into Sewage Treatment	Into Sea	unit
1	Temperature or Temp. increase	<3	<3	<3	°C
2	pH value (H^+)	6-9	6-9	6-9	
3	Biological Oxygen Demand $(BOD)_5$ at 20°C	80	250	80	mg/l
4	Chemical Oxygen Demand (COD)	150	400	400	mg/l
5	Total Suspended Solids (TSS)	200	400	200	mg/l
6	Total Dissolved Solids (TDS)	3500	3500	3500	mg/l
7	Oil and Grease	10	10	10	mg/l
8	Phenolic Compounds (as Phenol)	0.1	0.3	0.3	mg/l
9	Chloride (as Cl^-)	1000	1000	SC	mg/l
10	Fluoride (as F^-)	10	10	10	mg/l
11	Cyanide (as CN^-)total	1.0	1.0	1.0	mg/l
12	An-ionic detergents (as MBAS)	20	20	20	mg/l
13	Sulphate(SO_4^{2-})	600	1000	SC	mg/l
14	Sulphide (S^{2-})	1.0	1.0	1.0	mg/l
15	Ammonia (NH_3)	40	40	40	mg/l
16	Pesticides	0.15	0.15	0.15	mg/l
17	Cadmium	0.1	0.1	0.1	mg/l
18	Chromium (trivalent and hexavalent)	1.0	1.0	1.0	mg/l
19	Copper	1.0	1.0	1.0	mg/l
20	Lead	0.5	0.5	0.5	mg/l
21	Mercury	0.01	0.01	0.01	mg/l
22	Selenium	0.5	0.5	0.5	mg/l
23	Nickel	1.0	1.0	1.0	mg/l
24	Silver	1.0	1.0	1.0	mg/l
25	Total toxic metals	2.0	2.0	2.0	mg/l
26	Zinc	5.0	5.0	5.0	mg/l
27	Arsenic	1.0	1.0	1.0	mg/l
28	Barium	1.5	1.5	1.5	mg/l
29	Iron	8.0	8.0	8.0	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6.0	6.0	6.0	mg/l
32	Chlorine	1.0	1.0	1.0	mg/l

3.3.4 Antiquities Act 1975

The Antiquities Act, 1975 ensures the protection of Pakistan's cultural resources. The Act defines "antiquities" as ancient products of human activity, historical sites or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GoP to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the Project proponents are obligated to ensure that no activity is undertaken within 61 m (200 ft) of a protected antiquity, and to report to the GoP's Department of Archaeology any archaeological discovery made during the course of the project.

The federal Department of Archaeology maintains a master register containing basic and vital information on the protected monuments and sites including full measurements of the protected area, description, location and Government Notification number with date of protection. The central directorate general of Archaeology has a separate list which is continuously updated as and when new sites are declared as protected.

The Act is designed to protect the antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GOP to prohibit excavation in any area that may contain articles of archaeological significance. The project site does not have any cultural sensitivity in the vicinity to require protection. The provisions of this law therefore do not apply on the project.

No protected antiquity/cultural heritage site was identified in the proposed Project area.

3.3.5 Sindh Cultural Heritage (Preservation) Act, 1994

The Sindh Cultural Heritage (Preservation) Act, 1994 is the provincial law for the protection of cultural heritage. Its objectives are similar to those of the Antiquity Act, 1975. The Act empowers the Antiquities Department to protect the cultural and heritage sites from any development /improvement work.

None of the sites protected under this law are found in the vicinity of project site. The project will therefore not influence the integrity of cultural heritage in the macro-environment.

3.3.6 Forest Act 1927

The Forest Act deals with the matters related with protection and conservation of natural vegetation/habitats. In that regard it empowers the concerned agency to declare protected and reserved forest areas and maintaining the same. In spite of the fact that it recognizes the right of people for access to the natural resources for their household use, it prohibits unlawful cutting of trees and other vegetation. The permission is required prior to undertaking any tree cutting from the area under the charge of Forest Department of Sindh.

The Project site does not encompass any reserve/protected forest area. However, it is not just the protected forests that the Forest department needs to attend to; it is equally responsible to protect the forest cover, protected or unprotected, to abate rampant desertification. The process of desertification is linked to availability of firewood, which is now in greater demand than ever because of the exhaustion of all fuel resources in the country. This has led to not just felling, lopping and topping of trees, branches anywhere but to extracting the tree by the roots.

3.3.7 Cutting of Trees (Prohibition) Act, 1975 and The Protection of Trees and Bush wood Act, 1949

The Cutting of Trees Act prohibits cutting or chopping of trees without prior permission of the Forest Department. Section 3 of this Act states "No person shall, without the prior written approval of the local formation commander or an officer authorized by him in this behalf, cut fell or damage or cause to cut, fell or damage any tree."

Similarly, the Protection of Trees and Bush wood Act, 1949 prohibits cutting of trees and bush wood without permission of the Forest Department. The Act was enforced to prevent unlawful removal /clearing of trees and green areas for any reason without the consent of the Forest Department.

3.3.8 Sindh Wildlife Protection (Second Amendment) Ordinance, 2001

This ordinance provides for the preservation, protection, and conservation of wildlife by the formation and management of protected areas and prohibition of hunting of wildlife species declared protected under the ordinance. The ordinance also specifies three broad classifications of the protected areas: national parks, wildlife sanctuaries and game reserves. Activities such as hunting and breaking of land for mining are prohibited in national parks, as are removing vegetation or polluting water flowing through the park. Wildlife sanctuaries are areas that have been set aside as undisturbed breeding grounds and cultivation and grazing is prohibited in the demarcated areas. Nobody is allowed to reside in a wildlife sanctuary and entrance for the general public is by special dispensation. However, these restrictions may be relaxed for scientific purpose or betterment of the respective area on the discretion of the governing authority in exceptional circumstances. Game reserves are designated as areas where hunting or shooting is not allowed except under special permits.

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Two amendments to the Ordinance were issued in January and June 2001 respectively pertaining to oil and gas exploration activities within national parks and wildlife sanctuaries. The first amendment allowed the Government to authorize the laying of an underground pipeline through protected areas. The second amendment allowed exploration and production activities within national parks and wildlife sanctuaries. This amendment is not applicable to other development projects including power generation using wind energy for example.

The Jhimpir ecosystem which includes the Project site does not fall in a protected area or wildlife sanctuary.

Legalization of hunting on disappearing creatures in Pakistan and specifically the hunting of houbara bustard has been allowed as the preservation method for local wild animal habitat. However, because of the lukewarm attitude of the authorities that be, this method of conservation has failed in its mission. The wildlife department is hardly able to monitor the actual number of animal or bird killed as against the legally allowed numbers, and that makes it hard to control the trophy hunters.

Big-game hunting is banned in Pakistan vide the above regulations, except in community-controlled areas with an existing limitation on exact kinds and numbers of species as well as countries they can be exported in. There is decline in such species as cranes, geese, storks, pelicans, and houbara bustards, which are migratory birds. The illegal hunting has led to continuous loss, fragmentation and degradation of natural habitats that include forests, rangelands, and freshwater and marine ecosystem.

Sindh Wildlife Department is responsible for protection of wildlife in the Province. The Department's concerns are limited to areas designated as game reserves, national parks and wildlife sanctuaries and to protecting species afforded protection under the law. So as long as the law is not being contravened they have no artificial interest in activities carried on outside game reserves, national parks and wildlife sanctuaries. The Department nevertheless has the powers to halt illegal activities outside the protected areas.

Protection of measures such as restriction of hunting/poaching of animals, cutting of wood for fuel, and careful transportation etc. will be adopted to ensure the protection of wildlife in the microenvironment and immediate surroundings.

3.3.9 The IUCN Red List

Some animal species are already extinct in Pakistan, and many are internationally threatened. The 1996 IUCN Red List of Threatened Animals classifies 37 species and 14 sub-species of mammals that occur in Pakistan as internationally threatened or near-threatened.

The Red List is based on field data that is more than 10 to 15 years old and needs to be re-assessed. The country also provides critical habitat to 25 internationally threatened bird species and 10 internationally threatened reptiles.

According to the National Avian Research Centre in Abu Dhabi, with Houbara's birth rate of 5 per cent a year and if number of Houbara keeps decreasing at the same rate with more than 6,000 being bagged by hunting parties and more than 4000 smuggled out of country, the worst scenario is that the Houbara bustard would disappear as a species.

There are a number of organizations that were formed to protest the illegal hunting and preserve the wildlife. This includes National Council for Conservation of Wildlife (NCCW), established in 1974 and supported by the UN, which breaks into three groups: Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Wetland of International Importance Especially as Waterfowl Habitat (RAMSAR) and Convention on the Conservation of Migratory Species of Wild Animals (CMS).

3.3.10 Land Acquisition Act, 1894

This Act is a colonial legacy which provides law for the acquisition of land needed for public purposes and for companies. The Act provides complete mechanism for determining the amount of compensation for land, trees, horticulture, to be made on account of such acquisitions. The law provides details of various peculiarities involved in acquisition of land such as preliminary investigation, objection to acquisition, declaration of intended acquisition, enquiry into measurements, value & claims, taking possession, reference to court and procedure thereon, apportionment of compensation, payment, temporary occupation of land, acquisition of land for companies, disputes resolutions, penalties and exemptions, etc. This Act has 55 sections addressing different areas. Section 4(2) of the Act mentions that it shall be lawful for any official authorized by the Collector to enter upon and survey, to dig or to do all other acts necessary to ascertain whether the land is suitable for such purpose.

The project site is already acquired by the proponent; therefore no land acquisition is involved.

3.3.11 Pakistan Penal Code (1860)

The Pakistan Penal Code (1860) authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.

3.3.12 Civil Aviation Rules (1994)

These rules apply to flight operations within Pakistan by aircrafts other than military aircrafts and, except where otherwise prescribed, to flight operations by aircrafts registered, acquired or operating under these rules, wherever they may be. The rules with relevant significance to the activities taking place in Jhimpir Wind Corridor are the following:

- No person shall erect any temporary or permanent structure, nor position a vehicle or other mobile object on or in the vicinity of an aerodrome (airport), that will be within the clearance area, or will protrude through an obstacle limitation surface, at that aerodrome.
- No person shall operate a light in the vicinity of an aerodrome which because of its glare is liable to dazzle pilots of aircraft taking off from or landing at that aerodrome; or which can be mistaken for an aeronautical ground light. If such a light is operated it shall be extinguished or satisfactorily screened immediately upon notice being given to the person or persons operating the light, by the Director General or by the Manager or by a person authorized by him.
- No person or persons shall operate a radio station or electrical equipment in the vicinity of an aerodrome or of a radio aid to navigation serving an airway or an air route in Pakistan which is liable to cause interference with radio communications between aircraft and an Air Traffic Services Unit, or which is liable to disturb the signal from a navigational radio aid.
- A captive balloon or a kite shall not be flown at a height above 200ft within 6km of an aerodrome, and a free balloon shall not be flown at any place, except with the express permission of the Director General and in compliance with the conditions attached to such permission
- An aircraft shall not be flown over congested areas of cities, towns, or settlements or over an open air assembly of persons, except by permission of the Director-General, unless it is at such height as will permit, in the event of an emergency, a landing to be made without undue hazard to persons on the ground, and except when it is taking off or landing, shall not be flown closer than 500ft to any person, vessel, vehicle or structure.

The proposed Wind farm site is neither used by the domestic air traffic, nor does it fall under the flyway of the air traffic. It is therefore unlikely that wind farm construction and operation activities would contravene any of the aforementioned rules. The Proponent will nevertheless submit a promissory note to the Director General Civil Aviation informing the Authority of the construction and operation schedule and install aviation lighting at the top of wind turbine if required by regulations.

3.3.13 Self-Monitoring and Reporting by Industry Rules, 2014

These rules classify the industrial units for monitoring and reporting their liquid effluent and gaseous emissions into three and two categories respectively. According to each category they define the priority parameters to be monitored and reported to SEPA according to a specific frequency based on working conditions. This monitoring and reporting is in addition to the monitoring conditions as required by the conditions of approval of IEE. The sampling for testing must be carried out according to Environmental Samples Rules, 2014 and be sent to SEPA certified environmental testing laboratories.

3.4 Approval and Lease Requirements

- All development activities are now required by law to obtain an Approval/No Objection Certificate (NOC) from the provincial EPA or Federal EPA, as the case may be.
- Power Production Units based on Renewable Energy sources are required to obtain a No Objection Certificate (NOC) from the Alternative Energy Development Board (AEDB). However, in order to encourage generation through renewable resources, small projects for self-use will not require any permission from the government, and will also be able to sell surplus power to Distribution Companies under the Renewable Energy Policy - 2006.
- The small renewable energy projects also do not require tariff determination from NEPRA. Alternative Energy Development Board has been allowed to handle Wind and solar projects, irrespective of size of the plant (even more than 50 MW), while the power purchaser will bear the wind risk just as well.
- Approvals/leases are required from Local Government, Highway Department, and Irrigation Departments for installation of transmission lines and their crossing of highways, roads, canals and public property. Approvals will also be needed from Civil Aviation Authority as well as Telecommunication Authority in case the project is sited near or under the aircraft flyway zone. Each of these departments has its own set of requirements for grant of approval.

The following departments will be consulted and their consent obtained, if necessary, before commencement of work at the Project site:

- Sindh Wildlife and Forest Department
- National Highway Authority
- Water and Power Development Authority (WAPDA)
- National Transmission and Dispatch Company (NTDC)
- Hyderabad Electric Supply Company (HESCO)
- Pakistan Telecommunication Company Limited (PTCL)
- Civil Aviation Authority (CAA)

3.5 Environmental and Social Guidelines

3.5.1 Environmental Protection Agency's Environmental and Social Guidelines

The Federal EPA has prepared a set of guidelines for conducting environmental and social assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the environmental and social guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below followed by comments on their relevance to proposed project:

Policy and Procedures for Filing, Review and Approval of Environmental Assessments, Pakistan Environmental Protection Agency, September 1997: These guidelines define the policy context and the administrative procedures that govern the environmental assessment process from the project pre-feasibility stage to the approval of the environmental report. The section on administrative procedures has been superseded by the IEE-EIA Regulations, 2000.

The overall flow of obtaining the approval of IEE and EIA is shown in figure 3.1 and 3.2.

- **Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997:** The guidelines on the preparation and review of environmental reports target project proponents and specify:
    - The nature of the information to be included in environmental reports
    - The minimum qualifications of the EIA conductors appointed
    - The need to incorporate suitable mitigation measures at every stage of project implementation
    - The need to specify monitoring procedures.
- The terms of reference for the reports are to be prepared by the project proponents themselves. The report must contain baseline data on the Study Area, detailed assessment thereof, and mitigation measures.
- **Sectoral guidelines for Environmental Reports – Wind Power Projects:** These Wind Power sectoral guidelines are part of a package of regulations and guidelines. They should be read in the context of the overall EIA Guideline Package. This "Package" has been prepared by the Federal EPA in collaboration with other key stakeholders, including Provincial EPA's and Planning and Development Division from both the Federal Government and the provinces, other Agencies, NGO's representatives of Chambers of Commerce and Industry, and academics and consultants. The Package consists of comprehensive procedures and guidelines for environmental assessment in Pakistan. It is emphasized that the various guidelines should be read as a package; reliance on the sectoral guidelines alone will be inadequate.
- Guidelines for Environmental Impact Assessment of Wind Farms allow for adoption of methods mentioned in the Pakistan Environmental Assessment Procedures 1997.

- **Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May, 1997:** These guidelines support the two guidelines mentioned above. They deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.
- **Guidelines for Sensitive and Critical Areas:** The guidelines identify officially notified protected areas in Pakistan, including critical ecosystems, archaeological sites, etc., and present checklists for environmental assessment procedures to be carried out inside or near such sites. Environmentally sensitive areas include, among others, archaeological sites, biosphere reserves and natural parks, and wildlife sanctuaries and preserves.

3.5.2 IFC- Environmental, Health, and Safety Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry specific examples of Good International Industry Practice (GIIP). For Wind Energy the EHS Guidelines for wind energy include information relevant to environmental, health, and safety aspects of onshore and offshore wind energy facilities.

Construction activities for wind energy projects typically include land clearing for site preparation and access routes; excavation, blasting, and filling; transportation of supply materials and fuels; construction of foundations involving excavations and placement of concrete; operating cranes for unloading and installation of equipment; and commissioning of new equipment. Decommissioning activities may include removal of project infrastructure and site rehabilitation.

Environmental issues associated with the construction and decommissioning activities may include, among others, noise and vibration, soil erosion, and threats to biodiversity, including habitat alteration and impacts to wildlife. Due to the typically remote location of wind energy conversion facilities, the transport of equipment and materials during construction and decommissioning may present logistical challenges.

Environmental issues specific to the operation of wind energy projects and facilities include the following:

- Visual impacts
- Noise
- Species mortality or injury and disturbance
- Light and illumination issues
- Habitat alteration
- Water quality
- Electric Power Transmission and Distribution

The EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas.

Examples of the impacts addressed in the General EHS Guidelines include:

- Construction site waste generation;
- Soil erosion and sediment control from materials sourcing areas and site preparation activities;
- Fugitive dust and other emissions (e.g. from vehicle traffic, land clearing activities, and materials stockpiles);
- Noise from heavy equipment and truck traffic;
- Potential for hazardous materials and oil spills associated with heavy equipment operation and fuelling activities.

Environmental issues during the construction phase of power transmission and distribution projects specific to this industry sector include the following:

- Terrestrial habitat alteration.
- Aquatic habitat alteration.
- Electric and magnetic fields.
- Hazardous materials.

Chapter 4 DESCRIPTION OF ENVIRONMENT

4.1 General

This section describes the environmental conditions of the project area. Information for this section was collected from a variety of sources, including published literature, reports of other studies conducted in the area by the EMC Pakistan Pvt. Ltd. and archives of the experts, consultations with institutions, Non-government Organizations (NGO's) and field surveys conducted for this study by the team of EMC Pakistan Pvt. Ltd.

Description of the environment of the project requires baseline data on the existing resources of its microenvironment and macro environment, the following in particular:

a. Physical Resources.
b. Ecological Resources.
c. Social, Economic Development and Cultural Resources.

In order to carry out environmental assessment study, it is first necessary to demarcate the existing environmental feature in and around the proposed project, on the existing environment and section describes the environmental setting of the project area.

Baseline data reported here pertain to the physical, biological and socio-economic aspects of the macro-environment as well as the microenvironment of proposed project site. The project is located in Jhimpir- Thatta, Sindh. Information available from electronic/printed literature relevant to baseline of the area, surroundings and Karachi was collected at the outset and reviewed subsequently. This was followed by surveys conducted by experts to investigate and describe the existing status and scenario.

4.2 Physical Baseline of the Macro-Environment

The physical environment of Project has been described here in terms of climate and meteorology, ambient air quality, surface water resources, groundwater resources and quality, geology and seismicity.

4.2.1 Location of the Project

The site is located at about 110 km from Karachi.The site is easily accessible through Karachi Hyderabad Motorway (M9) and through Thatta-Thano Bula Khan access road. Keenjhar Lake is located over 7 km towards south of wind farm site. The project area stretches in nearly northwest-southeast direction, with a length of about 7.25 km and width of about 2.7 km. The elevation of the project area is 50m~73m. The project area can be reached through M9 Highway from Karachi to Nooriabad and through Thatta-Thano Bula Khan road from Nooriabad to Jhimpir. The location map of proposed Project is presented in Figure 4.1.

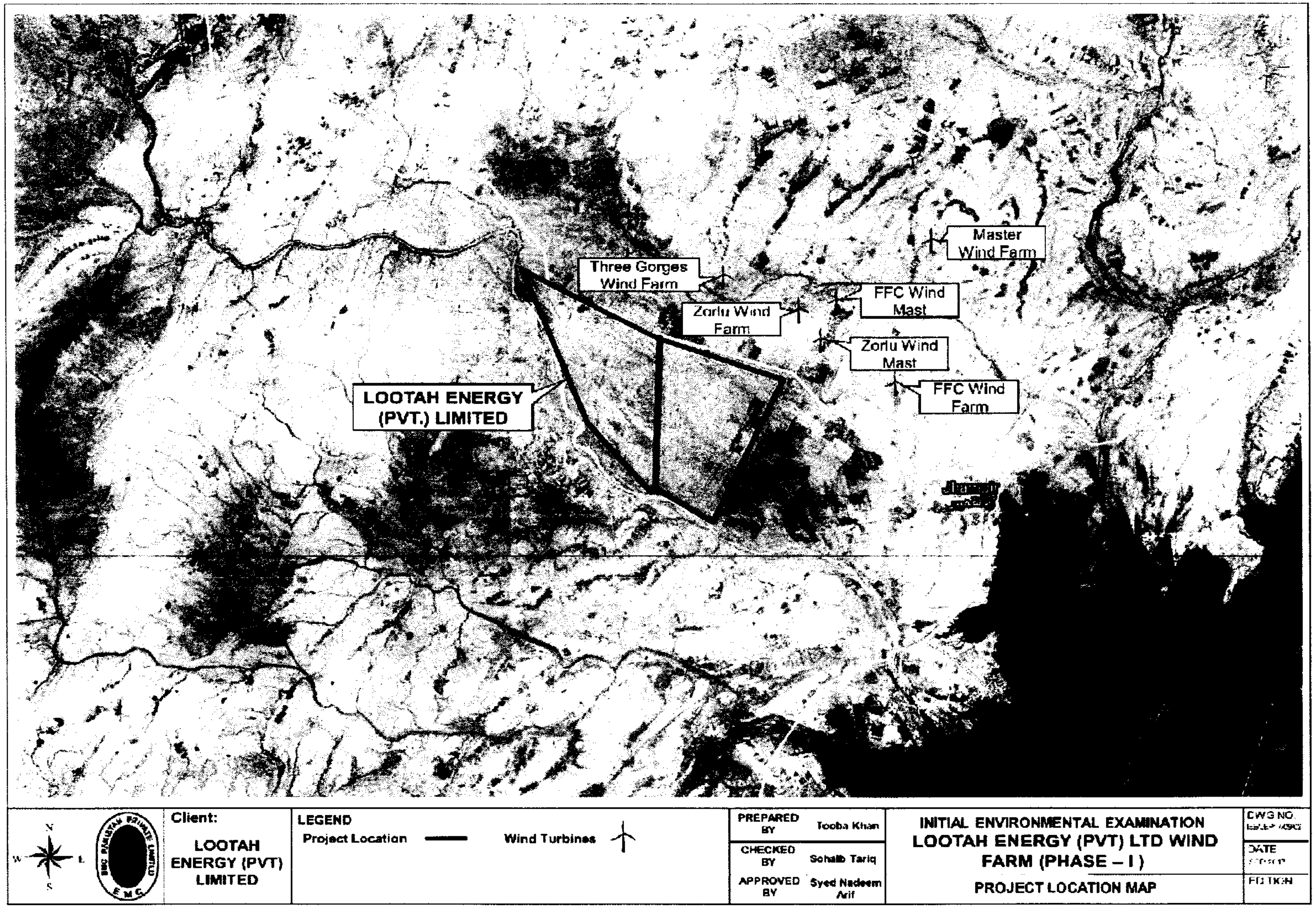


Figure 4.1: Map Showing Proposed Total Project Area and the existing wind farms in vicinity

4.3 Macroenvironment of the Project

The macro environment of the proposed project is at large scale comprises of District Thatta on the whole. District Thatta spreads over 17, 355 sq. km and located between 23° 43' to 25° 26' N and 67° 05' to 68° 45' in Sindh, Pakistan. Thatta district comprises 38.9 % wet areas with Indus River and Keenjhar Lake as the major fresh water resources. Crop irrigated area is around 19.6% and Crop Marginal and irrigated Saline is 3.7% in Thatta district. Forestry includes natural trees and Mangroves consisting of 5.4% in the district and bare areas with sparse natural vegetation comprise 5.9% land. In Thatta district range lands include Natural shrubs and Herbs around 6.1%.

The district is administratively subdived into 4 tehsils (talukas or sub-district): Ghora Bari, Mirpur Sakro, Thatta and Keti Bunder. Tehsils included 55 Union Councils, 7,200 villages and over 190,000 households with an average size of 6.5 persons per household, before the Sujawal district was carved out of Thatta. The Proposed 50MW Lootah Energy wind farm project would be sited in Thatta tehsil of the district.

In its physical aspects the Thatta District has very varied features which range from coastal swamps to fresh water marshes and lakes and from river islands to coastal deltas. However, this wide variation has diminished as a result of the lack of water in the Indus River. The current terrain of the district consists of the Makli Hills close by the Thatta Town. These hills are 32 kilometers in length and are well known on account of the ancient tombs which are located here. The nort western part of the district consists of hilly tracts known as Kohistan. The hills are bare and mostly composed of limestone while the valleys are covered with grass or brushwood. Southwards, the area degenerates into sandy wastes, uncultivated and almost devoid of vegetation.

There are short ranges of low stones, hills and intersected by nais or torrent beds which carry the drainage of the Kohistan to the Indus. To the west, wind has blown sand over large tracts of land. In the south eastern quarter of the delta, there is a wide expanse of salt waste, embracing a large part of the southern tehsil.

There are many lakes in the district. The most famous are Keenjhar, also known as Kalri, and Haleji Lake. The Keenjhar Lake is a reservoir for feeding canals in the Thatta sub-division. It also supplies water to Karachi. During winter it is an ideal spot for fishing and duck-shooting. There have been many ecological changes in the district, which have changed the nature of the delta. The lack of water below Kotri has damaged the ecology of the delta. The old branch of Indus, which used to run past it into the Gharo Creek, has silted up.

The climate of the district is moderate. The mean maximum and minimum temperature recorded during this month is about 40°C and 2°C respectively. The winter season starts from November when the dry and cold northeast winds replace the moist sea breeze. As a result there is an immediate fall in temperature. January is the coldest month. The annual average rainfall of the district is about 200 mm.

As regards the physiographic features, district Thatta can be characterized as the piedmont colluvial fans. The district is covered with un-differentiated piedmont and sub-piedmont deposits consisting of loosely packed boulders, cobbles, pebbles and coarse to fine stand. In regimen of fluvial erosion, the colluvial fringe has developed by merging of alluvial fans of individual streams depositing the erosional load of coarse sediments at the foot of each hillside. The deposits combined with material brought by sheet wash from hillsides has remained mostly unconsolidated, and under the process of weathering it has developed into good fertile soil where water is available. In dry or semi-arid conditions this shelving deposit of unconsolidated material has created badland topography of deeply scarred earth, unsuitable both for cultivation and habitation. Covered by sparse thorny shrubs, these however, serve as grazing grounds for livestock that is limited to goat and sheep.

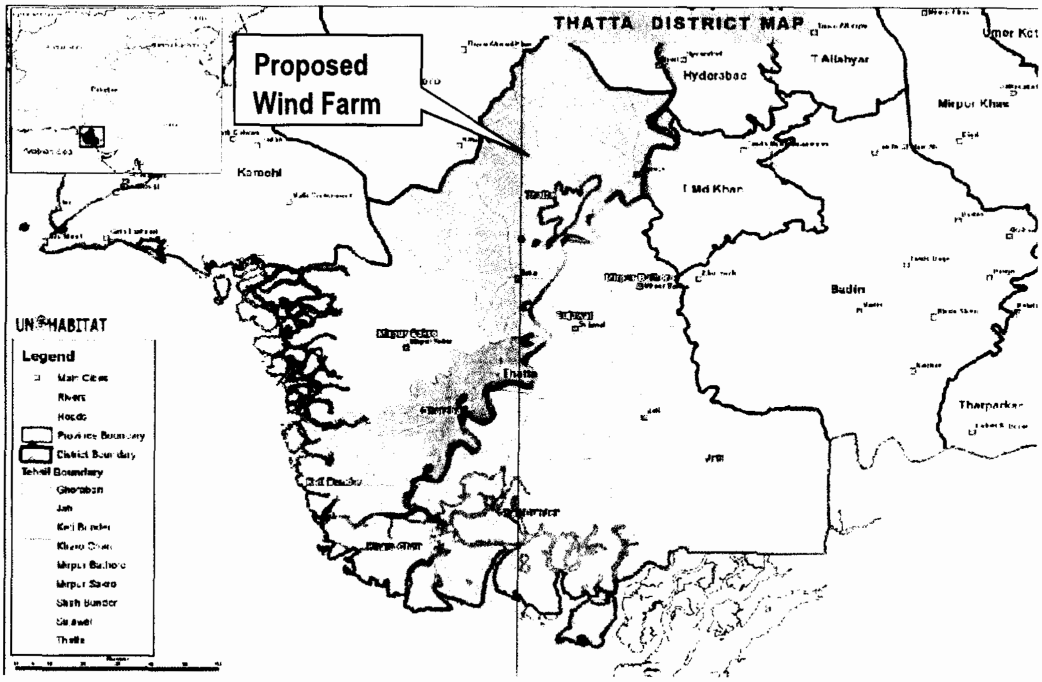
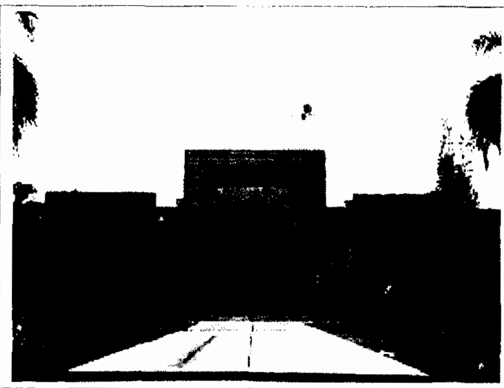


Figure 4.2: Map of Greater District Thatta. District Sujawal was formed out of the District in 2013



Shahjhan Mosque

Makli Hills Graveyad

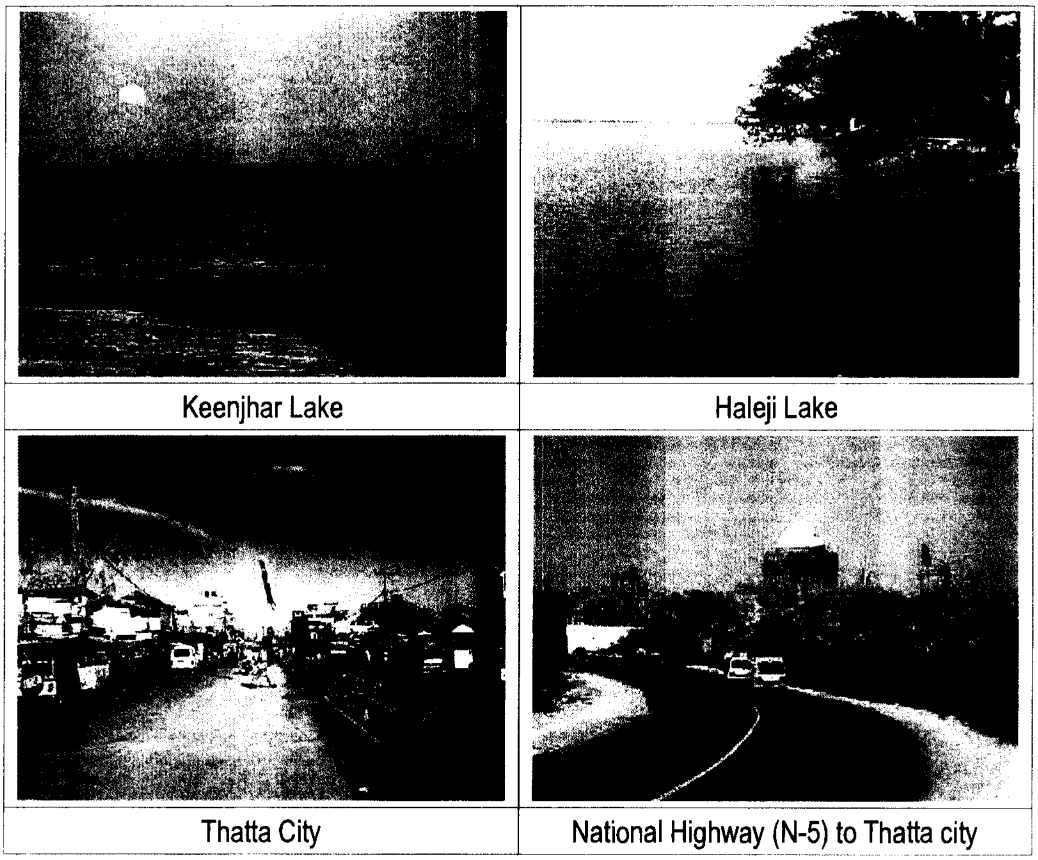


Figure 4.3: Macro environment of Thatta

4.3.1 Geography of Macroenvironment

The Jhimpir Wind corridor lies in the mid-southwestern part of Sindh province. It is in fact bounded by the drainage basin of Baran nai including Darawat Dam site on the north, the Baran nai on the east, the Super Highway on the immediate south and the drainage area of Harolo nai on the west. The Harolo nai drains into Keenjhar Lake beyond the Jhimpir-Meting coal field along the Pakistan Railway Line in the south.

The land here is a barren, flat to mildly hilly tract, consisting of outlying spurs of the Kirthar Range. Cultivation is carried out wherever alluvial soil exists and near or along the numerous depressions where rain water carried by hill streams (nallas) can be stored. Cattle grazing, stone quarrying, gravel and sand collection and transportation, besides wood cutting are the main occupation.

4.3.1.1 Urban Clusters in Macroenvironment of Jhimpir Wind Corridor

Major human settlements are located farther than 5 km from Jhimpir Wind Corridor. Thano Ahmad Khan and Thano Bula Khan are the main towns on the north of Super Highway M-9. Jhimpir (Population 40,000 approx), Meting (Population 2,000), Nooriabad (Population 4,000 approx) and Jherruck (Population 5,000 approx), the main towns in the Jhimpir Wind Corridor are located on the south of Super Highway.

Jhimpir is an old town of historical significance, rich in minerals and natural resources, located close to Keenjhar Lake. The main source of income is fishing in Keenjhar Lake and hunting/catching wintering birds for at least 4 months of the year. Other sources of income are wage labor in coal mines, stone quarries, other menial labor and working at the Jhimpir railway station. Those who have received some education are in jobs at school, offices and industries in Nooriabad.

Nooriabad is about 30 km from Jhimpir and is home to the Nooriabad Industrial Area on 5,342 acre area with 522 plots out of 1150 or 30 percent in occupancy. Textile units, light engineering, food processing, and chemicals manufacturing are the major types of industries in the area.

4.3.2 Geology

The prevailing geologic conditions in the region are the results of extensive inundation, depositions, coastal movements, and erosions over a long period of time in the geological ages. The geology of the region is closely related to the formation process of Himalayan ranges resulting in intense deformation with complex folding, high angle strike-slip faults and crust thickening expressed in a series of thrust faults. The important tectonic changes which have had so much influence in the region are feebly visible particularly in the Indus Plain, and it is only by considering the geology on a broader regional scale, as well as in site specific detail, that the effects can be appreciated.

Most parts of Sindh are covered either by recent alluvium or wind-borne sand. The principal features of geological significance are to be found in the hilly portions of the province, towards the west of the Indus. Outlying extensions of this hilly tract occur east of the Indus as well, near Sukkur, Hyderabad and Jerruck.

The hilly region of western Sindh consists almost entirely of rocks belonging to the tertiary system of geological nomenclature. It is only along the Laki Range and in its neighborhood that there are some exposures of rocks belonging to the next older system, the Cretaceous. With the exception of some volcanic beds associated with these Cretaceous strata, all the rock formations of western Sindh are of sedimentary origin. All of the more important hill masses consist of limestone. A great majority of these limestone deposits belong to the Nummultic period and are largely built up of the accumulated shells of foraminifera, principally those belonging to the genus Nummulites.

Pediments and fluvial terraces at various levels in the landscape indicate that uplift is intermittent, because these surfaces only form during periods of vertical stability. In general the landscape of Kirthar Range is dominated by erosion while the stony plains are dominated by deposition.

The mountains of the Kirthar region have been cut by deep gorges, the Darawat Gorge being one of them. The gorges have passed onto a piedmont that is characterized by the following units: bedrock-cut pediments that are now dissected by alluvial fans which terminate in a plain, and finally a floodplain.

The piedmont plain is subdivided into plains cut in bedrock (pediments) and plains formed of alluvium (alluvial plains). The area contains bedrock-cut pediments that have been dissected by alluvial fans which terminate in a plain and in the floodplain of the Barannai. The dissected plain geomorphological land unit is bounded by bedrock outcrops. The main difference between this land unit and the 'Plain' land unit is the degree of fluvial incision into this surface. Streams like Layari and HaroloNai are deeply entrenched. The 'Dissected plain' surface is higher in the landscape than the 'Plain' surfaces, and the streams have therefore incised it more deeply in an attempt to maintain regular stream long profiles.

While the Sonda area is generally covered by scattered rock outcrops and hills, a large part of the area is covered by few to tens of feet thick alluviam. The soil comprises mainly of silt, sand, and gravel size particles deposited from the erosion of shales and limestone of the Lakhra formation. The soil is brown yellow to dark brown color and is quite fertile in areas where limited agriculture is carried out using rain and river water.

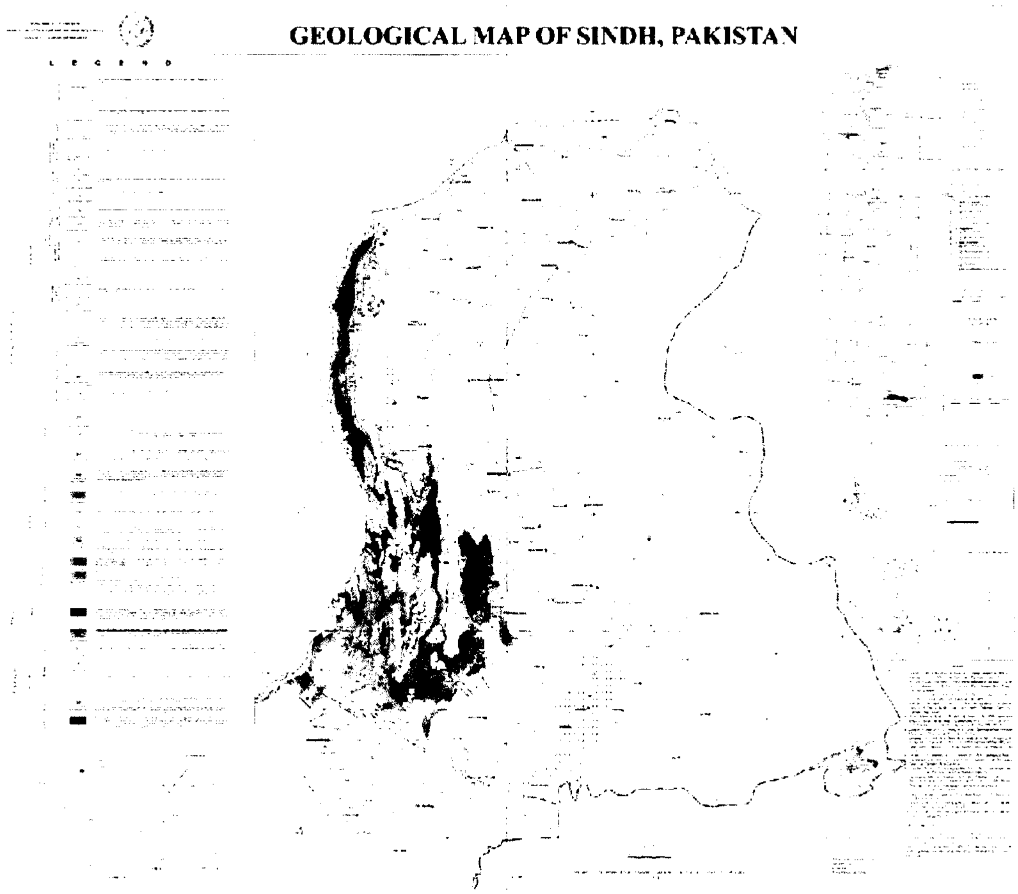


Figure 4.4: Geological map of Sindh (source: Geological Survey of Pakistan (GSP))

4.3.2.1 *Basic geological conditions of the project area*

Topography and geomorphology

The wind farm is about 7.25km long and 2.77km wide. It is a land with flat and open terrain and lesser fluctuation northeast and southwest direction, higher in the northwest and southeast direction, forming a relatively inclined platform, with general elevation of 50m~73m.

Stratum and rock type

According to area survey and engineering investigation data of nearby existing wind farms, the project area is mainly composed of the Quaternary Holocene alluvial and proluvial deposits and the underlying Jurassic limestone. From top to bottom it is divided into two main layers:

Layer ①: Quaternary Holocene alluvial and proluvial rubbles, which is dry, composed of rubbles of 0.5cm~1.5cm in size with less medium ~ coarse sand and clay, limestone is the dominant rock type. The layer is unevenly distributed, generally 0.1m~0.5m thick on the platform surface and 0.2m~1.5m along gentle slope and at the bottom of gullies, of moderate ~ dense structure.

Layer ②: Jurassic limestone, which is hard, grey white in color and widely exposed in the project area. The occurrence of the layer is nearly horizontal, and the thickness of highly weathered rock mass is 3m~5m according to estimation. Karst development can be seen in the layer, mainly appearing as small dissolved pores and karst caves of 0.5cm~7cm in diameter, which are mostly filled.

Hydrogeology

Investigation shows that the groundwater depth is comparatively great, exceeding 30m according to estimation. The corrosive effect of groundwater on structures can be omitted. Recent rains (June-August 2017) may have increased the groundwater level in the Jhimpir area.

Thickness of frozen soil

According to local meteorological data, there is no seasonal frozen soil in the project area.

4.3.3 Soil

The soil in the plains of Sindh is plastic clay that has been deposited by the Indus. Combined with water it develops into a rich mould and without water it degenerates into a desert. Nearly the entire Indus valley has soil which is extremely friable and easily disintegrated by the flow of water. Resultantly, the water always contains a large amount of suspended silt.

4.3.3.1 Soil condition of Project Area

The deposition of the area mainly consists of 'extremely weak to very weak' mudstone, highly weathered and fractured limestone, highly weathered and fractured sandstone and very dense coarse grained sand with traces of silt. Groundwater table was not encountered in the boreholes up to the explored depth of 30 meters.

The subsurface deposits up to the explored depth consist of the following units.

- Sand
- Limestone
- Mudstone

- Sandstone

Following sub-sections describe the strength characteristics of the geological units and the groundwater conditions. Rock samples have been classified in accordance with BS-5930. Unconfined compressive strength, moisture content, density etc. of these deposits was carried out in the laboratory.

Sand: Deposits of coarse grained sand with silt and gravel were found in all of the boreholes drilled at the site. The grain size analysis of these deposits was carried out in the laboratory. Unified Soil Classification System (USCS) classifies these deposits as 'SP', 'SM' and 'SP-SM'.

Limestone: Deposits of highly weathered and fractured limestone were found in one of the boreholes drilled at the site. Rock core samples were collected from these deposits.

Mudstone: Deposits of highly weathered and fractured mudstone were found in three of the boreholes drilled at the site. Rock core samples were collected from these deposits. State of compactness according to unconfined compressive strength has been determined as 'extremely weak to very weak' mudstone in accordance with BS 5930. The unconfined compressive strength of the mudstone encountered at the site ranges from 1.86 kg/cm2 to 29.44 kg/cm2.

Sandstone: Deposits of highly weathered and fractured sandstone were found in all of the boreholes drilled at the site. Rock core samples were collected from these deposits.

Density and Moisture Test				
Borehole	**Sample Depth (m)**	**Moisture Content (%)**	**Dry Density (gr/cm3)**	**Wet Density (gr/cm3)**
BH-01	6	4.06	2.18	2.27
BH-02	7.6	19.3	1.79	2.14
BH-02	18.1	7.68	2.21	2.38
BH-03	1.5	14.21	1.86	2.12
BH-03	9	15.7	1.76	2.03
BH-03	12	16	1.78	2.07
BH-03	16.5	18.78	1.74	2.07
BH-03	19.5	16.86	1.71	2
BH-03	22.5	16.56	1.58	1.84
BH-03	27	15.43	1.68	1.94
BH-03	28.7	18.13	1.67	1.97
BH-04	15	15.51	1.75	2.02

Chemical Test Results			
Borehole	**Sample depth (m)**	**Description**	**Value**
BH-01	1.5	pH	7.65
BH-02	1.5		7.7
BH-03	1.5		7.78

Chemical Test Results			
Borehole	**Sample depth (m)**	**Description**	**Value**
BH-04	1.5		7.73
BH-01	1.5	Sulphate Content	0.01
BH-02	1.5		0.01
BH-03	1.5		0.01
BH-04	1.5		0.01
BH-01	1.5	Chloride Content	0.12
BH-02	1.5		0.13
BH-03	1.5		0.09
BH-04	1.5		0.1

Detailed Geotechnical investigation report is found as **Annex-IV**.

4.3.4 Construction materials

According to investigation of the natural construction materials in the project area and the neighboring area, a few quarries are found in the macro environment of project area which can supply concrete aggregates for the project with satisfied quality and storage.

4.3.5 Seismicity

Seismic Zones are a vestige of the Uniform Building Code (UBC). The Zone number correlates to a level of acceleration expressed as a % of gravity. The maps are intended to represent the likely levels of earthquake ground shaking and, therefore, the potential for structural damage.

The ground accelerations associated with the Zones are probability based and correlate to prescribed levels of ground accelerations with Zone 4 being the highest and 0 being negligible.

According to the seismic zoning map of Pakistan, Sindh falls into medium to low seismicity risk zone of 2A/2B, with about 0.08g to 0.16g value. GSP has publishes seismic data which when in combined and mapped with the data provided by Pakistan Meteorological Department (PMD) become a useful tool to identify the potentially hazardous earthquake zone.

Following faults are located within the province of Sindh:

A. Jhimpir Fault

B. Karachi-Jati Fault

C. Surjani Fault

D. Pab Fault

E. Hab Fault

F. Allah Bund-Rann of Kutch Fault

4.3.5.1 *Jhimpir Fault*

N-W Trending. A number of epicenters are located on the fault. The fault has produced an earthquake of M=5.6 on Ritcher Scale. This fault is developed near the area.

4.3.5.2 *Surjan Fault*

These N-S trending dip-slip or bedding-plane faults are active along the Kirthar Range Front. This fault cuts across the Quaternary deposits on the north of Karachi and west of MirpurSakro. The southern end of this fault is intersected by the northwest trending Surjani Fault on the west of Jhimpir. The interaction of these two faults is characterized by at least four tele-seismic events of shallow focal depth and magnitude 3.6. The maximum magnitude of the earthquake associated with the Surjani Fault is of the order of M ≈ 6.1.

A number of epicenters are located on this N-W trending fault. The fault has produced an earthquake of M ≈ 5.6 on Richter scale.

4.3.5.3 *Pab Fault*

This NNW-SSE trending is 135 km in length and is located in the eastern part of the Pab Range and has dislocated vertically the Quaternary alluvial fans. The maximum magnitude of the earthquake associated with this fault is of the order M ≈ 7.0 on Richter scale.

4.3.5.4 *Hab Fault*

The Hab valley is traversed by this fault.

4.3.5.5 *Rann of Kutch Fault*

This E-W trending fault has produced earthquake of the order of M ~ 7.6 on Richter scale. In 1819 and 1956, this fault was responsible for severe earthquakes in Gujarat, Tharparker and Indus delta. This fault system also known as Allah Bund Fault passes in the proximity of the Steel Mills and Karachi Nuclear Power plant. It is 225 km in length and is responsible for the production of earthquake of considerably high magnitude of up to 7.6 M on Richter scale and of IX to X intensity on the Modified Mercalli, MM scale on June 16, 1819.

Additionally a complex series of faults generally oriented easterly and slightly concave to the north have been identified through aerial photographs. They are roughly parallel to the inferred zone of rupture for the 1819 earthquake event.

The Table 4.1 shows the earthquake occurrences over the last forty years. The Table does not include the numerous events of magnitude less than 4.0 on Richter scale. Earthquakes of recent occurrence were recorded on July 16, 2005, followed by one on August 6, another on August 13, yet another on October 9 and then again on October 11, 2005. They were all of magnitude between 4 and 5.1 on Richter scale. The epicenter of these earthquakes was away from those listed in table. The epicenter of the most recent tremor of January 2, 2009 was 100 kilometers in the coastal regions of Lower Sindh. It had a shallow depth of 10 kilometers and magnitude of 2.2 M on Richter scale

Table 4.1: Epicenter, Depth, Magnitude & Intensity of Earthquakes in Sindh

Year	Coordinates	Depth	Magnitude Richter Scale	Intensity MM	Location
1962	24°70'N66°00E	0	4.50	-	Karachi
1965	25° 03N67°76'E	40	4.50	-	Karachi
1966	25° 0N68°00' E	-	5.0	VI-VII	Jhimpir
1968	24°61N66°42' E	19	4.10	-	Karachi
1970	25°28N66°65' E	33	4.90	V	Karachi
1971	25°00N68°00' E	-	4.50	V	Jhimpir
1972	25°35N66°71' E	33	4.50	V	Karachi
1973	25°00N68°00' E	-	5.00	VI	Jhimpir
1973	25°48N66°33' E	57	4.90	V	Karachi
1975	25°50N66°80' E	-	4.50	V	Gadani
1975	25°22N66°59' E	33	4.90	V	Karachi
1976	24°96N70°38' E	14	4.70	V	Karachi
1984	25°86N66°41' E	33	4.70	VI	Karachi
1985	24°90N67°39' E	33	5.00	VI	Karachi
1986	25°34N66°60' E	33	4.50	V	Karachi
1992	25°25N67°76' E	33	3.60	IV	Karachi
1996	25°06N66°76' E	33	-	-	Karachi
1998	25°69N66°46' E	33	4.40	V	Karachi
1998	24°85N66°35' E	33	4.50	V	Karachi
2009	24°31N67°18' E	10	2.2	IV	Thatta
2013		76	7.9	VIII	Kash / Pak-Iran Border
2013		14.8	7.7	VIII	Awaran

According to a map created by the Pakistan Meteorological Department, the country is divided into 4 zones based on expected ground acceleration. The areas surrounding Quetta, those along the Makran coast and parts of the Khyber Pakhtunkhwa, and also along the Afghan border fall in Zone 4. The rest of the Khyber Pakhtunkhwa lies in Zone 3, with the exception of southern parts of this province, which lie in Zone 2. The remaining parts of the Pakistani coastline also lie in Zone 3. The remaining parts of the country lie in Zone 2.

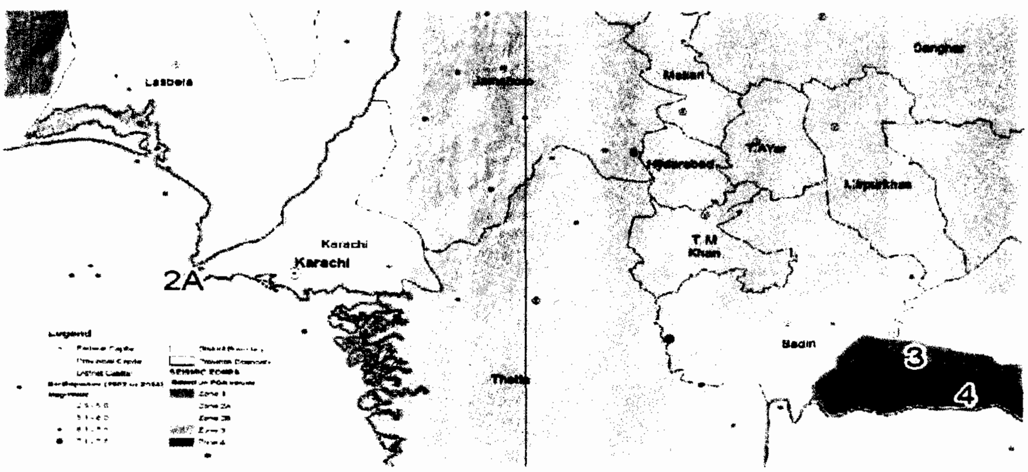


Figure 4.5: Seismic Zones of Thatta District[4]

[4] Map data source(s): PMD, GSP, Pakistan Engineering Council – Prepared by Al hasan Systems Private Limited

In view of the not too distant location of the Project site to Allah Bund Fault line, it is suggested that this ecosystem that includes the proposed project land should be placed in Zone 2A. Such Seismic Zoning would correspond to Magnitude between V and VII on Modified Mercallis Scale and hence ground Force in terms of Assumed Approximate Acceleration equivalent of 0.08-0.16g should be adopted for siting the Wind Farm for constructions and positioning of towers and WTGs, for operational basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (MM-V to VII). Therefore, the regional tectonic stability of the area is comparatively low.

The basic seismic intensity of the wind farm area is classified as VII degrees. The area overburden is comparatively thin, mainly composed of highly ~ moderately weathered limestone, with better mechanical property. The construction area is classified as Grade I, belonging to the area that is favorable to seismic design of structures. The area is suitable for construction of the wind farm.

According to the Code for Seismic Design of Buildings (GB50011-2001), there is no seismic liquefaction in the area foundation.

4.3.6 Seismic effect on the project area and foundation

The basic seismic intensity of the wind farm area is classified as VII degrees. The area overburden is comparatively thin, mainly composed of highly ~ moderately weathered limestone, with better mechanical property. The construction area is classified as Grade I, belonging to the area that is favorable to seismic design of structures. The area is suitable for construction of the wind farm.

According to the Code for Seismic Design of Buildings (GB50011-2001), there is no seismic liquefaction in the area foundation.

4.3.7 Climate

Pakistan's latitudinal and longitudinal extents and its northern rim of lofty mountains, are the two factors, which have a great bearing not only on the temperature and rainfall patterns, but also on the general circulation of the atmosphere on the southern Asia. Climate of Pakistan according to Koppen's classification18 falls under the following five types:

Tropical Semi-arid with Dry Winter: This climate type prevails in Karachi, Hyderabad, and southern Khairpur Division. The mean annual temperature is above 18°C.

Tropical Arid: This is characterized by average annual temperature of about 18°C with dry winters. This includes southern Kalat and whole of the Indus Plain.

Cold Semi-arid With Dry Summer: This climate type covers central Kashmir, Peshawar, D.I. Khan, Quetta and northern half of Kalat Division.

Snow Forest Climate: This climate type is characterized by average temperature of coldest month below 0 C. Mean temperature of the warmest month is between 10 and 22°C. It includes northern mountainous areas and parts of Kashmir.

Extreme Cold: This climate type is characterized by average temperature of the warmest months between 10 and 0°C. It comprises eastern and northern parts of Kashmir, Chitral, Gilgit and Laddakh. Based upon the above classification, most parts of the proposed project area are included in the Tropical Arid climate zone, while some southern parts of Sindh are located in the Tropical Semi-arid with Dry Winter climate zone.

The project area lies in the Tropical Arid climate zone because the mostly area experiences dry winters and with annual average temperature around 18°C. The climate of most parts of the Jhimpir is arid characterized by four distinct seasons in a year, that is, winter from Mid-November to February, spring during March and April summer from May to Mid-September and autumn from Mid-September to Mid-November.

4.3.8 Meteorology

There exist several meteorological stations in Sindh; data recorded at some of these stations is provided in the following sections.

4.3.8.1 Temperature

Atmospheric temperature is generally moderate through the year in Thatta due to the presence of sea. The mean yearly maximum 40°C and minimum around 8°C. The Tables below indicate that the mean monthly maximum temperature in Thatta ranged between 25°C and 40°C, while the mean monthly minimum temperature ranged between 8°C and 27.6°C. The Temperatures start falling from October each year to January and dry and hot weather prevails from April to September.

Table 4.2: Meteorological Parameters for Jhimpir Area

Months	Temperature °C		Rainfall mm	Relative Humidity %
	Maximum	Minimum		
January	25.78	8.73	0.96	50.38
February	28.59	11.60	3.60	48.81
March	34.02	16.80	2.30	48.36
April	38.40	21.80	2.49	48.67
May	39.85	25.47	0.69	53.10
June	38.02	27.46	10.76	60.70
July	35.11	27.04	70.49	69.61
August	33.61	26.06	89.88	72.55
September	34.36	24.87	34.43	68.78
October	35.80	21.70	3.72	58.15
November	31.87	15.86	1.67	53.88
December	26.68	10.10	1.11	52.46
Annual	33.48	19.76	221.64	57.56

Due to high temperatures in summer, the plant species with low vigor and shallow root system die away. Maximum temperature is high in these regions, especially in the dry season when there is little cloud or moisture in the atmosphere to absorb solar radiation. Under conditions of high temperatures life and work become difficult. Not only is lack of moisture in the form of rain, the chief factor causing arid conditions, but low air humidity in itself has an adverse effect upon plants and animals, because the rate of evaporation is very high at these temperatures. Loss of moisture from the ground and from vegetation is an indicator of rate of "evapo-transpirtion" which is very high in semi- arid and arid regions of Kohistan, Thatta. The incidence of high temperature causes heat damage. Maximum temperatures are high in Kohistan especially in dry season when there is little cloud or moisture to absorb solar radiation. Accordingly the rate of evapo-transpiration is very high.

4.3.8.2 Rainfall

The southwest monsoon brings in humid air from the sea, but the precipitation is generally very low with nearly 80% of the 100 to 200 mm rain falling from June to September. Rainfall, when it does come, it is often torrential causing problems of drainage and erosion of the light and sparsely vegetated land of Jhimpir.

The winters are short and mild from late November to early February with the prevailing wind coming from the North East with very little rainfall. The most important characteristics of the prevailing meteorological conditions are the generally high dust conditions as a result of the aridity of the surrounding area; dust storms occur especially before the onset of monsoon. The higher winds during the southwest monsoon tend to carry air-borne dust inland during the summer months, while in winter they tend to be light to moderate in intensity and carry air borne particulate matter seaward.

Monsoon in the arid area of Kohistan is characterized by low and high variable rainfall both in time and space. The rainfall has a specific trend and pattern that is below medium rainfall, which may come once in three years, whereas drought once in 8- 10 years. Annual rainfall increases from less than 100 mm in the north to 350 mm in the southeast. Nearly 14 per cent of the desert receives 350 mm rainfall, 25 per cent gets 250 mm, and 4.5 per cent receives less than 150 mm, and remaining 52.5 percent receives 150- 25 mm rainfall. Almost all the rain is received during monsoon from mid-June to mid-September, but July and August are the months of heavy rainfall. During remaining period of the year there are drought-like conditions for continuous period of six to nine months. Although, rainfall is in heavy showers yet there is generally little runoff. The rainwater is usually absorbed in the sandy grounds, however the village folks have constructed channels to divert the surface run-off into land area enclosed by dykes for storage in tanks or bandats, and also into fields for irrigation. Removal of vegetation, by overgrazing, or drying up due to continuous drought conditions greatly reduces the effects of rain, because the water runs off the surface of the ground. Within a few minutes, the dry Nai (rain fed channel) such as Layari and Harolo become roaring torrents removing any sign of topsoil and eroding deep gullies into the ravaged landscape. The two nais are dry except after rain. During some years the persistent wind with high velocity the monsoon winds do not reach the region and no rain occurs during such periods. The desertified area is subject to heavy soil erosion. During recent years the annual rainfall has ranged between a the minimum 4.6mm in 2002 and 800mm in 2006 with an annual average of 300mm. The rainy season is spread over the June-September period, with maximum rainfall occurring in September, and average rate of evapotranspiration 218.2mm.

4.3.8.3 Wind Speed and Direction

The wind direction in the area is generally west-northwesterly during the summer monsoon and east-northeasterly during the short winter monsoon season. The wind speed at ground level varies between 0 and 2 m/s during the calm months to 4 and 8m/s during the pre-monsoon season.

Pakistan Meteorological Department has conducted a detailed Wind Power Potential Survey of Coastal Areas of Pakistan. The list of stations located along Sindh are Badin, Baghan, Chuhar Jamali, DHA Karachi, Gharo, Golarchi, HawksBay, Hyderabad, Jamshoro, Jati, Karachi, Kati Bandar, Matli, MirPurSakro, Nooriabad, Sajawal, Shah Bandar, Talhar, Thano Bula Khan, Thatta.

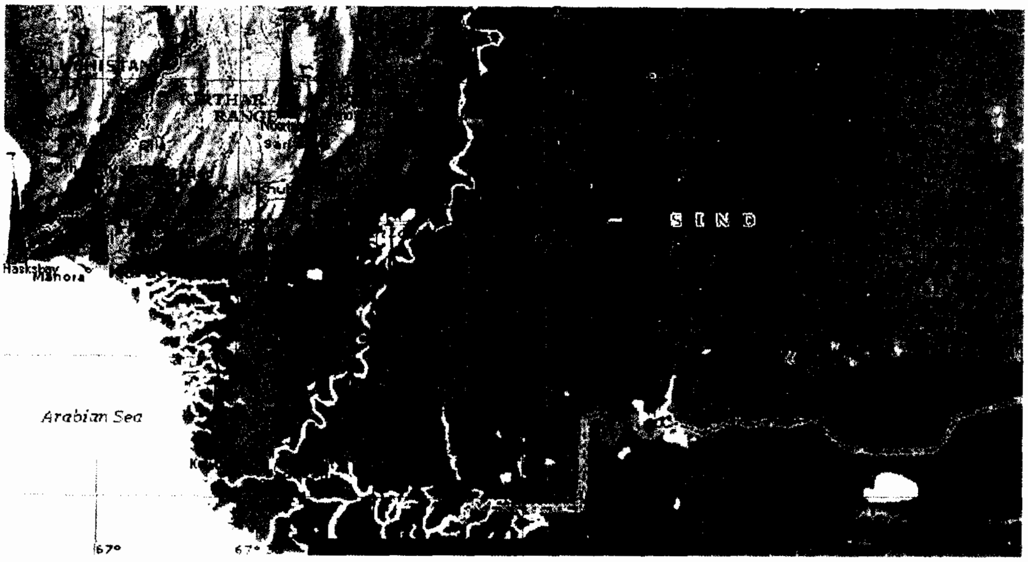


Table 4.6: Selected sites for wind power potential survey[5]

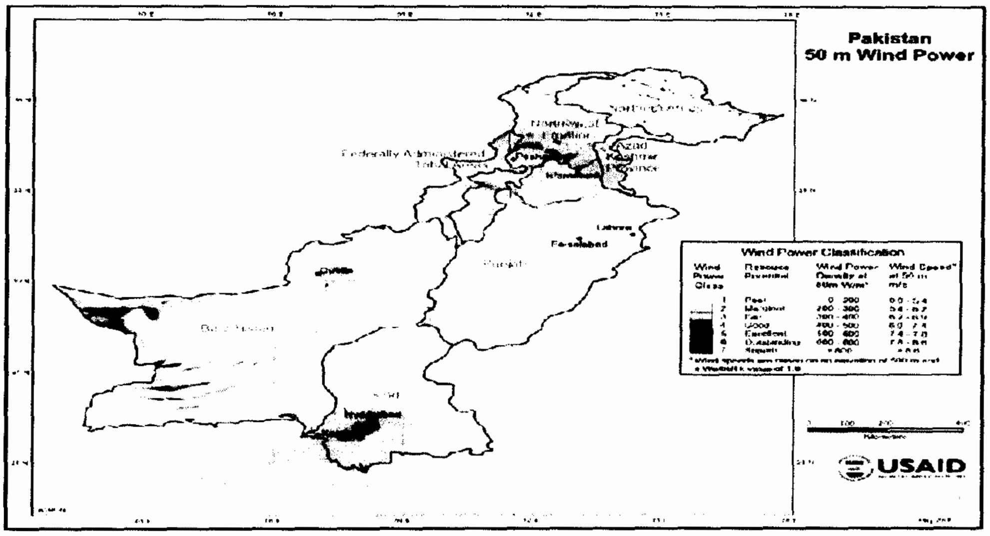


Table 4.6b: Wind map of Pakistan (source: AEDB; prepared by NREL in cooperation with USAID)

Monthly average estimated wind speed at 50m heights at six most windy stations. The graph clearly depicts that the windiest months are April to September in these areas of Sindh

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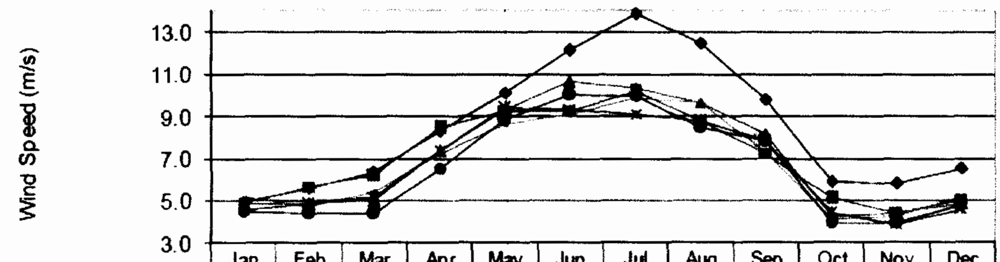
region. We can see that Jamshoro is the region of most powerful wind and hence considered very good site to generate electric power potential. Moreover Kati Bandar, Nooriabad, Thatta, Gharo, Hyderabad, Sajawal, Jati, Golarchi, Baghan, Talhar, MirPur Sakro, Chuhar Jamali are suitable sites for power generation.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jamshoro	5.0	5.6	6.3	8.3	10.1	12.1	13.9	12.5	9.8	5.9	5.8	6.5
KatiBandar	4.9	5.7	6.2	8.4	9.3	9.3	10.2	8.8	7.2	5.1	4.4	5.0
Nooriabad	4.9	4.8	5.0	7.3	9.3	10.6	10.4	9.7	8.1	4.2	4.4	4.9
Thatta	5.2	4.7	5.4	7.2	8.6	9.1	9.8	9.6	7.3	4.1	4.2	5.1
Gharo	4.6	4.9	5.2	7.4	9.4	9.3	9.1	8.8	7.8	4.4	3.8	4.5
Hyderabad	4.4	4.4	4.3	6.5	8.9	10.0	9.9	8.5	7.8	3.9	3.9	4.8

Months

Source: Pakistan Meteorological

Figure 4.7: Monthly Average Wind Speed at 50m in Sindh districts[6]

The range of variation in wind velocity at 50 m is between a low of 3.7 m in November and a high of 8.3 m in July, while at 30 m it ranges between 3.2 m/sec in November and 7.8 m in July. Thus there are minor differences in velocity between the 30 m and 50 m levels. High velocity winds of 6 to 8 m/sec are, according to the data recorded in the Table dominant from May to August, which are the monsoon months. Monthly average wind velocity decreases from 5.62 m/s at 50 m to 5.12 m/s at 30 m and 4.66 m/s at 20 m level.

The annual diurnal wind speed variations at 50m heights at six most windy stations. We have already mentioned that Jamshoro, Kati Bandar, Nooriabad, Thatta, Gharo, Hyderabad is the region of sustainable wind. At Jamshoro the wind varies from minimum 6.9 m/s to maximum 9.9 m/s, at Kati Bandar it varies from minimum 6.8 m/s to maximum 7.7 m/s, at Nooriabad it varies from minimum 6.7 m/s to maximum 7.9 m/s, at Thatta it varies from minimum 5.8 m/s to maximum 7.6 m/s, at Gharo it varies from minimum 5.7 m/s to maximum 7.9 m/s, and at Hyderabad it varies from minimum 5.8 m/s to maximum 7.1 m/s, We can see that Jamshoro is the region of most powerful wind in the region hence considered very good site to generate electric power potential.

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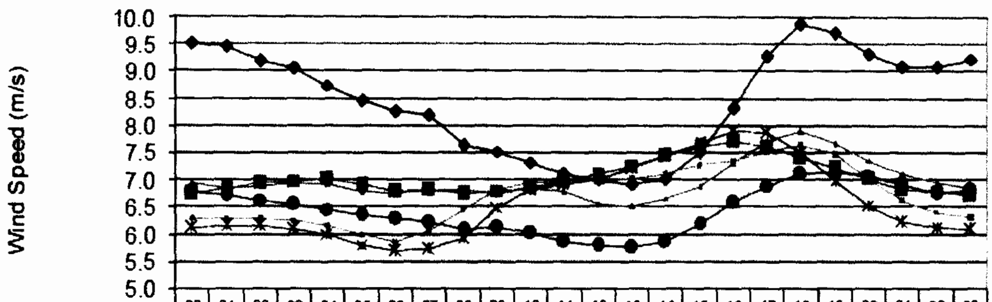

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Jamshoro	9.	9.	9.	9.	8.	8.	8.	8.	7.	7.	7.	7.	7.	6.	7.	7.	8	9.	9.	9.	9	9.	9.	9
KatiBander	6.	6.	6.	7	7.	6.	6	6.	6.	6.	6	7.	7.	7	7.	7.	7	7.	7.	7.	7	6.	6.	6
Nooriabad	6.	6.	6.	7	6.	6.	6.	6.	6.	6.	6	6.	6	6	6.	6.	7.	7.	7.	7.	7	7.	6.	6
Thatta	6	6.	6.	6	6.	6.	5.	6.	6.	6	6	7.	7.	7	7.	7.	7.	7.	7.	7.	7	6.	6.	6
Gharo	6.	6.	6.	6.	6.	5.	5.	5.	5.	6.	6	6.	7.	7	7.	7.	7.	7.	7.	7.	6	6.	6.	6.
Hyderabad	6	6.	6	6.	6.	6	6.	6.	6.	6.	6.	5.	5.	5	5.	6.	6	6.	7.	7.	7	6.	6.	6

Source: Pakistan Meteorological Department

Figure 4.8: Annual Diurnal Variation of Wind Speed at 50m in Sindh districts[7]

Studies shows the wind velocity recorded at ground level was recorded in the project surrounding

Table 4.3: Table 4.3: Wind Data at ground level in the project surrounding[8]				
	Wind Speed m/s	**Direction (Degree)**	**Air Temperature °C**	**Humidity %**
Average	2.8	104.5	25.3	20.9
Max	8.0	359.0	32.9	37.6
Min	0.0	0.2	15.9	10.1

4.3.9 Storms

The movement of cyclones and storms in the Arabian Sea. The movement is generally in the west-north-westerly direction. The one that moved into the coastal area on May 12, 1999 changed direction and hit the coastal area of Badin while the coastal area southeast of Karachi was in the periphery and only rain showers of moderate intensity were recorded. This coast is otherwise classified outside the zone of cyclone activity for the Arabian Sea. Thunderstorm frequency is also low and is reported to occur at an average rate of 10 thunderstorms/year. The pattern seems heading towards a change during the last two years. Coastal area of Pakistan has experienced an increase in the frequency of storms in the southern part of Pakistan especially along Baluchistan coast. In the month of June 2007 two tropical cyclonic storms namely Gonu and Yemyin hit the Baluchistan coast. Under their influence, rain /thunder showers associated with gusty winds and thunderstorms occurred at isolated places of Makran Coast, while the sea conditions were very rough along the coast of Sindh. The high heat content of the Arabian Sea that is adjacent to the heat zone of Pakistan had disturbed the heat balance and water balance of the region. This induced the windstorm in late May, followed by the Tropical Cyclone Gonu in the first week of June, then by Tropical Cyclone 03A from the south of Mumbai, and thereafter by Tropical Cyclone 04B nicknamed

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Yemyin. The June 6, 2010 cyclone 03A, nicknamed Phet had landed on the coast of Oman and had lost its intensity. Moving in clockwise direction it poured heavy rains on Gwadar and Pasni. The rain bearing winds moved along the coastline towards Karachi. It touched Karachi only tangentially and brought 100 mm rainfall in Karachi and 50 mm rainfall in Hyderabad two days before it landed south of Thatta District.

4.3.10 The Cyclones

The frequency of cyclonic disturbances has increased during last decade. The Table 4.5 shows the incidence of cyclones during the last two decades:

Table 4.4: Cyclones & Storms during Last 20 Years

No.	Year	Type/ Location of Cyclone	Wind Speed Range (km/h)
1	Nov 1993	Tropical Cyclone/ Northeast Arabian Sea	62 – 88
2.	June 1996	Cyclonic Storm /East Central Arabian Sea	62 – 88
3.	Oct 1996	Tropical Storm /Southeast Arabian Sea	62 – 88
4.	June 1998	Cyclonic Storm /Southeast Arabian Sea	62 – 88
5.	Oct 1998	Cyclonic Storm /East Central Arabian Sea	62 – 88
6.	May 1999	Very Severe Cyclonic Storm /East Central Arabian Sea	> 118
7.	May 2001	Very Severe Cyclonic Storm /East Central Arabian Sea	> 118
8.	Sept 2001	Cyclonic Storm /East Central Arabian Sea	62 – 88
9.	May 2002	Tropical Cyclone /West Central Arabian Sea	62 – 88
10.	May 2004	Very Severe Cyclonic Storm /Southeast Arabian Sea	> 118
11.	Oct 2004	Severe Cyclonic Storm /Northeast Arabian Sea	89 – 117
12.	Sept 2006	Tropical Cyclone /East Central Adjoining Northeast Arabian Sea	62 – 88
13.	02 June 2007	Tropical Cyclone /East Central Arabian Sea	62 – 88
14.	07 June 2007	Very Severe Cyclonic Storm /Northwesterly of East Central Arabian Sea	> 118
15.	21 June 2007	Tropical Cyclone (Deep Depression) /Northeast Arabian Sea	> 50
16	07 June 2010	Tropical Cyclone /Northeast Arabian Sea	> 50
17	06 June	Tropical Cyclone /Northeast Arabian Sea	> 50

The incidence of cyclones was considered as associated with the sun spot cycle. The tropical cyclone frequency was also related to El-Nino Scale Cycle (ENSO) of 2-5 years. Pakistan coast line was considered outside the normal pattern of the cyclone since in several ways it remains protected and has remained unaffected. Manmade interventions and tectonic activities in the region has been found to induce as much stress as to include the coastline in the zone of cyclonic activity.

For reasons stated above, it seems that the Hypothesis on Climate Change more appropriately explains the position. The Theory holds that high evaporation rate induced by high temperatures on the hinterland of the Arabian Sea have led to hyper-salinity of the sea water. The high temperature on vast territory in the Arabian Sea hinterland has (i) turned large territory of Pakistan into an extensive heat zone, and (ii) raised the temperature of the North Arabian Sea by 1oC to 1.5oC, and (iii) evaporated correspondingly larger volumes of seawater. The heat zone formation over land serves as the main heat engine for the monsoon. The significant rise in temperature of the Arabian Sea raises the surface salinity and induces salinity steep gradient on the sea; the impact of the two factors can trigger cyclones in the Arabian Sea, while the correspondingly large volume of water vapour is cause for heavy monsoon rains all over the Indo-Pakistan region.

The cyclones are a coastal activity and their impact remains confined to the coastal belt. They are not likely to have major impact on the site at a distance of 80 km inland. However, cyclones do disturb the atmospheric air current system and hence the Project personnel will be mandated to follow the contingency plan.

4.3.11 Hydrology

In the Sindh province 24 percent of the area is irrigated by canals (95 per cent), wells (4 percent) and tube wells and other means. In proposed project area surrounding, the water sources include dug wells, tube wells and lake. The soil sustains moisture for longer period to support the dry-land agriculture. When these sources of water dry up, the herders of surrounding hamlets have to walk 10 to 12 kilometers to watering points, and they were found saying during the consultation meetings that they have to fetch water from very far areas.

4.3.11.1 Surface Water

The major fresh water source in district Thatta is Keenjhar Lake which is at a distance of over 7 km from the project site. The sweet water lake Keenjhar, also known as Kalri Lake, is located in the dry and stony land at a distance of about 20 km north and north-west of Thatta. It is 24 km long and 6 km wide and has an area of about 14000 ha. The lake is fed by the Kalri Bagar feeder canal from the north-west which originates from River Indus, as well as by small seasonal streams entering it from the north and the west. The feeder is also the conduit for the industrial wastes of Kotri town. The only outlet is the Jam branch canal in the south-east end of the lake. Keenjhar is a wild life sanctuary and a Ramsar site. Jhimpir town, on the northern banks of the lake is the main town on Keenjhar besides twelve large and twenty small villages scattered around it. About 50,000 people are said to be dependent on the lake and in 2005-06 about 800 boats of different size are said to be operating in it (declining from 2200 in 1988-89 and 1710 in 1998-99). There are four fish landing centers at Chilya, Sonahri, Jhimpir and Khumbo.

4.3.11.2 Ground Water Resources

The Indus Basin was formed by alluvial deposits carried by the Indus and its tributaries. It is underlain by an unconfined aquifer covering about 15 million acres (60,700 km2) in surface area. In Sindh, about 28% of the area is underlain by fresh groundwater. This is mostly used as supplemental irrigation water and pumped through tube-wells. Some groundwater is saline. Water from the saline tube-wells is generally put into drains and, where this is not possible, it is discharged into large canals for use in irrigation, after diluting with the fresh canal water. Before the introduction of widespread irrigation, the groundwater table in the Indus Basin varied from about 12 m in depth in Sindh and Bhawalpur areas to about 30 m in RechnaDoab (the area between Ravi and Chenab Rivers). After the introduction of weir-controlled irrigation, the groundwater table started rising due to poor irrigation management, lack of drainage facilities and the resulting additional recharge from the canals, distributaries, minors, water courses and irrigation fields. At some locations, the water table rose to the ground surface or very close to the surface causing water-logging and soil salinity, reducing productivity.

Geotechnical investigation revealed that none of the 4 drilled Boreholes encountered the groundwater till 30m depth at the project site.

4.4 Microenvironment of the Project

Microenvironment comprises of Jhimpir wind corridor. Cattle grazing, stone quarrying and crushing, gravel and sand collection and transportation, and livestock are the main occupation.

Microenvironment land is barren. The site comprises partly of plain land with no major variations in elevation, and partly of uneven land due to presence of sand dunes. Bushes and different types of wild plants were also found across the site.

Topographic undulation in some parts of district is substantially large with the relative height varying between 65 meters and 105 meters with the differential being 20 to 25 meters. Similarly, in some parts, the differentia is not large; the terrain undulates between 70 and 100m above sea level.

4.4.1 Physical Features of the Project Site

The physical features of the project area consist of relatively flat terrain. The project area is surrounded on all sides by unconsolidated gravel. Its physical features portray the distinctive features of desertified arid land. Vegetation is xerophytic and is characterized by dried up thorny scrubs and poor grasses all over the region. The area is studded with rocky spurs and small mounds on barren lands with scant bushes and grasses in low lying areas. WTG#1 is near the intersection Thatta-Thano Bula Khan Road and the unpaved road towards southwest towards other wind farms. Sattar-Brohi hotel is located at the intersection. MV/HV transmission lines passes through the project area.

4.4.2 Land Use

Project area is agriculturally unproductive (rock) land and some poor grazing gravely land. Perennial grazing areas consist of moisture shortage, sandy soils with low to high salinity. This land area in the form of semi-arid/arid sand desert is also present in the upper half of the wind corridor in small patches. The outgrowth in these areas mainly consists of short grasses, shrubs and scrubs along with a few drought resistant trees.

4.4.3 Topography

The general topography of the area is that of valleys and hill ranges. A natural torrential stream flooded in the rainy season and brings the hill torrents of Kirthar Ranges to Keennjhar Lake.

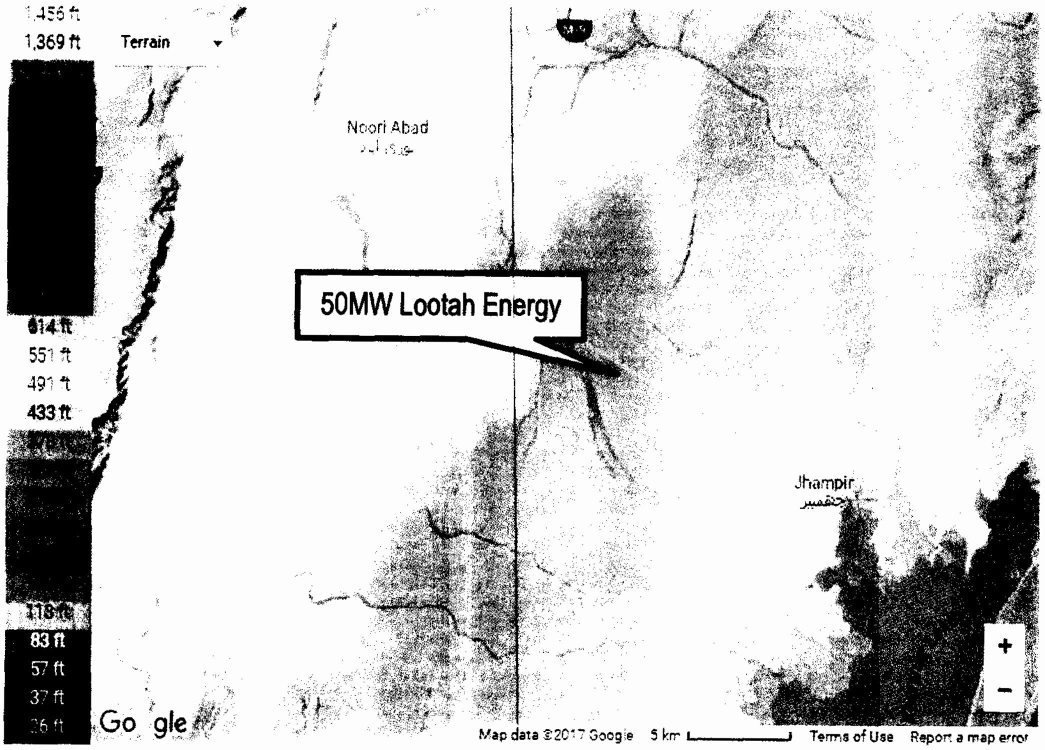

Figure 4.8b: Topographic map of the Project Area within the Jhimpir Wind Corridor. Macro environment areas of Nooriabad, Jhimpir town and Keenjhar Lake also visible[9]

4.4.4 Ambient Air Quality & Noise

The area in and around the Project site is underdeveloped with no industrial development nearby but likely to develop into a complete planned city in near future. The primary sources of air pollution include traffic near Karachi Hyderabad Motorway. The key pollutant likely to be found at these locations includes Carbon monoxide (CO), oxides of Nitrogen (NO_x), Sulfur dioxide (SO_x) and particulate matters but in very minor quantities. In general, the air quality of the Project area is good with no substantial air pollutants.

Findings of the recently conducted (June 2017) Ambient Air Monitoring by EMC Pakistan in the Jhimpir Wind Corridor is shown below;

Sr #	Date	Time (from-to) hrs	Results								
		Parameters	SO2	NO	NO2	O3	SPM	PM_{10}	$PM_{2.5}$	Pb	CO
		SEQSAA*2	120.0	40.0	80.0	130.0	500.0	150.0	75.0	1.5	10.0
			µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
1	22.06.2017	07:00-07:30	1.0	23.0	62.0	12.0	438.0	112.0	56.0	BDL	0.21
2	22.06.2017	07:31-08:00	1.0	19.0	78.0	9.0	383.0	118.0	54.0	BDL	0.23
3	22.06.2017	08:01-08:30	1.0	9.0	48.0	3.0	276.0	113.0	45.0	BDL	0.27
4	22.06.2017	08:31-09:00	1.0	22.0	53.0	8.0	318.0	105.0	59.0	BDL	0.24
5	22.06.2017	09:01-09:30	1.0	36.0	79.0	16.0	328.0	143.0	63.0	BDL	0.22
6	22.06.2017	09:31-10:00	1.0	28.0	74.0	9.0	416.0	132.0	54.0	BDL	0.25
7	22.06.2017	10:01-10:30	1.0	12.0	28.0	19.0	335.0	118.0	58.0	BDL	0.25

[9] Webportal of Topographic Map. Retrieved from http://en-in.topographic-map.com/places/Thatta-6836834/

Sr #	Date	Time (from-to) hrs	Results								
		Parameters SEQSAA*2	SO2	NO	NO2	O3	SPM	PM_{10}	$PM_{2.5}$	Pb	CO
			120.0	40.0	80.0	130.0	500.0	150.0	75.0	1.5	10.0
			µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
8	22.06.2017	10:31-11:00	1.0	18.0	34.0	8.0	382.0	102.0	57.0	BDL	0.21
9	22.06.2017	11:01-11:30	1.0	14.0	43.0	13.0	412.0	113.0	64.0	BDL	0.23
10	22.06.2017	11:31-12:00	1.0	23.0	48.0	16.0	403.0	124.0	63.0	BDL	0.62
11	22.06.2017	12:01-12:30	1.0	34.0	73.0	8.0	436.0	108.0	65.0	BDL	0.52
12	22.06.2017	12:31-13:00	1.0	19.0	62.0	9.0	487.0	138.0	69.0	BDL	0.42
13	22.06.2017	13:01-13:30	1.0	21.0	58.0	10.0	436.0	103.0	49.0	BDL	0.71
14	22.06.2017	13:31-14:00	1.0	34.0	69.0	8.0	452.0	136.0	43.0	BDL	0.19
15	22.06.2017	14:01-14:30	1.0	17.0	36.0	9.0	402.0	119.0	55.0	BDL	0.21
16	22.06.2017	14:31-15:00	1.0	19.0	23.0	16.0	362.0	118.0	51.0	BDL	0.53
		Minimum Conc.	**1.0**	**9.0**	**23.0**	**3.0**	**276.0**	**102.0**	**43.0**	**BDL**	**0.19**
		Maximum Conc.	**1.0**	**36.0**	**79.0**	**19.0**	**487.0**	**143.0**	**69.0**	**BDL**	**0.71**
		Average Conc.	**1.0**	**21.8**	**54.3**	**10.8**	**391.6**	**118.9**	**56.6**	**BDL**	**0.332**

*1*EPA= United State Environmental Protection Agency Methods 40 CFR 50, App B., L&J.*

2 SEQSAA= Sindh Environmental Quality Standards for Ambient Air (The Sindh Govt. Gazette No.EPA/TECH/739/2014) Part-I, Published on Jan. 28, 2016, pg-32*

There is no continuous source of noise emission in the project wind farm site. Occasionally there is some intermittent noise level due to natural wind blowing and noise level therefore fluctuates between 50dB to 60dB in the project site.

4.4.5 Surface & Ground Water Hydrology and Drainage

Major water reserve of the area is Keenjhar Lake also known as Kalri Lake. It is over 7 km from the wind farm site. It is 24 km long and 6 km wide and has an area of about 14000 ha (35,583 acres). The lake is fed by River Indus through the Kalri Baghar feeder canal from the north-west as well as by small seasonal streams entering it from the north and the west. The feeder is also the conduit for the industrial wastes of Kotri town. Keenjhar is a wild life sanctuary and a Ramsar site.

The only perennial water channel in the area is the Kalri Baghar (KB) Upper Feeder which feeds Keenjhar Lake with Indus water from Kotri Barrage. The KB Feeder is about 20 km away from the Jhimpir wind farm sites and lies on its eastern side. The KB feeder is about 61 km long and its design discharge is about 258 cubic meters per second (cumecs). Keenjhar Lake is also being fed by the hill torrents during floods from the western side.

The catchment area of these hill torrents are about 1664 sq km and have their outfall into the Kinjhar Lake. These hill torrents includes; Rodh Nai and Liari Nai. Baran Nai which is the principal source of flood drops into the River Indus downstream of Kotri barrage.

Figure 4.9: View of Keenjhar/Kalri Lake

Keenjhar Lake is the main source of fresh water for drinking and irrigation for the areas downstream of Jhimpir including the city of Karachi. Keenjhar Lake is an artificial water storage reservoir located in Thatta district. It came into existence as a consequence of implementation of the Kotri Barrage canals Irrigation Project. This artificial reservoir has been formed out of natural depressions of Sonheri and Keenjhar Dhands. The gaps between the surrounding hills of the dhands were closed with the construction of earthen embankments having an average height of about 7.6 m. Apart from KB Feeder, hill torrents and Keenjhar Lake there is no other source of surface water available in the area.

Regular Surveys have not been carried out to assess the availability and quality of Ground water in the Province of Sindh. Various sources estimate that the volume is 3-5 MAF scattered in 28% of the geographical area of Sindh. This water is found mainly along the Indus water channels and in a few underground streams.

In recent years, drought has caused excessive extraction of groundwater to make up for the lack of irrigation water. This, in turn, has resulted in rapid depletion of the groundwater and filling up of the underground freshwater channels and reservoirs with brackish water.

The area is very poor in terms of the indicator of piped water, which is available to only about 14% of the housing units. About 13% of rural households have hand pumps inside the housing units, while 16% use outside ponds for fetching water and 6% of housing units use dug wells. The ground water level of the site is 115 meter.

The dr`ainage system in the area is not developed. Booster pumping station for water supply pipeline is established to supply water from Keenjhar lake to Nooriabad Industrial State which is located at about 12 km from wind farm. Local villagers fetch water for domestic use from the open sections of the pipeline.

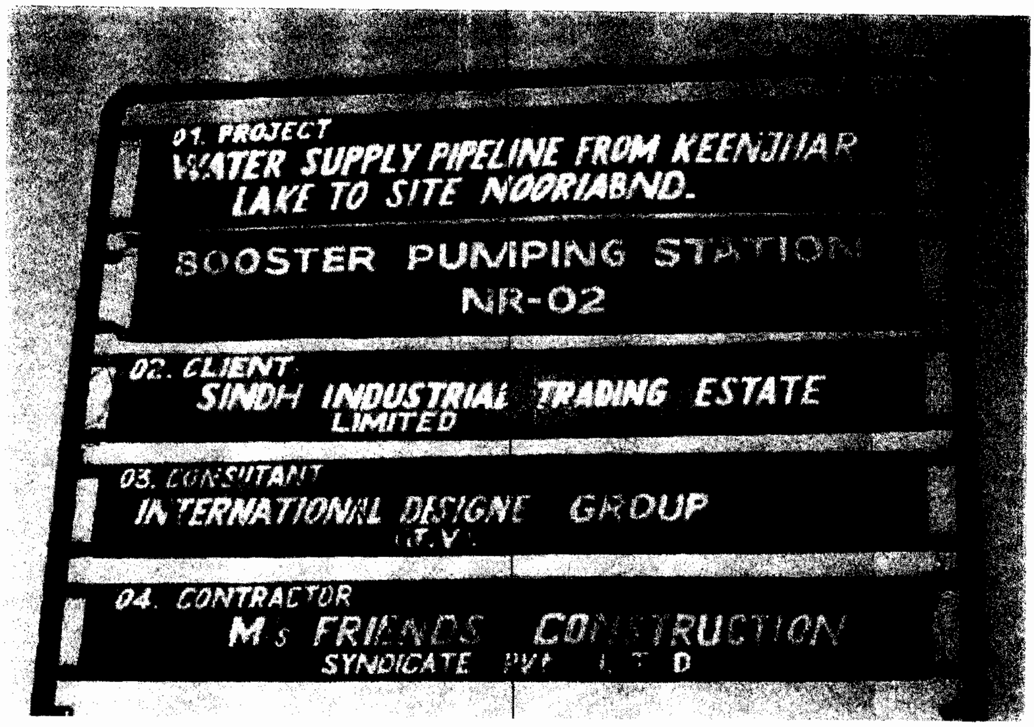

Figure 4.10: Booster Pumping Station from Kinjhar Lake to Nooriabad IndustriaL Estate

Water Quality

The only major surface water body in the micro and macro environment is Keenjhar Lake. An assessment of Water Quality and Characterization of of Toxicity of Keenjhar Lake was carried out by Space and Upper Atmosphere Research Comission (SUPARCO)[10]. Samples were collected from six (06) different locations of lake and analyzed for physical, chemical and bacterial parameters. The ranges of these analytical results have been produced in the Table below;

Spatial Variations in Water Quality Parameters (Physical) in Keenjhar lake water samples		
S. No	**Parameters**	**Range**
1	Temperature, °C	29.9 to 30.5
2	pH	7.74 to 8.47
3	Turbidity, NTU	1.33 to 8.75
4	Conductivity, µS/cm	542 to 628
5	Dissolved Oxygen (DO), mg/l	9.3 to 14.3
6	Total Dissolved Solid (TDS), mg/l	326 to 378
7	Hardness, mg/l	160 to 240
8	Sulphate, mg/l	90 to 146
9	Chloride, mg/l	62 to 89
10	Nitrate, mg/l	0.2 to 2.0

[10] Water Quality Assessment and Characterization of Toxicity of Keenjhar Lake by SUPARCO, June 2012.

The results also show that E-Coli ranged between 5-30 MPN/100mL and that of Fecal Coliform between 12-70 MPN/100mL. The levels of the physical & biological parameters were found lower than those observed at both feeding sources of the lake i.e KB Feeder Canal and Haroolo Drain. The presence of Toxic metals including As and Cr was detected while Pb and Hg were untraceable in any of the lake water sample. The physical parameter of these water samples were found within the safe limits of Pak NEQS for drinking water. The higher level of DO was recorded at site of Lake exit near KG Canal regulator. This indicates the presence of organic species in the location and in case the DO is increased to much higher level, incidence of mass aquatic life killings specifically the fish species may happen around the site of the lake. Moreover, E. Coli and Fecal coliform bacteria were also detected in each of water samples which suggest the lake water unsafe for dinking purposes unless passed through treatment process. The presence of toxic elements like As, Ni, Cr and Al in the samples of lake sediments and traces of cyanide in the lake water samples were also found.

The SUPARCO study therefore suggested that a strict and prompt action by the concerned authorities (including Sindh Irrigation and Drainage Authority (SIDA), KS&WB and Sindh EPA) should be taken to block the discharge of toxic effluent of Kotri industrial area into KB canal.

4.5 Ecological Baseline

This report also takes into account the data collected during previous surveys conducted by EMC specialists for other projects. The land which is present around the project is sparsely inhabited, has plain sandy, rocky areas and wastelands along its sides. Most of the land is barren with very little vegetation comprising mostly of bushes.

4.5.1 Ecology of Project Area

4.5.1.1 Ecological Habitats in the Project Area

As a result of extensive cultivation and expanding centers as well as rural settlements, most of the natural habitats have now been rendered altered. The main habitats of the project area include ridges, rocky areas, plain/sandy areas, agricultural areas and wastelands. Ridges and ravines are either flat places or soil filled cracks in the rocks.

- Rocky areas having stony plains provide habitat for Desert Hare, Baluchistan Gerbil.
- Plain / Sandy areas provide for sparse vegetation cover. This is the favorable habitat of Grey Mongoose, Desert Cat, Common Buzzard Ring Dove, Little Brown Dove, Garden Lizard, Fat-Tailed Gecko, Indian Spiny-tailed Lizard.

4.5.1.2 Terrestrial Flora in the Microenvironment

Grasses

The following grass species have been reported at the site and some of them were found to have grown in the recent rainy season: Arisdita adscensionis, A. Mutabilis, Cenchrus ciliaris, Cenchrus biflorus, Cenchrus, Cenchrus pennisetformis, Cynodon dacdylan, Cymbopogon jawarancusa, Digitaria sp, Eleucine flagellifera, Lasiarus sindicus, Saccharum spontaneum, Sporobolus marginantus. When the rainy season is over, these grasses usually sccumb to aridity and overgrazing.

Forbs

Aerva tomentosa, Cassia holoserica, Convolvulus glomeratus, Crotolaria bifolia, Fagonia cratica, Helotropium ophioglossum, Indigofera oblongifloia, Rynccosia minima.

Bush

Predominant bush species found in the area include Devi, Chali, Damral and Darathi (local names). No special medicinal value is associated with these bush species by the locals.

Crops

Agricultural activities are constrained by rainfall which has been erratic as well as scant in the microenvironment. Major crops grown on the few fields outside the villages include Indian corn. No crop production was possible during the current season because there was cloud burst which flooded the land area and the soil being largely sandy and gravely could not retain the moisture.

Trees

During the survey, there were a few trees found in the Project area. The few tree species located in the microenvironment include Acacia nilotica (babul) (spotted during survey, low frequency), Acacia senegal (khor) (spotted during survey, low frequency), Calotropis procera (spotted, low frequency), Salvadora oleoides (khabar) (dominant) and Prosopsis senegal (kandi) (dominant but with low frequency), Acacia arabica (kikar) (dominant but with low frequency), Capparis aphylla (reported but not spotted),Commiphora wrighti (spotted during survey, low frequency), Commiphora stocksiana (spotted during survey, low frequency), Prosopis cenraria (spotted during survey, low frequency), Tamarix gallica (lai) (dominant), tamarix aphylla(low frequency), Euphorbia cauducifolia, Lasiurus sindicus ; willo or bahan (populus euphratica), Rhazya stricta (spotted during survey, low frequency), karil (capparis aphyila), and siris (acacia lebbek) (not found during survey), Prosopis cineraria, Eleusine flagelliforia, Salsola foetidia; Baleria acanthoides (spotted during survey, low frequency), Lasiurus sindicus, Aristida sp. Ziziphus nummularia (spotted, low frequency), Cordia gharaf (spotted during survey, low frequency), Grewiavillosa, Leptodenia pyrotecneca, Lyssium depressum (spotted during survey, getting scarce), Pterophyllum oliveri (spotted during survey, low frequency), Tecoma undulate (spotted during survey, low frequency).

Onsite Flora

4.5.1.3 *Terrestrial Fauna in the Microenvironment*

The guidelines for sensitive and critical areas were followed to identify sensitive and critical areas in the project area. Most wildlife species were found to be present or reported quite far away from the project area in relation to the officially notified protected areas which may comprises ecosystems that includes wildlife reserves and forests, archaeological sites, monuments, buildings, antiquities or cultural heritage sites.

Reptiles

Reptiles are also getting rare because of aridity which has in general reduced the biodiversity of the area. The monitor lizard population in the microenvironment of project site is low, while that of spiny-tailed lizard is abundant. Indian Monitor lizard (Varanus bengalensis) Wadhi Go/Gioh (reported but not spotted), and Monitor lizard (Varanus griseus) were neither reported nor spotted. The Indian spiny-tailed lizard (Saara hardwickii) Sandho/Sandha was spotted several times. All sand mounds in the area were found to have their burrows. Other reptiles reported here include: Yellow-headed Agama (Stellio Agama nupta fusca) Batth Kirro/Zard Sar Pahari Girgit (spotted during the survey), Indian Garden Lizard (Calotes versicolor) Wann Kirro/Rang badal Girgit (not spotted), Long-tailed Desert Lacerta (Eremias guttulata watsonana) Wadhi Puch Kirri/Taweel dum Sandhi (reported but not spotted), Sindh Sand Gecko (Crossobamon orientalis) Thari Kirri/Regi Chhupkali (reported but not spotted).

Snakes

The Indian sand boa (Eryx johni) Bar Matti/Do Muhi (reported but not spotted); Saw-scaled Viper (Echis carinatus) Lundhi Bala/Jalebi Samp (reported to be less frequent but not spotted), are common in the project area, while the Sindh two-headed snake, Indian common krait, and oxus cobra are rare. All these snakes are front-fanged. The krait, viper, and cobra are deadly but incidence of snake bite, as reported by the locals, is getting lower and lower, quite likely because their population has been thinned out.

Birds

The most common birds found in the macro environment are sparrows, robins and doves. Characteristic bird species that have adapted to the environment and are still to be found in the area, include the Indian grey partridge (francolinus pondicertanis), chest-nut-bellied sand grouse (pterocles exustus), rock dove (Columbia livia), Indian little button quail (turnix sylvatica) and Eurasian roller (coracias garrulous). Kites and vultures the highflying birds were not spotted during the survey. They were reported by the locals to be only occasional visitors. Other birds usually here include Grey Parttridge (Francolinus pondiceranus); Indian Sand grouse (Pterocles exustes); Painted Sand grouse (Pterocles indicus); Partridge (Ammoperdix griseogularis) See See Teetar/Sissi Tittar; Common Quail (Coturnix coturnix) Butair/Bhuntrio; Eurasian Wryneck (Jynx torquilla) Gandam Muroor/Nando Kath-Kulho (not spotted); Sindh Woodpecker (Dendrocopos assimilis) Sindhi Khat-Khat/Kath Kutho (reported but not spotted); Common Hoopoe (Upupa epops) Hud Hud /Hud Hud (spotted during previous surveys of the area); Indian Roller (Coracias benghalensis) Neel Kanth/Sat Rango (not spotted); Asian Koel (Eudynamys scolopacea) Koel/Koel (not spotted); Rose-ringed Parakeet (Psittacula krameri) Tota, Gulabi Kanth Tota/Mitthu, Chattu (reported); Spotted Owlet (Athene brama) Chittidar Ullu/Nandho Chibhro (reported but not spotted); Rock Pigeon (Columba livia) Jhungi Kabutar (reported but not spotted); Indian Collared Dove (Streptopelia decaocto) Bari Fakhta Gero (spotted during survey); Common Crane (Grus grus) Koonj (reported but not spotted); Tawny Eagle (Aquila rapax) Gandoori Okab, Rigger/Par Mar (not spotted), Common Myna (Acridotheres tristis) Myna Ghursal/Kabbri, Myna (spotted during survey); Pale Crag-martin (Hirundo obsoleta) Peeli Chatani Ababeel/Jabal wari Ababeel also as pithee (reported but not spotted); House Sparrow (Passer domesticus) Gorrea, Gharelu Chiriya/Jhirki (spotted during survey).

Mammals

Indian Pangolin (Scaly Anteater) (Manis crassicaudata) Safna Shikam, (reported but not spotted by locals and also not during survey) in IUCN Red List as low risk, near threatened; Jackal (Canis aureus) /Geedarr (not spotted during survey), in IUCN Red List as low risk; Ratel (Honey Badger) (Mellivora capensis) Gorrpat/Qabar Ka Bijju (abandoned burrow spotted during survey); Black-naped Hare (Lepus nigricollis dayanus) Saho/Khargosh (abandoned burrow spotted during survey); Grey Spiny Mouse (Mus saxicola) Kandan Waro Kuo/Kharpusht Chooha (reported but not spotted).

Livestock

Local inhabitants in the microenvironment maintain stocks of cows, goats and sheep that were found grazing in the area. Livestock and ruminants include: Domestic Goat (Capra hircus) Bakri/Bakra; Domestic Sheep (Ovis aries) Bhairru/Bhairr; Domestic Cattle (Bos taurus) Gaon/Dhaggo, Dhaggi (male, female); Domestic Donkey (Equus asinus) Gadduh/Gadah.

4.5.1.4 Sensitive and Critical Habitats

A number of sensitive and critical habitats exist in Sindh, but none of them lie near the proposed project site. None of the critical sites will therefore be intercepted.

Project Site does not lie inside the protected area or buffer zone of protected area. The nearest Wildlife Protected Area is the Keenjhar Lake wildlife sanctuary which lies at a distance of over 7 Km from the proposed project site.

No areas of primary forest are found within or adjacent to project site. If some trees need to be cut down, compensatory plantation at a ratio of 1:5 (i.e. 5 trees will be planted on account of cutting of 1 tree) for the mature trees and at a ratio of 1:3 for immature trees, will be done in the open land or after consultation with forest department.

4.5.1.5 Migratory Birds

Figure 4.21 shows Indus Flyway. This famous route from Siberia to various destinations in Pakistan over Karakorum, Hindu Kush, and Suleiman Ranges along Indus River down to the delta is known as International Migratory Bird Route Number 4. It is also called as the Green Route or more commonly Indus Flyway, one of the important migratory routes in the Central Asian - Indian Flyway. The birds start on this route in November. February is the peak time and by March they start flying back home. These periods may vary depending upon weather conditions in Siberia and/or Pakistan. As per an estimate based on regular counts at different Pakistani wetlands, between 700,000 and 1,200,000 birds arrive in Pakistan through Indus Flyway every year.

Figure 4.22 shows the Migratory route, breeding range and wintering range of Ferruginous Duck *Aythya nyroca* in Pakistan.

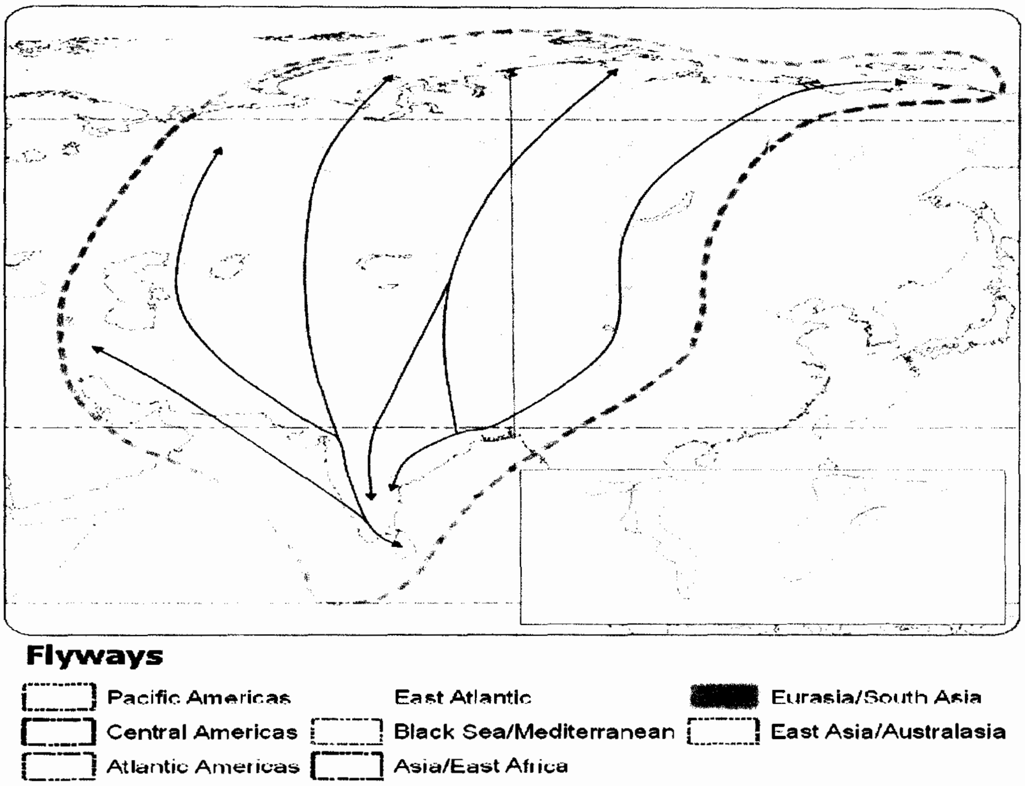

Figure 4.11: Eurasian/South Asia Migratory bird flyway (Source: Birdlife International)

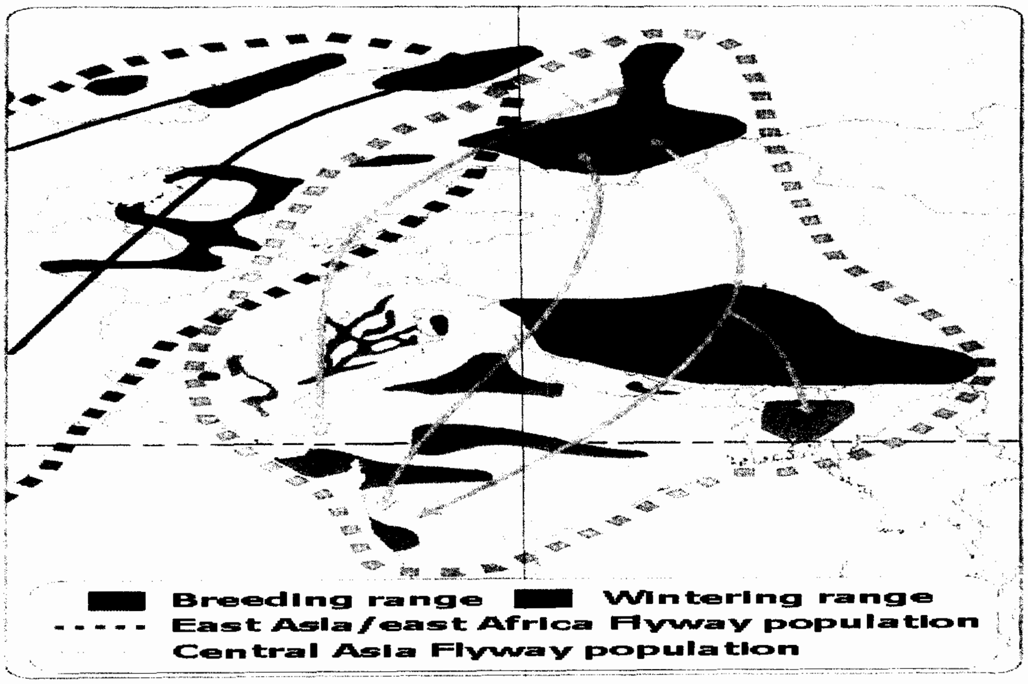

Figure 4.12: Migratory route. breeding range and wintering range of Ferruginous Duck *Aythya nyroca* in Pakistan (Source: Birdlife International)

4.6 Socio-Economic Environment

This section presents the socio economic profile of the project area, based on primary and secondary information. Primary data was gathered through an extensive field survey, while various relevant sources were used for secondary data. Social baseline has been developed to identify the social settings that may be affected during project operation.

There are several small, temporary or permanent settlements /Goths in the immediate macro environment namely Gulzar Chang Goth, Chaakar Chang Goth, Shah Muhammad Chang Goth, Ramzan Chang Goth, Muhammad Panwar Goth, Mark Jakhro Goth, Mian Bux Jakhro Goth, Miran Jakhro Goth, and Muhab Ali Jakhro Goth which are observed while survey and located at over 0.5 km away from Lootay Energy Wind Farm site.

4.6.1 District Thatta

The macro environment include Thatta district having an area of 17,355 km2 (including the newly formed district Sujawal). The district is bordered on the east side by Sujawal and Tando Muhammad Khan districts, Hyderabad and Jamshoro districts at north, on the southern side by Arabian Sea, and on the west side by Karachi (District Malir). The river Indus Thatta and newly formed Sujawal districts.

The project is situated in Thatta, a taluka of Thatta District which has 4 talukas or tehsil. Formerly, it had 9 talukas and 55 union councils.

4.6.2 History

District Thatta with vast cultural history and its glorious past which may not be found now but in monuments, buildings, mosques, graveyards which speak eloquently of its glorious past, Thatta remain capital of Sindh from the 14th century under the rule of Summa Rulers. Since 1592 it was governed by Mughal emperors of Delhi, then in 1739 it falls to Nadir Shah's forces who came from Persia in 1739, which was end of its glorious years and since then it has fallen in to neglect from where it has not yet succumb to.

A tomb at Makli Hills built in 1559 Thatta is known to be the burial place of 125,000 (Sawa Lakh) saints; it also was a place of great learning where eminent scholars from Khurasan, Qandhar, and Heart etc had assembled. Thatta is also famous of being known as Door of Islam to subcontinent which symbolizes the famous entry of Mohammad Bin Qasim to the region.

4.6.3 Population

According to EDO Planning & Development, District Government, Thatta report 2010, the population of Thatta District was in 1.581922 with 837493 males and 74,4430 females. Table 4.11 shows taluka wise total population in 1998 and 2010 of Thatta district and Figure 4.23 also shows Taluka wise percentage of current population.

Table 4.5: Population of District Thatta								
S #	**Taluka**	**Population 1998**			**Population 2010**			
		Male	**Female**	**Total**	**Male**	**Female**	**Total**
1	Thatta	134200	119548	253748	190707	169886	360593
2	Mirpur Sakro	105345	93507	198852	149702	132880	282582
3	Keti Bundar	13553	12147	25700	19260	17262	36521
4	Ghorabari	55527	49955	105482	78908	70989	149897
10	District Thatta[11]	589341	523853	1113194	837493	744430	1581922
Source: EDO Planning & Development, District Government, Thatta								

[11] Data also includes Sujawal district

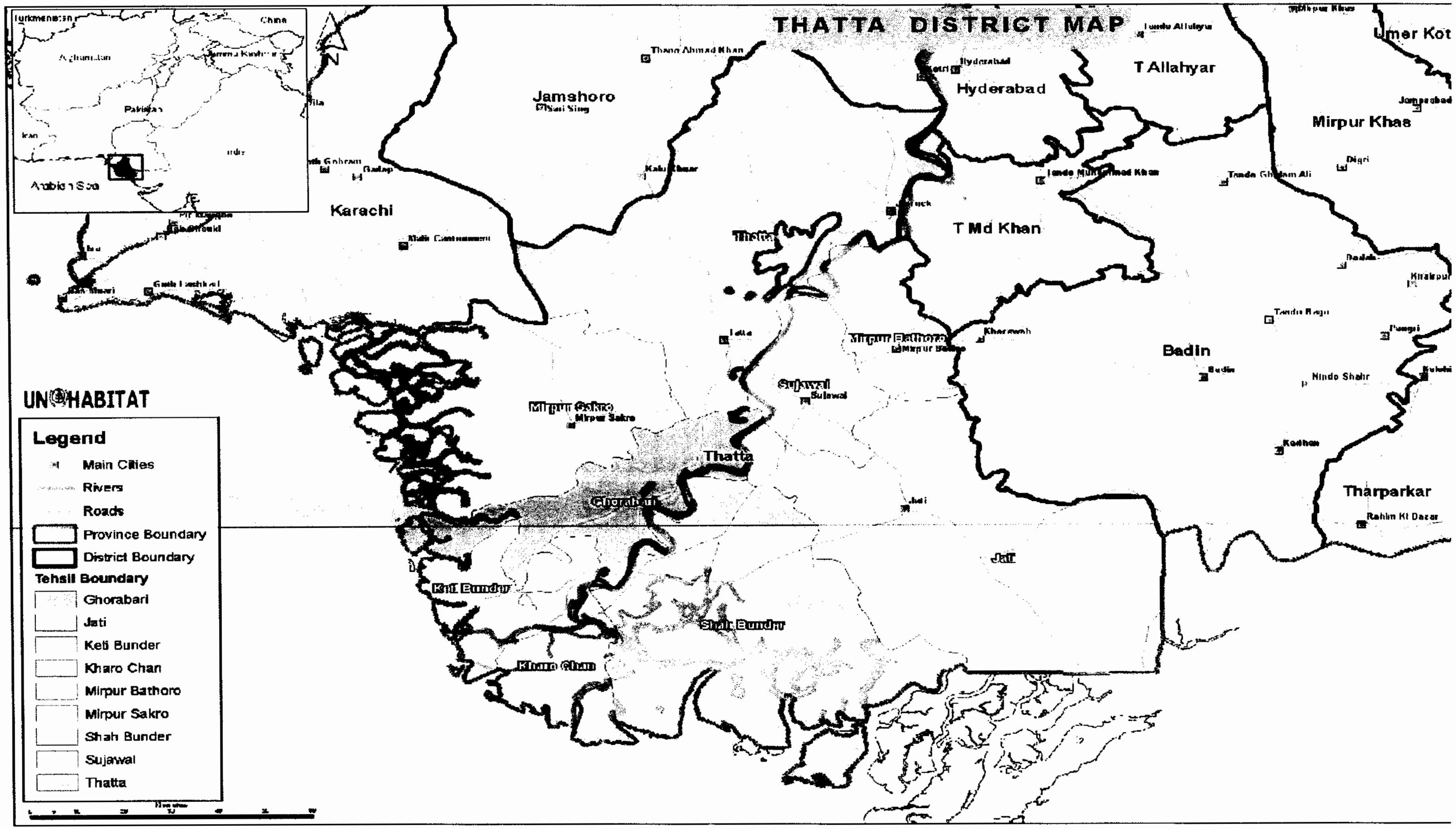

Table 4.13: Map of Original Thatta District Showing Taluka Boundaries of the district. Talukas of left bank of River Indus (Sujawal, Mirpur Bathoro, Jati, Kharo Chan and Shah Bunder) are now included in District Sujawal

4.6.4 Taluka Municipal Administration Thatta

TMA Thatta is a Head TMA of District Thatta; it holds a very rich cultural heritage since the beginning of civilization. Thatta remain Capital of Sindh and saw many local rulers beside foreign invaders who invaded this land to fulfil their desire to rule Sindh. Its past glory can be witnessed from the historical monuments that have survived the cruelty of time and are still exist though being in dilapidated condition.

Some monuments worthy to mention here are Shahjahani Mosque, Tombs of Jam Nizamuddin (reigned Thatta), tombs of several Turkhan rulers and Mughal officials are can be seen in the famous graveyard of Makli.

TMA Thatta is situated at about 100 kms east of Karachi, it has an area of 1321 Sq. Miles scattered upon 845,219 acres of Land. It is comprised of 13 Union Councils with the total population of 254,056 as per the estimates of 1998 census.

Table 4.6: UC wise Population of Taluka Thatta

S. No	Name of UC	Population 1998 Census	Estimated Current Population in 2007
1	Thatta-1	20,002	24,456
2	Thatta-2	19,983	24,421
3	Chatto Chand	21,246	25,980
4	Makli	18,742	22,916
5	Doomani	19,658	24,035
6	Kalla Kot	18,568	22,698
7	Soonda	18,192	21,884
8	Jhirk	18,105	21,709
9	Ongar	18,880	23,085
10	Tando Hafiz Shah	18,102	21,890
11	Jhimpeer	20,614	25,205
12	Jungshahi	22,348	27,325
13	Kalri	20,146	24,633

Source: TMA Sindh Devolved Social Services Program (SDSSP)

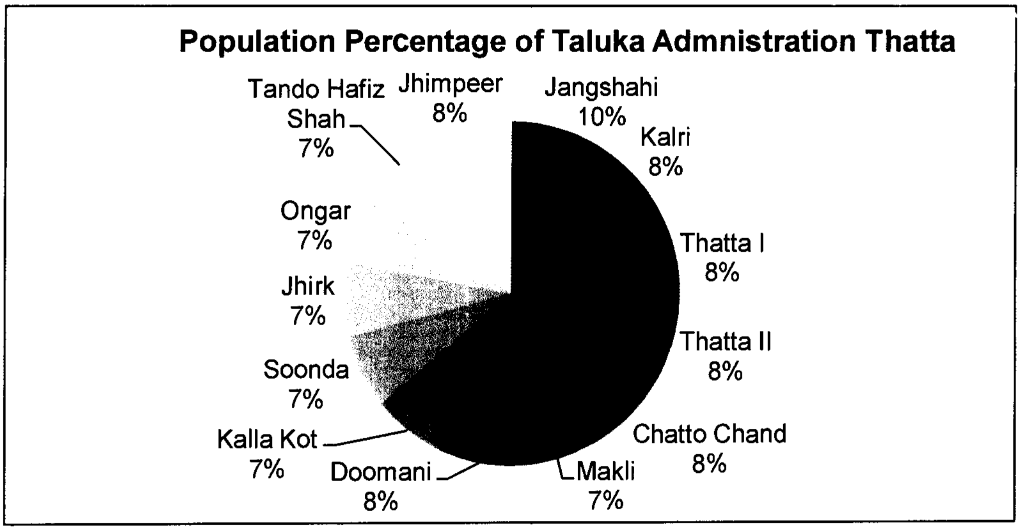

Figure 4.14: Population Percentage of Taluka Administration Thatta (source: TMA Sindh Devolved Social Services Program (SDSSP))

4.6.5 Administrative setup

District administration in Thatta district was tilled recently governed by the local government system. The District is subdivided into 4 tehsils (talukas or sub-district): Ghora Bari, Mirpur Sakro, Thatta and Keti Bunder. These talukas include 55 Union Councils, 7,200 villages and over 190,000 households with an average size of 6.5 persons per household. The data for union councils, villages and households also includes the newly formed district Sujwal which was carved out of the district. The talukas are governed by their respective Taluka Municipal Administration (TMA), while the UCs of talukas are governed by Union Council Administration (UCA).

4.6.6 Social Infrastructure

Thatta district is considered as a neglected and backward area of Pakistan as most of the villages in Thatta district has not proper physical infrastructure like roads, electricity and other basic necessities. The agricultural activities are suffering due to non-availability of irrigation water since last three years. The underground water is brackish and not fit for irrigation or drinking which resulted in poor agriculture and non-availability of safe drinking water.

4.6.7 Water Supply

District Thatta gets the water from River Indus which flows from here till it meets to the great Arabian Sea in the south. The Thatta District is also very poor in terms of the indicator of piped water, which is available to only about 14% of the housing units. About 13% of rural households have hand pumps inside the housing units, while 16% use outside ponds for fetching water and 6% of housing units use dug wells.

Some cases found that the majority of people suffering from water borne diseases and having no option or awareness regarding its control, survey reports said. It said that women fetching canal water from 1-2km meters and sometimes even more. They have no awareness to clean or filter that water in the area. During the water intervals they have small ponds, tanks or ditches to store water and use that water for drinking purposes as that water is contaminated and sometimes animals and birds also drink from these ponds and same is used by the village communities.

4.6.8 Potable Water

Lack of potable water is one of the primary issues of this region. The Union Councils have provided water supply lines to most villages, but these schemes are largely non-functional. Groundwater levels are low and prospecting for water is an expensive proposition.

4.6.9 Sanitary Waste Disposal

The residents of units without proper latrine facility use adjacent rural environs. Majority uses the bushes or open fields to answer the call of nature. Only a few households have latrines as part of their bathing area. In the bushes outdoors the toilet area is demarcated; although the women's enclosures are separate, but they are not usually properly concealed.

In the interviews conducted of the locals by EMC team, locals living in the project vicinity revealed that they did have limited facilities for sanitation. There was no sewerage network either so the solid waste from homes is thrown in a demarcated garbage dumping area in the bushes.

Moreover, when the solid waste is in excess it is either lifted via tractor and taken to the lands and dumped in a big hole for bio-degradation into manure, or it is burnt. Conversely, this waste might also be sold to contractors from some other villages, which then have the garbage lifted and removed to cultivable lands where it is used to make manure.

Animal waste is not collected in special ways. Rather it is thrown in the same garbage area and allowed to dry after which if the quantity of animal waste is substantial then it is lifted and taken to the agricultural lands and dumped in a pit to turn it into manure, or else sold to contractors from other villages who have it lifted via tractor and taken to their own lands.

4.6.10 Electricity

Overall the electricity is available only to about one-third of the housing units in Thatta District. There is a wide variation in the availability of electricity in urban and rural areas. It is estimated that about 79 percent in urban areas had access to electricity in contrast to about 21 percent in the entire District. Kerosene oil is used in over 77 percent of the rural dwellings.

4.6.11 Roads

The Thatta District is linked by road with other districts. National Highway (N5) from Karachi to Peshawar passes through Thatta for a length of 200 kilometers. All major towns of the district are connected with metaled roads of 1,585 kilometers length. The district is also connected by the main railway line from Karachi to Peshawar. The principal railway stations are Jangshahi, Dhabeji and Jhimpir. The district is also equipped with digital and non-digital telecommunication system besides postage and telegraph. Sindh coastal highway passes through the macro-environment on the southern side in the district.

4.6.12 Literacy rate

Literacy rate for Thatta is amongst the lowest in Sindh. Total literacy rate stands at 22%. There are marked urban and rural and male-female differentials in Thatta as 46% urban and 19% rural. The literacy rate in Thatta District was reported to be 22 percent in 1998. The male literacy rate was three times higher than females at 60% compared with the female at 20%. The literacy rate in urban areas was much higher at 46 percent compared to only about 19 percent in rural areas. There is a wider gap between males and females in rural areas where literacy ratio for males is 28 percent compared to only 8 percent for females. Of the total educated persons, 35 percent have passed primary, 13 percent middle and 13 percent matriculation. After matriculation, the percentage falls steeply to 6 percent for intermediates, 3 percent for graduates and less than 2 percent for post graduates. Things have started to change with the emergence of new leadership which has started setting up mosques and madressas in the area of influence.

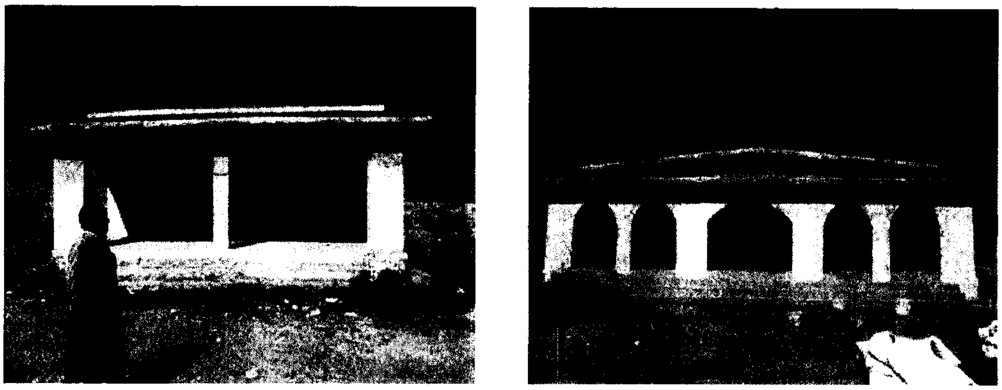

Figure 4.15: A View of Primary School for Boys (Left), and for Girls (Right) in the project area

4.6.13 Health Facilities

Overall, the health infrastructure in Thatta is scant. Three out of the six coastal Talukas do not have any Rural Health Centre or any veterinary dispensary. The BHUs and dispensaries are also in small number. It is estimated that there is one dispensary with one compounder for about 5000 people in the coastal Talukas. A particular problem of access to health services is the scattered nature of the population. Thus many of the people have no access to health services within a convenient location from their homes. This has left room for a lot of untrained people posing as heath care providers who establish camps and thus illegally prescribe medicines.

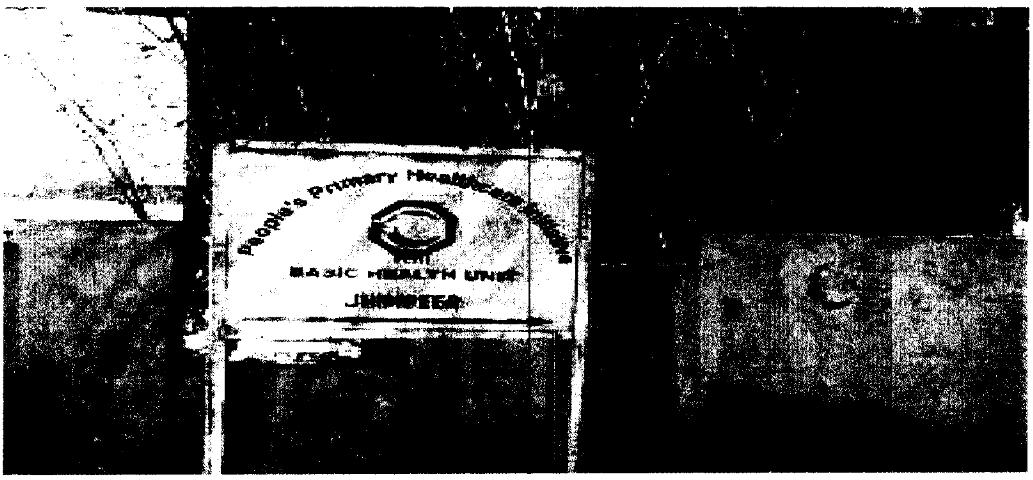

Figure 4.16: A View of Basic Health Care Unit Jhimpir

4.6.14 Enterprise and Industrial Sector

From the industrial point of view Thatta District has progressed considerably. There are about 30 industrial units established in the district. Apart from the sugar mills all the larger industrial units are located in Dhabeji and Gharo adjacent to Karachi. Most of the labour in these units is generally non-local and commutes from Karachi. These include sugar mills (5), textile mills (9), paper mills (2), flour mill (3) salt works, ice factory (2), etc. In addition, stone from the Makli Hills and Kohistan is supplied to the Pakistan Steel Mill and the Thatta Cement Factory. There are also large coal deposits in Thatta Taluka. Recent additions to the industrial units are the car manufacturing plant near Budho Talpur, belonging to the Deevan Group adjacent to the Deevan Sugar Mills. The group also employs non-locals in large numbers; the number of different industries in the district is given in Table 4.9.

Table 4.7: Industries in District Thatta

S #	Type of Industries	No of Factory
1	Sugar Mill	5
2	Textile Mill	9
3	Paper Mill	2
4	Jute Mill	1
5	Salt Works	3
6	Flour Mill	3
7	P.V.C Industries	1
8	Garment Industry	1
9	Industrial Gases	1
10	Specialized Textile	1
11	Ice Factory	2

Source: District Coordinate Officer District Thatta

Salt industry: There are numerous sites for salt production in the Bambhore area. Private contractors have leased these lands from the government and local people are working there since the inception of the salt works, under primitive conditions for seven days a week, at an average salary of Rs. 250-350 per day.

Poultry farming: A large number of poultry farms were observed during the site visit for socioeconomic survey in the project area. The climatic condition favors this profitable business in terms of quality and quantity. These farms are major suppliers to urban centers.

Handicrafts: Both men and women in the project area supplement their major income source with handicrafts. Women particularly use their leisure time, albeit minimal, for handmade products like rali, comforters called sour, sagi, agath and embroidery on shirts, bed sheets, pillows, handkerchiefs and table covers.

4.6.15 Agricultural and Livestock

Like in the rest of Pakistan there are two main agricultural seasons in the Thatta District. The main crops grown in the district in the Rabi season are wheat, barley, gram and oil seeds. In Kharif the main crops grown are rice, maize, millet and Jowar. Most common vegetables are grown in all the Talukas in the district. As far as fruits are concerned these include the date palm which only flourishes in Jhimpir in Thatta Taluka. Coconut trees are found in Keti Bunder, Mirpur Sakhro and Thatta Talukas. Bananas are grown in Thatta, Ghorabari and Mirpur Sakro Talukas. Other fruits grown in the district are Papaya, Guava and Mangoes. However, the banana crop exceeds the other fruits in terms of the area and production by far. The district is surplus in rice. Besides, bananas of good quality are exported to Iran and the Middle East. The important items of trade in the district are rice, leather and wool. Good breed of buffalo and cow are found in the district. Sheep, goat, camel, horse, ass and mule are also the main livestock of the district.

4.6.16 Irrigation and Drainage Systems

The hilly areas of the district are cultivated on monsoon water and wells, while the canals and channels irrigate the other lands. The areas within the protective banks of the Indus used to have fertile patches of land which depended upon flood and lift water system from barrage channels at various places for irrigation purposes. However, the pattern of irrigation has been transformed in the district due to lack of water availability.

4.6.17 Occupation

According to the Household Survey Data (Jan 2005), 20 percent of the households relying on fishing as an occupation in the Thatta Districts, Almost 88% of the population resides in rural area and the population base indicates a high level of younger population. Table shows inland and marine fisheries in Thatta District.

Table 4.8: Inland and Marine Fisheries in Thatta District (2009-10) (Metric Tons)

District	*Production In Metric Tones*	*No. of Fisher Man*			*No. of Boats*		
	Fish Production	*Full Time*	*Part Time*	*Total*	*Sail*	*Row*	*Total*
Thatta	11587	10600	780	1180	600	850	1450
Source: Fisheries Department of District Thatta, Government of Sindh							

4.6.18 Poverty

According to the Pakistan National Human Development Report 2003, Thatta stands 64th among 91 Districts (UNDP 2003) and one of its Taluka Mirpur Sakro was declared the most poverty ridden Taluka in District Thatta, the 80% of the population living below the poverty line in the district.

4.6.19 Employment Opportunities Associated with the Project

The area is backward and limited opportunity of education is available, therefore it is expected that mostly labor force could employed during construction and operation phase. This project will have a relatively short construction period, and will require a relatively smaller number of skilled and semi-skilled workers, including crane and heavy equipment operators, engineers, electricians, electronic technicians, mechanical technicians, concrete workers and laborers. The project developer should accommodate as much local labor as possible from the local area. Short-term positive economic impacts to area businesses may result from increased expenditures for meals, motels, fuel, etc. However, given the small number of employees involved and the temporary nature of the work, it is not anticipated that there will be significant positive or negative impacts at the community level.

4.6.20 Benefits to women due to the project

When someone thinks of development and physical change in vulnerable area, he must think of the infrastructure and machines moving in it. Weather, it can be a large industry in big/small cities or just bringing electricity in the area. Development can be just lighting in rural areas. What will be the first need that shakes your mind for bringing about immense change in a place; of course it will be availability and significance of energy, which is a basic need and start point of development at grass root level. The inhabitants of far flung areas of

Pakistan do not have access to this basic and modern amenity of life. Consequently, such population has minimum opportunity for development. The same is the case for the residents of the area under discussion Like, generally in the third world countries, one of the main drawbacks of this society is that females' home management is not recognized as a productive activity whereas the fact is other way round; women at home are working for very high value cause of society building.

However, during public consultation process, it was noted that females generally work for maintaining livestock, helping male members in agriculture related activities. Some women also work as a labor as well. As for as male members are concerned, some of them who have some education have moved to cities for jobs whereas most of them work as a laborer, maintain their agricultural land and look after their livestock.

Traditionally, women are more skilled and hard workings due to local norms like female have to fetch water and keep themselves busy in other nonproductive activities in community. Another difference made by local cultural between man and woman which force them to wear special dresses that should be different from man and must show specific sign of specific community, so that woman from every community is recognized from their dress.

The women in the area have a lot of potential for development of economic activities that can lead to income generation and improve their livelihood. Migrating activities by men (who are by and large head of the family) for getting economic resources during drought in the area is also necessitated for woman to involve in economic activities to fulfill families' immediate necessities. However they have to be provided with necessary infrastructure including adequate facilities of electricity, access to market, appropriate training, credit facilities etc.

Chapter 5 POTENTIAL ENVIRONMENTAL & SOCIOECONOMIC IMPACTS AND RECOMMENDED MITIGATION MEASURES

This chapter presents the screening of potential environmental and social impacts of different activities of 50 MW Lootah Energy Wind Farm (Phase-I) Project. Using the general guidelines as well as professional judgment, it evaluates the positive and negative impact of emissions and waste discharges on the aesthetics, air shed, watershed, fauna, flora and the living environment at Project site at Jhimpir, District Thatta. The screening process, besides identifying significant environmental impacts and the persistence of residual impact, if any, suggests mitigation measures that may have to be adopted in order to reduce minimize or compensate for the impact.

5.1 Screening of Potential Environmental Impacts Assessment

The environmental, socioeconomic, and Project information collected was used to assess the potential impacts of the proposed activities. The issues studied included potential Project impacts on:

- Land Use
- Visual Effects
- Noise Effects
- Flicker Effects
- Geomorphology
- Groundwater and surface water quality, with particular reference to the coast
- Ambient air quality and ambient noise levels
- Ecology of area, including flora and fauna especially with reference of migratory birds
- Local communities
- Noise impact
- Shadow impact

Wherever possible and applicable, the discussion covers the following aspects:

- The present baseline conditions
- The potential change in environmental parameters likely to be effected by Project related activities
- The identification of potential impacts
- The evaluation of the likelihood and significance of potential impacts
- The defining of mitigation measures to reduce impacts to as low as practicable

- The prediction of any residual impacts, including all long-term and short-term; direct and indirect; beneficial and adverse impacts
- The monitoring of residual impacts

5.2 Method for Evaluating Impact

The description of baseline conditions represents the basis for evaluating the impacts of the Project. The description and evaluation of the environmental impacts and proposals for measures to be taken to mitigate and compensate for any determined environmental impacts during the project operations are presented in Environment Management & Monitoring Plan. On the basis of a point system, the severity of a particular environmental impact together with its general trends i.e. negative or positive is described. The evaluation scale applied is as follows

◇◇◇	= High Impact
◇◇	= Medium Impact
◇	= Low Impact
◉	= No Impact
★	= Locally Favorable
★★	= Regionally Favorable

5.3 Physical Environmental Impacts

5.3.1 Land Use

The land for the proposed wind farm is leased by Government of Sindh.

The total land area of the acquired land is about 5,000 acres which will be utilized for construction and installation of wind turbines. There is absence of following aspects since the last few decades on the land;

- Any agricultural activity on the land
- Any habitat permanent existence
- Any major commercial activity on the land to support the livelihood of local residents nearby
- Any major human settlement
- Any permanent green field, wetland or protected area

The project has no protected areas such wildlife/game reserves or national park, or any archaeological, historical or cultural heritage in its immediate neighborhood; as such it would have no impact on them. Therefore there is no threat to the existing land use or degradation and there is no net impact on the land use.

Extent of displacement of existing land use or other environmental resources	◉ = No Impact
◇◇◇ = High Impact	
◇◇ = Medium Impact	
◇ = Low Impact	

◉	= No Impact
★	= Locally Favorable
★★	= Regionally Favorable

5.3.2 Seismic Hazards

The damage zone classification of the Thatta region where the site is located is ZONE II-B (moderate to severe damage). The foundation design of the wind turbine generator (WTG) will take account of this seismic factor.

Seismic Impact Rating	◇ = Low
◇◇◇	= High Impact
◇◇	= Medium Impact
◇	= Low Impact
◉	= No Impact
★	= Locally Favorable
★★	= Regionally Favorable

5.3.3 Visual Impact

Visual impact depends on the visual contrast between turbine structures and visual character against the skyline and landscape, both of which result from color, form and scale. Visual effects are so far a non-issue in the construction of large structures. They have so far not appeared as a major constraint to development of high-rise apartments, towers, minarets and chimneys. There are also no regulations for visual effects while siting wind turbines.

Reflected light can nevertheless be distressing to the eye of persons in living environment in close proximity. The rotor blades will have to have dull finish so as to minimize the visual effects.

<u>Mitigation Measures:</u> The wind turbines would be suitably landscaped so as to make them visually attractive and also matt-finished to make the rotors less glossy. The wind farm established near the Jhimpir would be viewed as a curiosity. The cluster of WTG all lined up along the 1 row will create a point of interest in the distantly located rural landscape. This point of interest could be complemented by suitable landscaping to demonstrate the performance of this clean, renewable form of energy generation.

Visual Impact on Landscape	◇ = Low Impact
◇◇◇	= High Impact
◇◇	= Medium Impact
◇	= Low Impact
◉	= No Impact
★	= Locally Favorable
★★	= Regionally Favorable

5.3.4 Air Quality

The Project involves power generation using wind energy — a clean source of energy (i.e., no fuels are used). Air pollution impacts are limited to the construction activity (due to truck/vehicle traffic to the Project site, minor construction required to erect the WTG, earthwork, development of access roads, vehicle traffic on un-metaled road, etc). Also, use of construction vehicles and equipment and idling of vehicles carrying construction raw materials add to the emissions. Minor air quality impact could be occurred due to the presence of diesel fuel generator or vehicular movement at site.

However, the increase in air pollution is temporary. Thus the impact of the construction activity on air pollution will be minor and temporary. Construction emissions will be substantially greater than emissions from Project operational phase activities, but still limited in magnitude.

Mitigation Measures

- Environmental Management Plan (EMP) will be effectively implemented and followed and contractors will be mandated to adopt the EMP in letter and spirit.
- Emissions from the generators or vehicles will be monitored to ensure that the engines are properly tuned and maintained, and generators are so located that emissions are dispersed away from the camp and work areas.

Impact on Air Quality		◇ = Low Impact
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
⊙	= No Impact	
★	= Locally Favorable	
★★	= Regionally Favorable	

5.3.5 Noise Quality

Project construction involves a variety of noise generating activities that include the use of grading, excavating/drilling/minor blasting of tower foundations, concrete batching, tower erection, the construction of ancillary structures / concreting, material movement, site cleanup etc.

Noise levels generated by construction equipment vary significantly depending on the type and condition of equipment, the operation method and schedule and the site of the activity.

Construction activities at site are expected to produce noise levels in the range of 75–90 dB(A), with most of the works carried out during daytime.

The noise levels produced during construction will not have a significant impact on existing ambient noise levels at receiving sites as noise generating activities are dispersed and most construction activities will occur during the day when higher noise levels are tolerated due to higher background noise levels. In addition, the constructions phase will only of some month's duration therefore the intermittent impact from construction noise is deemed to be negligible.

Noise created by the wind turbines would range between 90 and 105 dB(A) at a height of about 90 m. This level would attenuate at the ground level to perceptible range of 55 to 65 dB(A), which is almost the same as noted when the surface wind is blowing. With the rotation of blades by class 3-4 winds at 12 to 15 rotations, the noise emission would be at the lower level of 55 to 60 dB(A). At a distance of over 7 km, where Keenjhar Lake is located, the noise emission would be negligible. The average at site during the generally around 60 to 70s dB(A). The noise level as a result of exposure to wind was 60.0 to 65 dB (A).

Performance of WTGs at a recently installed wind farm in the Jhimpir Wind Corridor has been observed and the blades were found rotating at 12 to 15 rounds per minute and were not causing sound disturbance or roaring effect.

High noise levels are limited to the construction activities and its equipment vary significantly depending on the type and condition which could produce noise in the range of 75-90 dB(A). However it can be controlled by applying mitigation measures proposed in the environmental management and monitoring plan.

During Project operation, noise will be generated from rotor movement through the air, from turbine operation and from vehicle movements and machinery operation around the site for maintenance and repair purposes. Blades moving through the air produce an aerodynamic noise. This noise is detectable when it is greater than the background noise, generally at wind speeds between the turbine cut-in wind speed (when the turbine starts to generate power) and up to 8-9 m/s (before the background noise starts to mask the noise from the blades and turbine). In addition, the operating turbine may produce a tonal noise. The modern tubular towers contribute towards minimizing the noise emissions.

The Project will use modern wind turbine models, which have advanced technology that includes: gearless mechanism; upwind rotors; sound proof nacelles to reduce mechanical noise; and design amendments in blades. Noise from wind turbines varies with wind speed, but is generally comparable to the background sound in a typical household at 40 to 60 dB. The noise from wind turbines is usually measured in relation to ambient noise. If the wind is at higher speeds, the ambient noise level will be higher. Most new wind turbines will have noise levels at or close to ambient level. Distances of 100 feet are usually sufficient to keep noise levels below 60 dB, which has been suggested as a reasonable regulatory limit.

Mitigation Measures

- Emissions from the generators or vehicles will be monitored to ensure that the engines are properly tuned and maintained, and generators are so located that emissions are dispersed away from the camp and work areas.
- The staff will be provided with the personnel protective equipment (PPE).
- The proponent may seek evidence that the type(s) of turbines proposed will use best current engineering practice in terms of noise creation and suppression.
- Noise emission from the vehicles and equipment will exceed 75 dB (A) but the same would be reduced to less than 75 dB (A) at 7.5 m from the source. Workers will be provided ear plugs and other safety equipment as safeguard against the hazards in the 'high noise zones', which will be clearly defined.

Impact of noise		◇◇ = Medium Impact
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
◉	= No Impact	
★	= Locally Favorable	
★★	= Regionally Favorable	

5.3.6 Shadow Forecasting

Wind turbines, like other tall structures will cast a shadow on the neighboring area when the sun is visible. For a community living very close to the wind turbine, it may be annoying if the rotor blades chop the sunlight, causing a flickering (blinking) effect while the rotor is in motion.

It is predicted quite accurately the probability of when and for how long there may be a flicker effect. It might not be known in advance whether there is wind, or what the wind direction is, but using astronomy and trigonometry a likely, or a "worst case" scenario can be predicted.

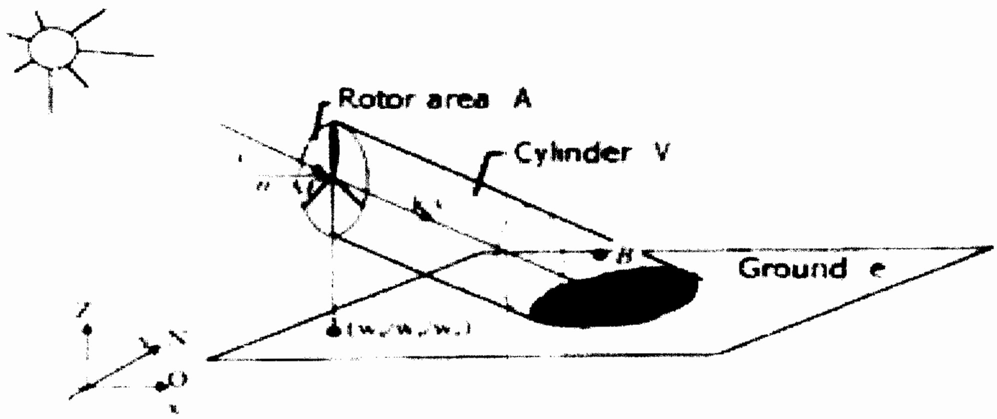

Figure 5.1: Shadow Flicker of Wind Turbine

In a study conducted by Department of Energy and Climate Change, UK, the data of wind turbines of 18 countries were selected to study the shadow flicker impact. The study concluded that "the so called "shadow flicker" caused by wind turbines does not pose a significant risk to health of the nearby residents. There is no case reported about any significant impact of shadow flicker in any of the wind farms in the countries included in the study[12].

At distances of greater than 1,000 feet between wind turbines and receptors, shadow flicker usually only occurs at sunrise or sunset when the cast shadows are sufficiently long. As there are no major permanent resettlements in the vicinity of the Project site, therefore the shadow

12 http://www.decc.gov.uk

impact on human life is negligible at this stage. Moreover, there is a common trend of the people is to build homes at shady places in Pakistan.

Impact of Shadow flicker		◇ = Low
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
⊙	= No Impact	
★	= Locally Favorable	
★★	= Regionally Favorable	

5.4 Water Quality

Groundwater contamination can occur if chemicals or any other waste materials are not properly handled or are incorrectly disposed of and leach into the water table or if wastewater from plant activities is not properly disposed of.

All the waste material will be handled and disposed of in accordance with accepted safe practices, with no harmful substances released by the Project. Therefore, there will be no effect on surface water quality or ground water contamination.

Water Quality		◇ = Low
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
⊙	= No Impact	
★	= Locally Favorable	
★★	= Regionally Favorable	

5.5 Biological Environmental Impacts

5.5.1 Fauna

Birds may be affected by wind farm development through potential loss of habitat, disturbance to their breeding and foraging areas and by collisions caused by the rotating turbine blades. Compared to other causes of mortality among birds, the effect of wind power is relatively minor. As a general rule, birds notice that new structures have arrived in their area, learn to avoid them in movements, and are able to continue feeding and breeding in the location. The Project site is also not a migratory route thus there will be no effect on birds of the area. There seems no threatened or endangered bird species found at the site. Any development of the wind farm will have no impact on the existing bird life. Also an emission free power generation is clearly beneficial to all fauna in general.

Impact on Fauna		⊙ = No Impact
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
⊙	= No Impact	
★	= Locally Favorable	

★★	= Regionally Favorable

5.5.2 Flora

As there is no dense vegetation or forestation in the Project site area, therefore, there will be no damage to any kind of vegetation or forests. The existing sparse Xerophytic vegetation will be cleared where required.

Impact on Flora		◉ = No Impact
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
◉	= No Impact	
★	= Locally Favorable	
★★	= Regionally Favorable	

5.6 Socio Economic Environment

5.6.1 Archeological Site

No archaeological sites are present near the Project site.

Archeological Site		★★ = Regionally Favorable
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
◉	= No Impact	
★	= Locally Favorable	
★★	= Regionally Favorable	

5.6.2 Re-Settlement

No resettlement is required as the Project is located on un-utilized Government-owned land and the proponent has acquired the land from the Government of Sindh (GoS).

Re-settlements		◉ = No Impact
◇◇◇	= High Impact	
◇◇	= Medium Impact	
◇	= Low Impact	
◉	= No Impact	
★	= Locally Favorable	
★★	= Regionally Favorable	

5.6.3 Aviation Hazard

No aviation hazard will be created by the project as it is located 100 km from the nearest airport at Karachi. In addition, the blades are marked with red bands to make the structure more visible.

Aviation Hazard		◉ = No Impact
◇◇◇	= High Impact	
◇◇	= Medium Impact	

◇	= Low Impact
◉	= No Impact
★	= Locally Favorable
★★	= Regionally Favorable

5.6.4 Traffic Management

The impact on traffic will be minimal and short-lived due to trucks carrying construction material and WTG components as well as vehicles to carry personnel. Traffic will need to be planned and managed effectively to avoid inconvenience for the local populace and/or endanger public safety.

Traffic Management	◇ = Low Impact
◇◇◇	= High Impact
◇◇	= Medium Impact
◇	= Low Impact
◉	= No Impact
★	= Locally Favorable
★★	= Regionally Favorable

5.6.5 Labor Welfare & Safety

Significant number of labors will be deployed during construction. The labor camps need to provide proper water supply / sanitation facilities (toilets with septic tanks), otherwise pests, parasite and bacteria may proliferate and lead to public health hazard. The safety aspects to be covered include proper handling of electrical devices, tools, equipment, and construction materials to prevent accidents to personnel.

Labor Welfare & Safety	◇ = Low Impact
◇◇◇	= High Impact
◇◇	= Medium Impact
◇	= Low Impact
◉	= No Impact
★	= Locally Favorable
★★	= Regionally Favorable

Chapter 6 ENVIRONMENTAL MANAGEMENT PLAN

This section provides an approach for managing environment related issues and describes the institutional framework for environmental management and resource allocations to be carried out by Project Proponent for mitigating the negative impacts during project execution and operation phases.

Environmental management and monitoring is mandatory activity to be undertaken by the administration over the entire project cycle showing its commitment towards meeting environmental regulations / standards and good house keep practices as well as maintaining health and safety standards. In particular in water treatment projects, it not only requires regular monitoring but also adopting measures for conserving the project affected environment during design, construction as well as operation phase of the project assuring that the quality of the environment is maintained.

EMP is a dynamic and a live document that is under constant review having periodic revisions and may be updated as required. Any amendments in the procedures, information are notified to the concerned personnel after the approval from the competent authority for subsequent implementation.

It is important to remember that the main aim of producing an EMP is to improve environmental outcomes. The EMP needs to be communicated to appropriate staff and implemented.

6.1 Objectives of Environmental Management Plan

The EMP will help Project Proponent / Designer and Contractor in addressing the adverse environmental impact of the Project, enhance project benefits, and introduce standards of good environmental practice. The primary objectives of the EMP are to:

- Facilitate owner/project sponsors corporate policy on environment
- Define the responsibilities of project coordinators, contractors and other role players and effectively communicate environmental issues among them.
- Facilitate the implementation of mitigation measures identified in the IEE by providing the technical details of each project impact, and providing an implementation schedule.
- Define a monitoring mechanism and identify monitoring parameters to ensure that all mitigation measures are completely and effectively implemented.
- Ensure that after completion of Project, restoration of site and rehabilitation work will be carried out
- Required equipment and human resources for environmental monitoring and meeting contingency plan objectives are in place and personnel are trained to meet accidents and emergencies

6.2 Scope of EMP

This Environmental Management Plan has provided detailed strategy to be implemented for achieving improved environmental performance in the following areas:

1. Environmental Management
2. Water Usages and Disposal
3. Recycling and Waste Management
4. Storm Water Management
5. Pollution Prevention/Environmental Risk Assessment
6. Bio-Diversity
7. Energy Management
8. Transport
9. Community Awareness

6.3 Components of EMP

The EMP consists of the following components:

1. Legislation and Guidelines
2. Organizational Structure and Responsibilities
3. Mitigation Plan
4. Environmental Monitoring Plan
5. Emergency Response and Contingency Plan
6. Communication and Documentation
7. Change Management

6.4 Legislation and Guidelines

The IEE for Wind Power Generation has discussed national and international legislation and guidelines that are relevant to the project. Project Proponent will ensure that the key project management officials and staff and all its assigned and associated consultants and contractors are aware of these legislations and guidelines prior to the start of the project activities.

- EIA/IEE Regulation: The project will be conducted in conformance with EIA/IEE regulation and relevant international conventions and that guidance is sought from national and international guidelines. An independent monitoring consultant will be appointed for the project.
- SEQS Requirements: The SEQS for industrial gaseous emissions, Motor Vehicle Emissions and Noise levels, and Industrial and Municipal effluents will be followed throughout the project activities and operation.

- Protection of Wildlife & Endangered Species: The Wind Corridor in Thatta taluka is wasteland having few trees on its area and hence offers no attraction for habitation to the falcons or other highflying birds of concern to the project. As such they are only occasional visitors to Jhimpir Wind Corridor. It will be necessary to monitor the number and type of visiting bird species including the falcons, eagles and black kites during the pre-construction and subsequent stages of the project.

6.5 Institutional Arrangement

Lootah Energy (Pvt.) Ltd will establish an Environment & Social Management Cell (ESMC) at Corporate and Site level, headed by a Project Director to be responsible for day-today implementation of the Project. The proponent is responsible for undertaking the Project in accordance with the Initial Environmental Examination (IEE) and implementing the Environmental and Social Management Plan (ESMP).

The ESMC is responsible for coordinating and implementing all environmental and social activities. During Project implementation, the ESMC will be responsible for reflecting the occurrence of new and significant impacts resulting from Project activities and integrating sound mitigation measures into the EMP. The ESMC includes a safeguard specialist and supporting staff, together forming the Environmental and Social Unit, appointed by proponent to look after environmental, social and safety issues. The ESMC will be empowered to implement safeguards planning and monitor implementation.

The safeguards specialist gives guidance to the Project Manager and his staff to adopt the environmental good practice while implementing the Project. The safeguard specialist is responsible for implementing safeguard issues associated with the Project through a site team composed of proponent site staff and contractor's staff, to be assigned by the ESMC as necessary.

The duties of the Environmental and Social Unit of the ESMC at corporate level are to:

- Monitor the implementation of mitigation measures during construction and operation phases of the Project.
- Prepare suitable environmental management reports at various sites.
- Advice and coordinating field unit activity towards effective environment management.
- Prepare environment health and safety manual for the operation of transmission lines/substations.
- Advice during Project planning/design cells on environmental and social issues while route selection of the alignment at the planning/design stage to avoid negative environmental impact.
- Provide training and awareness on environmental and social issues related to power transmission Projects to the Project/contract staff.

The duties of the Environmental and Social Unit at site level are to:

- Implement the environment policy guidelines and environmental good practices at the sites.

- Advise and coordinate the contractor(s) activity towards effective environment management.
- Implement environment and safety manual.
- Carry out environmental and social survey in conjunction with Project planning cell while route selection of the alignment at the planning stage to avoid negative environmental impact.
- Make the contractor staff aware of environmental and social issues so that EMP could be managed effectively.

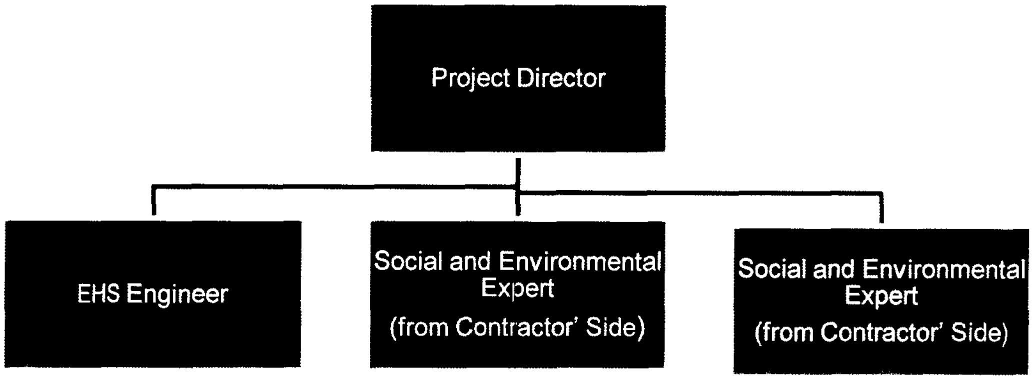

Figure 6.1: Framework of Environment and Social Management Cell (ESMC)

Table 6.1: Identification of Activities and Potential Impact (O & M) Phase

S. No	Designation	Responsibility
1	Project Director	Environment and Social Policy and Directions
2	EHS Engineer	Overall in-charge of operation of environment & social management facilities Ensuring legal compliance by properly undertaking activities as laid down by regulatory agencies from time to time and interacting with the same
3	Social and Environmental Monitoring Expert (from contractor side)	Secondary responsibility for environment & social management and decision making for all environmental issues including Safety and Occupational Health Ensure environmental monitoring and social issues related to Project as per appropriate procedures

6.6 Environmentally Sound & Safe Working Procedures

Contractors, sub-contractors and contract workers will be made aware of environmental aspects and Emergency Response Plan prior to commencing the work. Prior to leaving the site contractors, sub-contractors and contract workers will ensure that their work area is in safe position. On emergency call they will report in assembly area. Written procedures or standards will be prepared for all activities, where the absence of such procedures and standards could result in not following HSE policy, the law or the contract.

Safe Working Procedures will be based on the following four aspects of job safety:

- **Safe Place**: Work site will be designed and controls set up to ensure that working environment provides no significant risk to personnel, property and the environment.
- **Safe Equipment**: All equipment for any job, including tools, machinery and protective equipment will be specified and/or designed to ensure that it poses no significant risk to personnel, property or the environment. All equipment will comply with legislative standards for conformity and test.
- **Safe Procedure**: Procedures will be designed for all aspects of the job to facilitate safe use of equipment at the work site to complete tasks with no significant risk to personnel, property or the environment. Design of procedure will be based on step-by-step analysis of the tasks involved (Job Safety Analysis), identification of associated hazards and elimination of control of those hazards. Procedures should allow for work in ideal conditions as well as under aggravating conditions e.g. adverse weather.
- **Trained Personnel**: Suitable job-specific, safety skills and supervision training will be provided to personnel involved in construction and operation activities so that they are able to use the procedure and equipment at the worksite with no significant risk to personnel, property and environment.

Safe Working Procedures will be available to contractors and sub-contractors, who will adopt the relevant labor laws of the country.

6.7 Identification of Environmentally Safe Aspects

EMS will identify Environmental aspects at the initiation of activities at the site with regard to:

- Emissions of fugitive dust and gaseous pollutants from vehicles and equipment,
- Discharges of liquid effluent including oily waste and seepage to land, and water
- Disposal of excavated material and solid waste to land, water and air
- Noise
- Consumption of natural resources and energy
- Emergency releases
- Fauna including high flying/straying birds, and Flora.

6.8 Environmental Assessment of Safe Procedures

After identifying the environmental aspects, the related impacts will be assessed and the significance of each issue will be evaluated. Following aspects will be identified for evaluating the impacts:

- Parts of microenvironment impacted
- Parts of macro environment impacted

- Whether the impact is beneficial or damaging
- Severity of impact
- Frequency or likelihood of impact
- Existing mitigation measures
- Adequacy of mitigation measures
- Concerns of stakeholders/interested parties
- Regulatory requirements and their compliance

6.9 Emergency Response Plan

The Project EMS would implement its own Emergency Response Plan during the pre-construction and construction stages. The Emergency Response Plan during the construction period will be managed and monitored by the Project EMS Emergency Response Team. The Response team will ensure that the operations are carried out in minimal time avoiding any fire, safety and security hazard and affecting the environment. The team will be in readiness to adopt the following procedure:

- Evaluation of the situation to identify the most important steps, which must be taken first and can have an important bearing on the overall action to be taken.
- Deployment of required manpower and equipment.
- Organizing required logistical support so that there are no bottlenecks hampering the operation.
- See to it that injured persons are cared for.
- Isolate all sources of ignition and environmental hazard.
- Evacuation of people who are in immediate or imminent danger. Response Team and/or in-charge of the Campsite will exert positive leadership and give instructions calmly, firmly, explicitly, and courteously and obtain help of law enforcement agencies, if necessary.
- Block approach roads if necessary for safety of operations.
- Arrange for emergency notifications of water shed areas, public utilities, and the like to safeguard the public and property.
- Surveillance and monitoring operations.
- Retrieval and disposal of earth/debris and resources affected by the hazard at appropriate site.
- Termination of clean-up operation.

In the event of any EHS incident, Subcontractors will report details to the contractor project manager or EHS Chief.

External response services may be required where the site is not capable of responding to an incident or may require additional support services. These services may include local fire departments, medical emergencies teams or rioting response units where available, and they must be able to respond in an appropriate time frame.

An information schedule should be prepared in advance to prevent delays if it is necessary to contact a service provider. This should include:

- Exact location of the site including directions to the site from a well-known place such as highway exit or landmark.
- Inventory of chemicals that may be spilled/released.
- Site contact person(s) including 24 hour contact numbers

6.10 Training and Exercises

To ensure effective implementation of the Emergency Response plan, training programs for Disaster response personnel will be organized regularly in collaboration with wind farms in the neighborhood. The training program will aim at:

- Maintaining the plan and working document to be fully operational.
- Inform the Response Team members and other relevant personnel of their respective duties and procedures to be followed.
- Familiarize all relevant personnel with the use of equipment.

The training program will be structured according to the level of responsibility of the participants:

- Classroom instructions as well as field demonstration will be conducted.
- Regular operational exercise/drills will be conducted to ensure that the response organization and other components detailed in the plan function effectively and
- Response Team members and other relevant personnel assigned specific responsibilities become fully familiar.

All EHS training programs for site personnel will include the following:

- EHS Policy and Objective.
- Project related activities with potential EHS impacts.
- Mitigation requirements.
- Environmentally sensitive areas potentially impacted by the project.
- Specific activities mitigation measures and site EHS requirements.
- Chemical storage and handling.
- Reporting of EHS incidents.
- Emergency response strategies (including those for oil and chemical spill/releases).

All environmental orientation and training documentation shall be made available upon request.

6.11 Environmental Mitigation Plan

The mitigation plan is a key component of the EMP. It lists all the potential effects of each activity of the Project and their associated mitigation measures identified in the IEE.

For each Project activity, the following information is presented in the plan:

- A listing of the potential impact associated with that Project activity
- A comprehensive listing of mitigation measures (actions)
- The person(s) responsible for ensuring the full implementation of the action
- The person(s) responsible for monitoring the action
- The timing of the implementation of the action to ensure that the objectives of mitigation are fully met.

It should be emphasized that the mitigation measures will have to be translated into environmental as well as social requirements and specifications to be made part of the contracts for the construction activities, with legal binding.

The objective of environmental and social monitoring during the various phases of the proposed Project will be as follows:

- Ensuring that the mitigation measures included in the IEE are being implemented completely.
- Ensuring the effectiveness of the mitigation measures in minimizing the Project's impacts on social and environmental resources.

To achieve these objectives, the Environmental Management Plan (EMP) for construction and operation phase are given below;

Table 6.2: Mitigation Plan

Environmental issue	Mitigation Measure	Time Frame	Responsibility
SITE ACCESS	• Access in and out of the Project will be minimized to one point to minimize impact during construction • All areas of construction activity will be fenced to limit the activities within the premises	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
LAND ENVIRONMENT			
Impact on land use on Project site	Limit activities within the Project area	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Soil contamination by construction waste and fuel	Minimize oil and fuel spills from construction equipment by appropriate operation and maintenance practices.	Construction and Maintenance	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Sourcing quarry material	Sand, aggregates, and other quarry material from licensed quarries.	Construction	Project Director
Material spill	Use close cabin delivery vehicles or use an appropriate cover.	Construction	Project Director
Debris disposal	Make SOPs recommended by relevant agencies/authorities	Construction	Project Director

Table 6.2: Mitigation Plan			
Environmental Issue	**Mitigation Measure**	**Time Frame**	**Responsibility**
BIOLOGICAL ENVIRONMENT			
Ecological impact	Identify and approve shrubs and trees to be fell and removed if any within the wind farm area	Pre-Construction, Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Natural habitat	Avoid temporary disposal of demolition debris and excavated material Labor camps and stockyards beyond the Project construction area Staff will be trained to avoid prey of any wildlife	Pre-Construction and Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
SOCIO-ECONOMIC ENVIRONMENT			
Local traffic management	Plan temporary traffic arrangements during construction within the construction area. Review the plan periodically with respect to site conditions.	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Traffic control and safety	Give special consideration to local traffic management for the safety of pedestrians, especially nearby villages/Goths.	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Providing labor camps and facilities	Abide by the contract conditions and directions with respect to siting of labor camps, providing temporary sanitation facilities, addressing labor welfare issues etc.	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Occupational health	All the precautionary measures as required for the safety of workers are applicable	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Safety precautions	Take adequate precautions to prevent danger from electrical equipment	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Providing first aid kit	Provide a readily available first aid unit including an adequate supply of sterilized dressing material and appliances.	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert

Table 6.2: Mitigation Plan

Environmental Issue	Mitigation Measure	Time Frame	Responsibility
			(Contractor)
Exposure to loud noise	Ensure workers exposed to loud noise wear Ear plugs/ear muffs.	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
AIR POLLUTION			
Air quality impact	No major impact on air quality. Dust generated by movement of vehicles is temporary and will be minimize after the completion of Project construction activities.	Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Dust emission due to vehicles on un-metaled roads	Sprinkle unpaved roads used by the contractor with water at least once a day to control fugitive dust emissions—at least near habitations and vegetative cover (considering availability of water).	Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Dust emission during foundation civil works	Water the construction site periodically to minimize fugitive dust generation while laying foundations.	Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Dust emission during earthwork	Store all earthwork and construction materials in a manner to minimize generation of dust and spillage on roads.	Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Noise and dust Emissions from drilling operations	Employ all possible and practical measures to control noise emission during drilling operations.	Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Construction equipment emissions	Manage construction activity induced noise to within daytime hours. The contractor can employ mitigation measures such as restricted and/or intermittent activity.	Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
NOISE POLLUTION			
Noise from Construction Activities from site preparation, earth works,	All staff will be provided with ear plugs. No loud music is allowed in the	Construction and operation	EHS Engineer (Proponent)

Table 6.2: Mitigation Plan

Environmental Issue	Mitigation Measure	Time Frame	Responsibility
foundation and plant equipment installation	construction camps. A prescribed working times from 0800 hrs to 1700 hrs preferably with no work activities at nights or during holidays. A speed restriction of 40 km/h will be imposed on all construction vehicles. All construction material and machinery would be kept in good working conditions.		Social & Environmental Expert (Contractor)
WATER ENVIRONMENT			
Water contamination due to improper storage of construction material	Store construction material containing fine particles in an enclosure so that sediment laden water does not drain into nearby water drains.	Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Blockage and change in drainage pattern	If the channel or drains get blocked due to negligence, ensure that they are cleaned. Once the work is completed in all respects, the contractor will clean up the drains along the Project road to the extent possible.	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Water contamination due to improper debris disposal	Conduct daily inspections at the construction site to ensure removal of construction debris.	Construction	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Disposal of sewerage water	Provide an adequate treatment facility to treat the sewage generated from toilets before discharge.	Construction and Operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
WASTE MANAGEMENT			
Ineffective use of resources resulting in excessive waste generation	Ensure that care is taken to avoid any oil spill or hazardous waste Appropriate waste disposal facility must be arranged in consultation with the administrative authority	Construction and operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)
Littre or Contamination of the site or water through poor waste management practices	Visual inspection of the site must be carried out daily for evidence of liter or waste has been inappropriately disposed by the personnel	Construction and operation	EHS Engineer (Proponent) Social & Environmental Expert (Contractor)

6.12 Environmental Monitoring Program

Monitoring of different activities will be required to assess the impacts of activities during construction and operation on the environment. For this purpose Project EMS will establish its own unit to:

- Coordinate with other units
- Follow the monitoring frequency of selected parameters as per the monitoring plan given in the following Table.
- Record all non-conformities observed and report them along with actions to Project Manager for further action.
- Report any impact anticipated along with recommendations for further action.

Contractor shall take note of the recommendations relating to issues arising during monitoring of construction activities. The following Tables show the checklist of actions for monitoring different environmental aspects during the construction and operations phases of the Project:

Table 6.3: Monitoring Plan

Stage	Monitoring areas	Location of monitoring	Parameters to monitor	Documentation & Monitoring Frequency
Construction & Operation	Ecological Conditions	Access Road to Wind Mast, and Access Rd from Wind Farm to Powerhouse	Visual analysis and observations on flora and fauna for loss of biodiversity, recording number of trees lost, animals hunted/killed and number of visiting birds, hunted, killed or saved	Quarterly
Construction & Operation	Drinking Water	Sampling points at campsite, deep water well;	Water analysis for following parameters: pH Dissolved Oxygen Total suspended solids Common ions Oil & grease Coliform count	Monthly
Construction & Operation	Wastewater	Outlet of the wastewater treatment system / septic tanks	Wastewater analysis for the following parameters: pH Total suspended solids DO BOD Oil & grease	Monthly
Construction	Solid Waste (Kitchen)	Collection, handling and disposal to designated areas/borrow pits	Observations on solid waste type, quantity, segregation and disposal arrangement	Monthly
	Solid Waste (Other)			Monthly

Table 6.3: Monitoring Plan

Stage	Monitoring areas	Location of monitoring	Parameters to monitor	Documentation & Monitoring Frequency
Construction and Operation	Air quality	15 meters distance from activity area Diesel Generators Vehicles	Parameters to monitor include: CO SPM SO2 NOx	i. Before beginning of construction ii. Quarterly during construction iii. Quarterly during operations
End of Construction	Restoration of sites	All excavation sites & Borrow pits	Visual Observations	Status Report for Completion of Construction
Operations	Accidental risk /Avian collision at site	Whole Project Site	Visual Observations Recording accidents /avian collisions during operation of WTG & equipment	Monthly
	Noise	Activity area, Wind Farm, Access Road	Noise intensity measurement	Monthly
Construction & Operations	Occupational Safety	Installation of Machinery and equipment Operations areas	Visual observations and Recording hazard/accident	Monthly

Chapter 7 FINDINGS, RECOMMENDATIONS & CONCLUSION

The main benefit of the Project will be the replacement of conventional power generation which utilizes fossil fuel, with the renewable energy. Wind energy will replace fossil fuel powered generation; therefore reduce particulate and greenhouse gas emissions into the atmosphere.

Impacts are manageable and can be managed cost effectively. Adverse Environmental impacts are unlikely to result from the proposed Wind Power Project. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as correction in work practices at the construction sites, or through the careful selection of sites and access routes. Since proposed land is sparsely vegetated, thus there is no need for major floral removal.

The proposed Project will have number of positive impacts and negligible negative impacts to the existing environment as follows:

- Significantly improvement in the economic activities in the surrounding areas due to generation of direct and indirect employment opportunities.
- There is negligible removal of trees and Xerophytic floral for the Project activities.
- Environmental pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, black smoke, vibration are the short term negative impacts of the proposed Project which will be mitigated through proposed measures.

Proper Grievance Redressal Mechanism (GRM) will have to be implemented by the proponent to overcome public inconvenience during the proposed Project activities.

Based on the environmental and social assessment and surveys conducted for the Project, the potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the mitigation measures identified in the EMP. Adequate provisions are being made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs. Adequate provisions are being made by the proponent to cover the environmental mitigation and monitoring requirements, and their associated costs.

An environment and social analysis has been carried out looking at various criteria such as topology, air, noise, water resources and water quality, ecology, demography of the area, climate and natural habitat, community and employee health and safety etc. The impact analysis, found that due to careful consideration of environmental and social aspects during route and site selection by proponent, no major adverse impacts are expected. There is no adverse impact on the migration of habitat, any natural existing land resources and effect in the regular life of people.

Micro sitting analysis of the project reveals the 2nd option in Section 2.5 i.e. Site 2 to be the most optimal in terms of economics and energy yield. The environment and social impact associated with Project is limited to the extent of construction phase and can be mitigated through a set of recommended measures and adequate provision for environment and social impacts which cover monitoring, measuring and mitigation.

EMP has been prepared. Most impacts are expected to occur during the construction phase and are considered to be of a temporary nature. The transmission corridor will be carefully selected after undergoing a detailed assessment. This enabled the right of way alignment to bypass villages and important water supplies and resources. The main Project impacts are associated with clearing of shrub vegetation, waste management and excavation and removal of topsoil.

From this perspective, the Project is expected to have a small "environmental footprint". No endangered or protected species of flora or fauna are reported at the Project site.

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The Project is not considered highly sensitive or complex. Mitigation measures related to construction, as specified in the EMP, will be incorporated into civil works contracts, and their implementation will be primarily the responsibility of the contractors. Hence, the proposed Project has limited adverse environmental and social impacts which can be mitigated following the EMP & shall be a pollution free renewable source of Power in the region.

Screening of potential impacts suggest that the Construction & Operation of 50 MW Lootah Energy (Pvt.) Ltd Wind Farm (Phase-I) Project will, on adoption of the suggested mitigation measures, be an environmentally acceptable proposition and provide clean and renewable energy. It is recommended that the IEE be approved with the condition that recommendations given in the IEE and NOC will be duly followed by the proponent.

Lootah Energy (Pvt) Ltd.

- CERTIFICATE OF INCORPORATION SECP
- MEMORANDUM OF ASSOCIATION
- ARTICLES OF ASSOCIATION

NASSER ABDULLA LOOTAH GROUP

A008291

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

SECP

COMPANY REGISTRATION OFFICE, KARACHI

CERTIFICATE OF INCORPORATION

[Under section 32 of the Companies Ordinance, 1984 (XLVII of 1984)]

Corporate Universal Identification No. 0097895

I hereby certify that LOOTAH ENERGY (PVT.) LIMITED is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is limited by shares.

Given under my hand at Karachi this Ninteenth day of February, Two Thousand and Sixteen.

Incorporation fee Rs. 104,000/= only

(Sidney Custodio Pereira)
Additional Registrar of Companies
Comp. Karachi

Securities & Exchange Commission of Pakistan
Company Registration Office Karachi

Certified to be True Copy

Asstt. Registrar of Companies

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Advocate & Notary
Public Karachi.

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05 JAN 2018

THE COMPANIES ORDINANCE, 1984

(COMPANY LIMITED BY SHARES)

Memorandum of Association

of

LOOTAH ENERGY (PVT.) LIMITED

I. The name of the Company is LOOTHA ENERGY (PVT.) LIMITED".

II. The Registered Office of the Company will be situated in the Province of Sindh.

III. The objects for which the Company is established are all or any of the following:-

1. To carry on all or any of the businesses of generating, purchasing, importing, transforming, converting, distributing, supplying, exporting and dealing in electricity and all other forms of energy and products or services associated therewith and of promoting the conservation and efficient use of electricity and to perform all other acts which are necessary or incidental to the business of electricity generation, transmission, distribution and supply.

2. To locate, establish, construct, equip, operate, use, manage and maintain thermal power plants and coal fired power plants, power grid station, transforming, switching, conversion, and transmission facilities, grid stations, cables, overhead lines, sub-stations, switching stations, tunnels, cable bridges, link boxes, heat pumps, plant and equipment for combined heat and power schemes, offices, computer centres, shops, dispensing machines for pre-payment cards and other devices, showrooms, depots, factories, workshops, plants, printing facilities, warehouses and other storage facilities and to amalgamate the company with the company having same business and properties which this company to promote the business of the Company.

3. To carry on all or any of the businesses of wholesalers, retailers, traders, importers, exporters, suppliers, distributors, designers, developers, manufacturers, installer, filters, testers, repairers, maintainers, contractors, constructors, operators, users, inspectors, reconditions, improvers, alters, protectors, removers, hirers, replacers, importers and exporters of and dealers in, electrical appliances, systems, products and services used for energy conservation, equipments, machinery, materials and installations, including but not limited to cables, wires, meters, pylons, tracks, rails, pipelines and any other plant, apparatus equipment, systems and things incidental to the efficient generation, procurement, transformation, supply and distribution of electricity.

4. To ascertain the tariff for bulk supply that will secure recovery of operating costs, interest charges and depreciation of assets, redemption at due time of loans other than those covered by depreciation, expansion projects, payment of taxes, and reasonable return on investment, to quote the tariff to bulk purchasers of electrical power, and to

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05 JAN 2016

prefer petition to the appropriate authority for approval of the schedule of tariff and of adjustments or increases in its bulk supply tariff, where desirable or necessary.

5. For the purposes of achieving the above objects, the company is authorized:-

a) To purchase/import raw materials and allied items required in connection thereto in any manner the company may think fit;

b) To do and perform all other acts and things as are incidental or conducive to the attainment of the objects of the company;

c) To own, establish or have and maintain shops, branches and agencies all over Pakistan or elsewhere for sale and distribution of cables, wires, meters, pylons, tracks, rails, pipelines and any other plant, apparatus equipment, systems and things incidental to the efficient generation, procurement, transformation, supply and distribution of electricity;

d) To make known and give publicity to the business and products of the company by such means as the company may think fit;

e) To purchase, acquire, protect, renew, improve, use and sell, whether in Pakistan or elsewhere any patent, right, invention, license, protection or concession which may appear advantageous or useful to the company for running the business;

f) To pay all costs, charges and expenses, if any, incidental to the promotion, formation, registration and establishment of the company;

g) To borrow and arrange the repayment of money from banks/financial institutions or any lawful sources whether in Pakistan or elsewhere and in such manner as the company may think fit, including the issue of debentures, preference shares, bonds, perpetual or otherwise charged upon the whole or any part of the company's property or assets, whether present or future, and to purchase, redeem or payoff such securities;

h) To purchase, hold and get redeemed shares, debentures, bonds of any business, company, financial institution or any Government institutions;

i) To guarantee the performance of contracts, agreements, obligations or discharge of any debt of the company or on behalf of any company or person in relation to the payment of any financial facility including but not limited to loans, advances, letters of credit or other obligations through creation of any or all types of mortgages, charges, pledges, hypothecations, on execution of the usual banking documents or instruments or otherwise encumbrance on any or all of the movable and immovable properties of the company, either present or future or both and issuance of any other securities or sureties by any other means in favour of banks, Non-Banking Finance Companies (NBFCs) or any financial institutions and to

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borrow money for purpose of the company on such terms and conditions as may be considered proper.

6. The Company shall not engage in banking business or Forex, illegal brokerage, or insurance or leasing or investment finance or house finance services or REIT management services or business of managing agency or in any unlawful business and that nothing contained in the object clauses shall be so construed to entitle it to engage in such business directly or indirectly and the Company shall not launch multi-level marketing (MLM), Pyramids and Ponzi schemes.

7. Notwithstanding anything stated in any object clause, the company shall obtain such other approval or license from Competent Authority, as may be required under any law or the time being in force, to undertake a particular business.

IV. The liability of the members is limited.

V. The authorized capital of the company is Rs. 10,000,000/- (Rupees Ten Million Only) divided into1,000,000 (One Million) ordinary shares of Rs.10/- (Rupees Ten) each with power to enhance, reduce or consolidate the share capital and to divide the shares of the company into different classes and kinds subject to the provisions of the Companies Ordinance, 1984.

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We, the persons whose names and addresses are subscribed, are desirous of being formed into a company, in pursuance of this memorandum of association, and we respectively agree to take the number of shares in the capital of the company set opposite our respective names.

S. No.	Name, Surname and Father's Name (present & former) in full (in Block Letters) and CNIC/ PASSPOART No.	Occupation & Nationality (ies) with any former Nationality	Residential address in full	Number of shares taken by each subscriber	Signatures
1	NASSER ABDULLAH HUSSAIN LOOTAH S/o. ABDULLAH HUSSAIN LOOTAH PASSPORT # [illegible]	BUSINESS EXECUTIVE UNITED ARAB EMRATES (UAE)	H. NO. 55, AL-MAMZAR PARK, AL-JHAMRIAH, DERA DUBAI. (UAE)	80 (Eighty)	
2	KHALID MASOOD S/o. MASOOD HASAN ZAIDI CNIC #. 42301-3778143-9	BUSINESS EXECUTIVE PAKISTANI	H. NO. 80/2, 25TH STREET, KHYABANA-E-HILAL, PHASE-6, DHA, KARACHI.	20 (Twenty)	
			Total number of shares taken	100 (Hundred)	

Dated the **09** day **February** of **2016**
Witness to above signatures.

Signatures:

Full Name, MUHAMMAD ABDUL ALEEM

Father's/Husband's Name MUHAMMD ABDUL HALEEM

Full Address: FLAT NO. A-212, LARAIB GARDEN, GULSHAN-E-IQBAL, BLOCK-1, KARACHI.

CNIC Number: 42201-5695328-1

Occupation: PRIVATE SERVICE

9/X/19

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Asstt./Registrar of Company

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THE COMPANIES ORDINANCE, 1984
(COMPANY LIMITED BY SHARES)

ARTICLES OF ASSOCIATION

OF

LOOTAH ENERGY (PVT.) LIMITED

PRELIMINARY

1. The regulations contained in Table 'A' in the First Schedule to the Companies Ordinance, 1984 shall not apply to the Company except so far as the same are reproduced, contained or deemed to be contained in or expressly made applicable by these Articles or the said Ordinance. **Table 'A' not to Apply**

2. In these Articles the words and expressions below shall bear the meanings set opposite to them unless there be something in the subject or context inconsistent therewith. **Interpretations**

"The Articles" means these Articles of Association as originally framed or as from time to time altered by Special Resolution. **'The Articles'**

"The Board" means the Board of Directors of the Company for the time being. **'The Board'**

"The Company" means **Lootah Energy (Pvt.) Limited.** **'The Company' or 'this Company'**

"The Chief Executive" means the Chief Executive of the Company, by whatever name called appointed pursuant to Section 198 of the Ordinance. **'The Chief Executive'**

"The Chairman" means the Chairman of the Board of the Company appointed from time to time pursuant to these Articles. **'The Chairman'**

"The Directors" means the Directors for the time being of the Company including Alternate Directors for the time being of the Company. **'The Directors'**

"Dividend" includes bonus. **'Dividend'**

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Company Registration Office Karachi

05 JAN 2018

"Financial Statements" means a balance sheet, profit and loss account, cash flow statement, statement showing changes in equity, accounting policies and explanatory notes."	**'Financial statements'**
"In Writing" and "Written" includes printing, lithography, typewriting and other modes of representing or reproducing words in a visible form.	**'In writing' and 'written'**
"Member" means Member of the Company in accordance with the provisions of Section 2(1)(21) of the Ordinance.	**'Member'**
"Month" means calendar month.	**'Month'**
"The Ordinance" means the Companies Ordinance, 1984 or any statutory modification or re-enactment thereof for the time being in force.	**'The Ordinance'**
"The Office" means the Registered Office for the time being of the Company.	**'The Office'**
"Proxy" includes an attorney duly constituted under a power of attorney.	**'Proxy'**
"Person" includes the Government of Pakistan, the Government of the Provinces, Corporations, Associations, Bodies Corporate as well as individuals.	**'Person'**
"The Registrar" means a Registrar, an Additional Registrar, a Joint Registrar, a Deputy Registrar or an Assistant Registrar of Companies.	**'The Registrar'**
"The Register" means the Register of Members to be kept pursuant to Section 147 of the Ordinance.	**'The Register'**
"Special Resolution" has the same meaning as is assigned thereto by Section 2 (1)(36) of the Ordinance.	**'Special Resolution'**
"The Secretary" means the Secretary for the time being of the Company.	**'The Secretary'**
"The Seal" means the Common Seal of the Company.	**'Seal'**

Company Registration Office Karachi
Securities and Exchange Commission of Pakistan
SECP

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`Singular' and `plural number'

"**Words**" importing the singular number shall include the plural number and vice versa.

`Gender'

Words importing the masculine gender shall include the feminine gender.

Unless the context otherwise requires, words or expressions contained in these Articles shall bear the same meaning as in the Ordinance.

PRIVATE COMPANY

Company to be private Company

3. The Company is a private company and accordingly:

(a) The right to transfer shares of the Company is restricted in the manner hereinafter provided;

(b) The number of Members for the time being of the Company (not including persons who are for the time being in the employment of the Company) shall be limited to fifty (50) provided that, for the purpose of this provision, where two or more persons hold one or more shares in the Company jointly, they shall be treated as a single Member; and

(c) An invitation to the public to subscribe for any shares or stock or debentures or debenture stock of the Company is hereby prohibited.

Company Registration Office Karachi Securities and Exchange Commission of Pakistan

BUSINESS

Business

4. The business of the Company shall include all or any of the objects enumerated in the Memorandum of Association and can be commenced immediately after the incorporation of the Company as the Directors may think fit, notwithstanding that only part of the capital has been subscribed.

CAPITAL

Authorized capital

5. The authorized capital of the company is Rs. 10,000,000/- (Rupees Ten Million Only) divided into1,000,000 (One Million) ordinary shares of Rs.10/- (Rupees Ten) each with the rights, privileges and conditions attached thereto, with power to increase the capital of the Company and to divide the shares in the capital for the time being into several classes and attach thereto respectively, subject to the provisions of the Ordinance, such preferential, deferred, qualified, or special rights, privileges or conditions and to vary, modify or abrogate any such rights, privileges, or conditions in such manner as may for the time being be provided by the regulations of the Company.

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6. The Company may, in General Meeting, increase the authorized share capital by such sum as the resolution may prescribe, subject nevertheless to the provisions of Section 92 of the Ordinance.

Increase of authorized capital

7. The Directors shall, as regards any allotment of shares, duly comply with such of the provisions of Section 68 to 73, as may be applicable thereto.

Return as to allotments

8. New shares consistent with the provisions of the Ordinance shall be issued upon such terms and conditions and with such rights and privileges annexed thereto, as the resolution passed in a General Meeting creating the same shall direct and if no direction be given, as the Directors shall determine in accordance with the provisions of the Ordinance.

How far new shares to rank with shares of original capital

9. The Company may increase its capital by the issue of further shares and may decide to whom such shares shall be offered and in the absence of such determination, the shares shall be under the control of the Directors who may allot or otherwise dispose off the same to such persons, on such terms and conditions and at such times, as the Directors, subject to the provisions of Section 86 of the Ordinance, may deem fit and subject to Section 73(1)(b) to give to any person for such consideration as the Directors deem fit, in payment or part payment for any property sold or transferred, goods or machinery supplied or for services rendered to the Company in or about the formation or promotion of the Company or the conduct of its business or in satisfaction of any outstanding debt or obligation of the Company, and with power to issue shares either at par or at a premium and, subject to the provisions of the Ordinance, at a discount, provided always that upon the issue of further shares, the Directors shall offer such shares to the Members in proportion to the existing shares held by each Member and such offer shall be made by notice specifying the number of shares to which a Member is entitled and limiting a time within which the offer may be accepted or renounced in favour of any other Member of the Company or one or more of such persons as are mentioned in Article 26(a) of these Articles, otherwise the offer shall be deemed to have been declined and after the expiration of such time or on receipt of information from the Member to whom such notice is given that he declines to accept or renounce the same, the Directors may dispose-off such shares in such manner and on such terms as they may deem fit and consistent with the provisions of the Ordinance. The new shares shall be subject to the same provisions with regard to transfer, transmission and otherwise as the shares in the existing share capital.

Further issue of capital

10. A resolution by which any share is sub-divided or consolidated may subject to provisions of the Ordinance determine that as between holders of shares resulting from sub-division or consolidation, rights of profits, votes

Sub-division or consolidation of shares

and other benefit attaching to them will be proportionate to their paid up value and where shares issued or sub-divided or consolidated are of the same class as those previously issued, the rights attaching to them, subject as aforesaid, shall be the same as those attaching to the shares previously held.

Reduction of capital and how carried into effect

11. Subject to the provisions of the Ordinance, the Company may from time to time by Special Resolution reduce its share capital in any way and in particular (without prejudice to the generality of the power) by paying off capital or canceling capital which has been lost or is un-represented by available assets or reducing liability on the shares or otherwise as may seem expedient; and paid-up capital may be cancelled as aforesaid without reducing the nominal amount of the shares by the like amount to the extent that the unpaid and callable capital shall be increased by the like amount.

Loans, advances for and purchase of Company's shares prohibited

12. Except to the extent permitted by the Ordinance, no part of the funds of the Company shall be employed in the purchase of any shares of the Company, and the Company shall not give, whether directly or indirectly, and whether by means of a loan, guarantee, the provision of security or otherwise, any financial assistance for the purchase of or in connection with a purchase made or to be made by any person of any shares of the Company or give any loan upon the security of any shares of the Company.

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SHARES

Persons in whose name shares to be registered

13. Shares may be registered in the name of any individual, limited company or other body corporate but not in the name of minor or a firm. Not more than four persons shall be registered as joint-holders of any shares.

The first named of joint holders of shares

14. If any share stands in the name of two or more persons, the person first named in the Register shall, as regards receipt of dividend or bonus or service of notice, and all or any other matters connected with the Company except the transfer of shares, be deemed the shareholder.

Death of one or more of joint holders of shares

15. In the case of the death of any one or more of the persons named in the Register as the joint-holders of any share, the survivor or survivors shall be the only person or persons recognized by the Company as having any title to or interest in such share, but nothing herein contained shall be taken to release the estate of a joint-holder from any liability on shares held by him jointly with any other person.

Shareholders to give address

16. Every shareholder shall name to the Company an address and such address shall for all purposes be deemed to be his registered address.

CERTIFICATE

Member's right to

17. Every person whose name is entered as a Member in the Register

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shall without payment be entitled to receive, after allotment or registration of transfer, one certificate for all his shares or several certificates each for one or more of his shares and upon payment of such charges, if any, as the Directors may determine for every certificate after the first. **certificate**

18. The certificate of title of shares and duplicates thereof when necessary shall be issued under the seal of the Company and signed by two Directors, or by one Director and the Secretary. **Certificates**

19. The Company shall not be bound to issue more than one share certificate in respect of a share or shares held jointly by two or more persons, and delivery of a share certificate to any one of joint-holders shall be sufficient delivery to all. **Only one certificate for each share**

20. The Company shall, within ninety days, after the allotment of any of its shares, and within forty five days after the date on which the application for the registration of a transfer has been lodged, complete and have ready for delivery the certificates of all shares, allotted or transferred, and shall serve notice to the shareholder, unless the conditions of issue of the shares otherwise provide. **Delivery of certificate**

21. If any certificate be worn out, defaced, destroyed or lost or if there is no further space on the back thereof for endorsement of transfers, it may be replaced on payment of such fee, not exceeding five rupees, as the Directors may from time to time prescribe, provided, however, that such new certificate shall not be granted except upon delivery of the worn out or defaced or used up certificate for the purpose of cancellation or upon proof of destruction or loss to the satisfaction of the Directors and on such indemnity as the Directors may deem adequate in case of certificate having been lost or destroyed. Any replaced certificates shall be marked as such. **Replacement of certificate**

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22. If and whenever as a result of an issue of new shares or any consolidation or sub-division of shares any Member becomes entitled to hold shares in fraction, the Directors shall not be required to issue such fractional shares and shall be entitled to sell these shares at a reasonable price and pay and distribute to and amongst the Members entitled to such fractional shares in due proportion the net proceeds of the sale thereof. **Proceeds from fractional shares**

23. For the purpose of giving effect to any sale under Article 22 the Directors may authorize any person to transfer the shares sold to the purchaser thereof, and the purchaser shall be registered as the holder of the shares comprised in any such transfer, and he shall not be entitled to see the application of the purchase money nor shall his title to the shares be affected by any irregularity or invalidity in the proceedings in reference to the sale. **Sale of whole shares in lieu of fractional amount**

COMMISSION AND BROKERAGE

24. The Company may, subject to the Ordinance, at any time, pay commission or brokerage to any person for subscribing or agreeing to subscribe (whether absolutely or conditionally) for any shares or securities of the Company, or procuring or agreeing to procure such subscriptions (whether absolute or conditional). **Commission and brokerage**

25. The Company may issue shares or grant option to convert into shares against loans, indebtedness, debenture and/or redeemable capital or other security in the manner provided in Section 87 of the Ordinance. **Shares in lieu of debentures etc.**

TRANSFER AND TRANSMISSION OF SHARES

26 a) No transfer of share will be made by a Member except to his parents, sisters, spouse and any or all his/her children and except by a company, which shall be a shareholder, to its employees, nominees, subsidiary or associated companies. **No sale or transfer of shares**

b) A share may at any time be transferred by a Member or other person entitled to transfer, provided it is approved by the Board and except in respect of transfer of shares sought to be made under Article 26(a) above, the Directors may at their absolute and uncontrolled discretion decline to register any transfer of shares and shall not be bound to give any reason for such refusal.

c) A person proposing to transfer any shares, shall give a notice in writing to the Company (hereinafter called the transfer notice), that he desires to transfer the same. Such notice shall constitute the Company his agent (other than managing agents) for the sale of the shares to any Member of the Company at the fair value. The transfer notice shall not be revocable except with the sanction of the Directors.

d) The Company within sixty days of the date of service of the transfer notice find a Member or Members willing to purchase the shares at the fair value.

e) The fair value shall be such price as may be mutually agreed upon between the Member intending to sell and the purchaser, or in default of agreement, the fair value as at the date when the outgoing Member became bound as aforesaid, shall be fixed by the auditors for the time being of the Company. Either party may upon the outgoing Member becoming bound as aforesaid, apply to the Company to have the fair value fixed by the auditors and the auditors shall thereupon certify the sum which in their opinion is the fair value and in so certifying the auditors shall be considered to be acting as experts and not as arbitratots; and accordingly the Arbitration Act, 1940, shall not apply. The fees of the auditors for determining the fair value and for giving a certificate as aforesaid shall, unless the Company shall otherwise resolve, be paid by the outgoing Member and shall be a debt due from him to the Company.

f) If in any case the proposing transferor after having become bound as aforesaid makes default in transferring the share(s), the Company may receive the purchase money and shall thereupon cause the name of purchasing Member to be entered in the Register as the holder of the shares, and shall hold the purchase money in trust for the proposing transferor. A receipt by the Company in respect of the purchasing consideration shall be a good discharge to the purchasing Member, and after his name has been entered in the Register in purported exercise of the aforesaid power, the validity of the proceedings shall not be questioned by any person.

g) If the Directors shall not within the space of 60 days after being served with the transfer notice, find a Member willing to purchase the shares, the proposing transferor shall at any time within 60 days thereafter be at liberty to sell the shares to any person at any price.

h) Subject to the provisions of the Ordinance and these Articles Directors shall not refuse to transfer any fully paid shares.

Restriction on transfer

27. Subject to the provisions of the Ordinance and Article 26 hereof, no transfer of shares shall be registered unless a proper instrument duly stamped and executed by the transferor and the transferee has been delivered to the Company together with the certificate or certificates of the shares. The instrument of transfer of any shares shall be in the common form and shall be signed both by the transferor and transferee and shall contain the name and address of the transferor and transferee. The transferor shall be deemed to remain the holder of such share until the name of the transferee is entered in the Register in respect thereof. Each signature to such transfer shall be duly attested by the signature of one witness who shall add his address and occupation.

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28. Application for the registration of transfer of shares may be made either by the transferor or the transferee and subject to the provisions of Article 27 hereof, the Company shall enter into Register of Members, the

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name of the transferee in the same manner and subject to the same conditions as if application for registration was made by the transferee.

Notice of refusal to register

29. If the Directors refuse to register the transfer of any shares they shall within 30 days from the date on which the transfer was lodged with the Company send to the transferee and the transferor notice of such refusal.

Time limit for registering transfer

30. Upon the re-lodgment of instruments of transfer duly rectified from defect or the invalidity, the Company shall within 45 days thereof, register such transfer in favour of the transferee, if satisfied as to the validity of the transfer in all material respects.

Evidence of transmission and powers to refuse registration of transmission

31. Every transmission of share shall, if so required by the Directors, be evidenced by an instrument of transmission in such form and shall be verified in such manner as the Directors may require. The Directors may decline to register any such transmission unless it shall be in such form and so verified and the regulations of the Company complied with. All instruments of transmission which shall be registered shall remain in the custody of the Company for such period as the Directors may determine. Any instrument of transmission which the Directors may decline to register or act upon shall be returned to the person depositing the same.

Registration of transfer when instrument of transfer is lost.

32. Where it is proved to the satisfaction of the Directors that an instrument of transfer duly signed by the transferor and the transferee has been lost, the Company may, if the Directors shall think fit, by an application in writing made by the transferee and bearing the stamps required by an instrument of transfer, register the transfer on such terms as to indemnity as the Directors may think fit.

Fee for transfer

33. No fee will be charged for registering transfer of shares.

Books and Register may be closed

34. The transfer books and Register of Members may be closed for any time or times not exceeding in the whole forty-five days in each year, but not exceeding thirty days at a time, in accordance with the manner specified in Section 151 of the Ordinance.

Nomination and share of Deceased Members

35. The nominee, if any, appointed under Section 80 of the Ordinance, or the executor or administrator of the estate or holder of succession certificate of the securities of a deceased Member shall be the only person recognized by the Company as having title to his shares. In case of joint-holders, the surviving holders or the executors or administrators of the estate of or holders of succession certificate of the security of the last surviving holder shall be the only person entitled to be so recognized. Provided nevertheless that it shall be lawful for the Directors in their absolute discretion to dispense with the production of probate or letters of

administration or succession certificate upon such terms as to indemnity or otherwise as the Directors may deem fit.

36. No person shall be recognized by the Company as holding any share upon any trust and the Company shall not be bound by or recognize any equitable, contingent, future or partial interest in any share, or any interest in any fractional part of a share or (except only as by law required or under an order of court) any other right in respect of any share, except an absolute right to the entirety thereof in the registered holder. **Company may not recognize equitable rights in shares**

GENERAL MEETINGS

37. A General Meeting to be called Annual General Meeting shall be held, in accordance with the provisions of Section 158, within eighteen months from the date of incorporation of the Company and thereafter at least once in every calendar year within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding Annual General Meeting. A General Meeting shall be held on a date, time and place as may be determined by the Directors. **General Meeting**

38. The Directors may, whenever they think fit, and shall on the requisition of the holders of not less than 10% of the issued capital of the Company, forthwith proceed to convene an Extra-Ordinary General Meeting of the Company and in case of such requisition, the provisions of Section 159 of the Ordinance shall apply. **When an extra ordinary meeting to be called**

NOTICE OF MEETING

39. Subject to the provisions of Section 158 and 159 of the Ordinance twenty-one days notice at least (exclusive of the day on which the notice is served or deemed to be served, but inclusive of the day for which notice is given) shall be given specifying the place, the day and the hour of meeting. In case of special business the general nature of that business shall be given in manner hereinafter provided or in such other manner, if any, as may be prescribed by the Company in General Meeting or in the manner permitted by the Ordinance, to such persons as are under the Ordinance or under these Articles, entitled to receive such notice from the Company. **Notice of meeting**

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40. An accidental omission to give notice of a Meeting to or the non-receipt of notice of a Meeting, by any person entitled to receive notice shall not invalidate the proceedings of the meeting. **Omission to give notice not to invalidate proceedings**

41. With the consent in writing of the Members entitled to receive notice of an Extra-Ordinary General Meeting, that meeting may be convened by **Meeting by a shorter notice**

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such shorter notice and in such manner as the Members may deem fit subject to approval of application of Directors by the Registrar of Companies.

PROCEEDINGS AT GENERAL MEETINGS

42. The business of an Annual General Meeting shall be to receive and consider the financial statements and the reports of the Directors' and of the Auditors, to elect Directors, to declare dividends and to appoint Auditors and fix their remuneration. All other business transacted at an Annual General Meeting, and all business transacted at an Extra Ordinary General Meeting shall be deemed special. **Special business**

43. No business shall be transacted at any General Meeting unless a quorum is present at the time when the meeting proceeds to business and throughout its proceedings. Two Members personally present at the meeting representing not less than twenty-five percent of the total voting power of the Company, either of their own account or as proxies shall be a quorum. **Quorum**

44. If within half an hour from the time appointed for the Meeting a quorum is not present, the Meeting, if convened on the requisition of Members, shall be dissolved. In any other case it shall stand adjourned to the same day in the next week, at the same time and place and if at such adjourned Meeting a quorum is not present within half an hour from the time appointed for holding the Meeting, the Members present shall be a quorum. **Quorum within half an hour**

45. The Chairman if any, of the Board of Directors shall preside at every General Meeting of the Company, or if there is no such Chairman, or if he shall not be present within fifteen minutes after the time appointed for the holding of the Meeting or is unwilling to act, the Directors present shall elect one of their Member to be Chairman of the meeting, or if no Directors be present or if Directors present decline to take the chair, the Members present shall choose one of their number to be Chairman of the meeting. **Chairman to preside**

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46. The Chairman may with the consent of any Meeting at which a quorum is present (and shall if so directed by the meeting), adjourn the meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place. **Adjournment by Chairman**

47. At a General Meeting, a resolution put to the vote shall be decided on a show of hands, unless a poll is (before or on the declaration of the show of hands) demanded in accordance with the provisions of Section 167 of the Ordinance as follows: **Poll when demanded**

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a) by the Chairman of the meeting of his own motion; or

b) in the case of a private company, by one Member having the right to vote on the resolution and present in person or by proxy if not more than seven such Members are personally present, and by two such Members present in person or by proxy if more than seven such Members are personally present;

c) by any Member or Members present in person or by proxy and having not less than one-tenth of the total voting power in respect of resolution;

Unless a poll is so demanded, a declaration by the Chairman of the meeting that a resolution has on a show of hands been carried or carried unanimously or by a particular majority, or lost, and an entry to that effect in the book containing the minutes of the proceedings of the Company, shall be conclusive evidence of the fact without proof of the number or proportion of the votes recorded in favour of or against such resolution.

48. If a poll is demanded on any matter other than the election of a Chairman or on a question of adjournment, it shall be taken in accordance with the manner laid down in Section 168 of the Ordinance at such time, not more than fourteen days from the day on which it is demanded, as the Chairman of the meeting may direct. The results of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded. The demand for a poll may be withdrawn at any time by the person or persons who made the demand. **Poll**

49. The demand of a poll shall not prevent the continuance of the meeting for the transaction of any business other than the question on which the poll has been demanded. **Other business to continue**

50. The Chairman of any meeting shall be the sole judge of the validity of every vote tendered at such meetings. The Chairman present at the taking of poll shall be the sole judge of the validity of every vote tendered at such poll. **Chairman's decision conclusive**

VOTES OF MEMBERS

51. On a poll, every Member present in person or by proxy shall have one vote in respect of each share held by him. On a show of hands, every Member present in person or by proxy shall have one vote. **Votes of Members**

52. In the case of joint-holders the vote of the senior Member present whether in person or by proxy shall be accepted to the exclusion of the votes of the other joint-holders, and for this purpose seniority shall be determined **Rights of senior Members to vote**

by the order in which their names stand in the Register.

53. A Member of unsound mind, or in respect of whom an order has been made by any court having jurisdiction in lunacy, may vote, whether on a show of hands or on a poll, by his committee or other legal guardian and any such committee or guardian may, on a poll, vote by proxy.

Vote in respect of shares of Members of unsound mind

54. On a poll every Member present in person or by proxy shall have one vote in respect of each share held by him.

Poll

55. No objection shall be raised to the qualification of any vote except at the meeting or adjourned meeting at which the vote objected to is given or tendered, and every vote not disallowed at such meeting shall be valid for all purposes. Any such objection made in due time shall be referred to the Chairman of the meeting whose decision shall be final and conclusive.

Objection to qualification of votes to be raised at the meeting

56. On a poll, votes may be given either personally or by proxy.

How votes to be given on a poll

57. The instrument appointing a proxy shall be in writing under the hand of the appointer or of his attorney duly authorized in writing, or, if the appointer is a corporation, under its common seal or the hand of an officer or attorney so authorized. A proxy shall be a Member of the Company.

Instrument of proxy how made

58. The instrument appointing a proxy and the power of attorney or other authority (if any) under which it is signed or a notarial certified copy of that power or authority shall be deposited at the office not less than forty-eight hours before the time for holding the meeting at which the person named in the instrument proposes to vote, and in default the instrument of proxy shall not be treated as valid.

Time for depositing proxy at office

59. An instrument appointing a proxy may be in the following form, or in any other form which the Directors shall approve:

Form of proxy

> I,..of .... being a Member of **LOOTAH ENERGY (PVT.) LIMITED** and holder of Ordinary shares as per Registered Folio No. .... hereby appoint .... of .... as my/our proxy to vote for me/us and on my/our behalf at the annual or extra-ordinary (as the case may be) General Meeting of the Company to be held on the .... day of .... and at any adjournment thereof.
>
> Signed by me this .... day of ....

Signed by the said

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60. The instrument appointing a proxy shall be deemed to confer authority to demand or join in demand for a poll. **Effect of proxy**

61. A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the previous death or insanity of the principal or revocation of the proxy or of the authority under which the proxy was executed, or the transfer of the shares in respect of which the proxy is given, provided that no intimation in writing of such death, insanity revocation or transfer, as aforesaid shall have been received by the Company at the place of the meeting before the commencement of the meeting or adjourned meeting at which the proxy is used. **When vote by proxy valid though authority revoked**

62. Any corporation or body corporate which is a Member of the Company may by resolution of its Directors or other governing body authorize such person as it thinks fit, to act as its representative at any meeting of the Company or of any class of Members of the Company and the person so authorized shall be entitled to exercise the same powers on behalf of the corporation which he represents as that corporation could exercise if it were an individual Member of the Company, present in person. A corporation attending a meeting through such representative shall be deemed to be present at the meeting in person. **Member corporation may appoint representative**

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DIRECTORS

63. The number of Directors to be elected shall be fixed by the Directors, subject to the condition that until otherwise determined by the Company in General Meeting, the number of Directors including Directors nominated by the Company's creditors or other special interests by virtue of contractual arrangements, if any, shall not be less than two and more than nine, including the Chief Executive. **Number of Directors**

64. The following shall be the first Directors of the Company: **First Directors**

1. **NASSER ABDULLAH HUSSAIN LOOTAH**
2. **KHALID MASOOD**

All the first Director(s) who are subject to retirement in terms of the provisions of the Ordinance, shall hold office until the election of Directors in the first Annual General Meeting unless any of them earlier resigns, becomes disqualified as a Director or otherwise ceases to hold office. **Notice for election as a Director**

65. Any person who seeks to contest an election to the office of Director shall, whether he is a retiring Director or otherwise, file with the Company, not later than fourteen days before the date of the meeting at which elections are to be held, a notice of his intention to offer himself for election as a Director, provided that any such person may, at any time, before the holding of elections withdraw such notice. **Manner for electing Directors**

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66. The Directors shall be elected by the Members in General Meeting from amongst the candidates eligible for election in the following manner:

a) Every Member present in person or by proxy or by representative shall have such number of votes as is equal to the product of the number of voting shares held by him and the number of Directors to be elected;

b) The number of votes calculated in accordance with the preceding clause (a) may be given to a single candidate or may be divided between any two or more candidates in such manner as the person voting may choose; and

c) The candidate who gets the highest number of votes shall be declared elected as Director and then the candidate who gets the next highest number of votes shall be so declared and so on until the total number of Directors to be elected has been so elected.

Directors to be Members

67. Save as provided in section 187 of the Ordinance, no person shall be appointed as a Director unless he is a Member of the Company.

Retiring Directors continue to perform functions

68. Retiring Directors shall continue to perform their functions until their successors are elected.

Term of office of Director

69. A Director elected by the Members in General Meeting shall hold office for a period of three years following the date from which his election is effective unless he earlier resigns, becomes disqualified for being a Director or otherwise ceases to hold office.

Remuneration of a Director

70. The remuneration of a Director, shall, from time to time be determined by the Board and unless otherwise determined shall not exceed Rs.500/- per meeting at which the Director shall be present. The Directors shall be paid such travelling, boarding, lodging and other expenses properly incurred by them in or about the performance of their duties or business if any of them has to come to attend the Board or General Meeting of the Company from outstation.

Special remuneration to Directors for performing extra duties

71. Any Director appointed to any executive office including for the purpose of this Article the office of Chief Executive, or to devote special attention to the business of the Company or who otherwise performs extra services, which in the opinion of the Directors are outside the scope of the ordinary duties of the Directors, may be paid such extra remuneration by way of salary, fees, percentage of profits or otherwise as shall from time to time be determined by the Directors and be subject to provisions of any law for the time being in force applicable to the Company.

72. Subject to the provisions of Section 181 of the Ordinance, the Company may at any time, by resolution in General Meeting, remove a Director, appointed under Section 176 or Section 180 or elected in the manner provided for in Section 178 but no such resolution shall be deemed to have been passed if the number of votes cast against it is equal to or exceeds:

Removal of Director

i) the minimum number of votes that were cast for the election of a Director at the immediately preceding election of Directors, if the resolution relates to the removal of Director elected under sub-section (5) of Section 178; or

ii) the total number of votes for the time being computed in the manner laid down in sub-section (5) of Section 178 divided by the number of Directors for the time being, if the resolution relates to removal of Director appointed under Section 176 or Section 180.

73. A casual vacancy occurring among the elected Directors may be filled up by the Directors and in case of Directors nominated under these Articles, by the person who nominated such Directors, but a person so appointed in lieu of an elected Director shall hold office for the remainder of term of the Director in whose place he is appointed. Before filling in any casual vacancy on the Board, the Directors, shall in writing notify their intention of filling such vacancy to the Member or Members, if any, whose interest were represented by the Director vacating office and shall fix a term of not less than fourteen clear days during which such Member or Members may recommend a candidate for appointment as Director to fill the vacancy. If the Member or Members concerned recommend a candidate in writing within the term prescribed, the Directors may appoint him as Director to fill the casual vacancy but upon such recommendation being made no person, other than the candidate recommended by such Member or Members, may be appointed by the Directors to fill the casual vacancy on the Board.

Casual vacancy to be filled by Directors

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74. Any Director who intends to be, or is absent for a period of not less than three (3) months from Pakistan, may, with the approval of the Board, nominate any person to be his Alternate Director. Particulars of such nomination should be filed with the Secretary of the Company. Such Alternate Director during the absence of the appointer from Pakistan, shall be entitled to receive notice of and to attend and vote at meetings of Directors and shall be subject to the provisions contained in these Articles may exercise and perform all such powers, directions and duties as his appointer could have exercised or performed. A Director may at any time by notice in writing to the Company remove an Alternate Director appointed by him. Upon his return to Pakistan or on the death of, or retirement or resignation as Director of the Company, the Alternate Director shall cease to

Alternate Director

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be such provided that if any Director retires but is re-elected at the meeting at which such retirement took effect, an appointment made by him pursuant to this Article which was in force immediately prior to his retirement and re-election shall continue to operate after his re-election as if he had not so retired. All appointments and removals of Alternate Directors shall be effected in writing under the hand of the Director making or revoking such appointment. For the purpose of assessing a quorum in accordance with the provisions of Article 91 hereof, an Alternate Director shall be deemed to be a Director. An Alternate Director may resign as such upon giving thirty (30) days prior notice in writing to the Directors to this effect unless a shorter notice period is allowed by the Board. An Alternate Director need not be a Member of the Company.

Nominated Directors

75. The Company may have Directors nominated by any financial institution or a bank or consortium (hereinafter called institution). Where such institution requires appointment of its nominee as a Director under the terms of granting loans, redeemable capital, subscribing to the Company's debentures or debenture-stock, making bridge financing, or under stipulations that a loan granted shall be converted into shares at the option of either party to the contract or otherwise, such Director shall act as a Director at the pleasure of the institution appointing him. Such Director may be called "Institutional Director" or "Creditor Director" or prefixed by the name of nominating institution. Such Director shall neither be required to hold any qualification shares nor shall be subject to the provisions relating to retirement, removal, qualification, disqualification of Directors, but shall have same rights and privileges and be subject to the same obligations as other Directors of the Company. Institutions nominating a Director may require withdrawal or removal of such Director or upon resignation or death of such Director, such institutions shall have the right to nominate another person in his place.

Chairman

76. The Directors shall elect from amongst themselves from time to time a Chairman of the Board. In the event the position of the Chairman falls vacant or he is held by the Board as not being able to carry out the duties of his office satisfactorily, the Board shall revoke his appointment and appoint another Director to be the Chairman of the Board. The Chairman of the meeting shall be the sole judge of the validity of every vote tendered at such meetings. The Chairman shall have a casting or second vote.

Executive committee of Directors

77. The Directors may from time to time delegate any of their powers to a committee or committees consisting of 2 (two) or more Members of their body or any other person as they think fit. Any committee so formed shall conform to any regulations that may be imposed upon it by the Directors.

POWERS AND DUTIES OF DIRECTORS

78. The business of the Company shall be managed by the Directors, who may pay all expenses incurred in setting up and registering the Company. The Directors may exercise all such powers of the Company as are not by the Ordinance or any statutory modification thereof for the time being in force, or by any other law or these Articles, required to be exercised by the Company in General Meeting. But no regulation made by the Company in General Meeting shall invalidate any prior act of the Directors which would have been valid if that regulation had not been made.

General powers of Directors

79. The Directors may, subject to any limitation or restrictions as the Company in General Meeting may deem fit to impose from time to time, exercise all the powers of the Company to borrow money and to mortgage or charge its undertaking, property, or any part thereof, and to issue securities and debentures whether outright or as security for any debt, liability or obligations of the Company or of any third party.

Borrowing powers of Directors

80. The Directors may from time to time and at any time by power of attorney appoint any company, firm or person or body of persons, whether nominated directly or indirectly by the Directors, to be the attorney or attorneys of the Company for such purposes and with such powers, authorities and discretion (not exceeding those vested in or exercisable by the Directors under these Articles) for such period and subject to such conditions, if any, as they may think fit.

Power to appoint attorneys

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81. A Director of the Company or a firm of which such Director is a partner or a private company in which such Director is a Director or Member may with the consent of the Company in General Meeting hold any office of profit in the Company.

Directors may hold office of profit

82. Subject to the provisions of the Ordinance and in particular section 216 thereof, the Directors shall not be disqualified from contracting with the Company either as vendor, purchaser, or otherwise, nor shall any such contract or agreement entered into by or on behalf of the Company with any company or partnership or in which any Director of the Company shall be a Member or otherwise interested be avoided nor shall any such Director so contracting or being such Member or so interested, be liable to account to the Company for any profit realized by any such contract or arrangement by reason of such Director holding that office or of the fiduciary relation thereby established. However, the nature of his interest shall be disclosed by him at the meeting of the Directors at which the contract or arrangement is determined on, if the interest then exists, or in any other case at the first meeting of the Directors after the acquisition of the interest. A general notice that any Director of the Company is a Director or a Member of any other company or is a Member of any named firm and is to be regarded as

Directors may make contract with the Company

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interested in any subsequent transaction with such company or firm shall as regards any such transaction be sufficient disclosure under this Article. Any such general notice shall expire at the end of the financial year in which it is given.

83. In accordance with the provisions of Section 219 of the Ordinance, a Register shall be kept by the Directors in which shall be entered particulars of all contracts or arrangements to which Article 87 applies and which shall be open to inspection by any Member at the office during business hours. **Register of contract with Directors**

84. All cheques, promissory notes, drafts, bills of exchange and other negotiable instruments, and all receipts for moneys paid to the Company, shall be signed, drawn, accepted, endorsed or otherwise executed, as the case may be, in such manner as the Directors shall from time to time determine. **Manner of signing certain documents**

85. The Directors shall duly comply with the provisions of the Ordinance and in particular with the provisions with regard to the registration of the particulars of mortgages and charges affecting the property of the Company or created by it. **Directors to comply with the law**

86. The Director shall keep a Register of Directors and Managers and send to the Registrar all Returns and Statements required under the Ordinance, and in particular an Annual List of Members and a summary of particulars relating thereto and notice of any consolidation or increase of share capital and copies of special resolutions and a copy of the Register of Directors, officers, chief executive, secretary, chief accountant, auditors and legal advisers and any changes therein. **Register of Directors, etc.**

87. The Company shall cause minutes to be made in books provided for the purpose : **Company to cause minute books to be maintained**

a) of the names of the Directors present at each meeting of the Directors and of any Committee of the Directors;

b) of all resolutions and proceedings of all meetings of the Company, and of the Directors and of Committee of Directors; and every Director present at any meeting of Directors or Committee of Directors shall sign his name in a record to be kept for the purpose and any such minutes of such a meeting if purporting to be signed by the Chairman thereof, or by the Chairman of the next succeeding meeting of the same body, shall be sufficient evidence without any further proof of the facts and proceedings therein stated.

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DISQUALIFICATION OF DIRECTORS

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88. The office of Director shall be vacated if:-

Vacation of office of Director

a) he becomes ineligible on any one or more grounds enumerated in Section 187 of the Ordinance;

b) he absents himself from three consecutive meetings of the Directors or from all meetings of the Directors for a continuous period of three months, whichever is the longer, without leave of absence from the Board of Directors;

c) he or any firm of which he is a partner or any private company of which he is a Director without the sanction of the Company in General Meeting accepts or holds any office of profit under the Company other than that of chief executive or a legal or technical adviser or a banker or accepts a loan or guarantee from the company in contravention of Section 195 of the Ordinance;

d) he acts in contravention of Section 195 of the Ordinance;

e) he has been convicted by the Court of competent jurisdiction for an offence involving moral turpitude;

f) he resigns his office by notice in writing to the Company;

g) he has betrayed lack of fiduciary behavior and a declaration to this effect has been made by the Court under Section 217 of the Ordinance;

h) he is found to be of unsound mind by a court of competent jurisdiction;

i) he is adjudged an insolvent.

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PROCEEDINGS OF DIRECTORS

89. The Directors may meet together for the dispatch of business, adjourn or otherwise regulate their meetings, as and where subject to the provisions of the Ordinance, they may deem fit. However, the Board shall meet at least twice in a year and at such other time as may be deemed necessary by any Member of the Board or by the Board for the conduct of the business of the Company. A Director may, and the Secretary on the requisition of a Director(s) shall, at any time, summon a meeting of Directors. Notice of meeting of the Board shall be given at least ten days

Directors may regulate Meetings

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prior to the proposed date of meeting which may be dispensed with if the majority of the Members of the Board are willing to accept a shorter notice. However, it shall not be necessary to give notice of a meeting of Directors to any Director for the time being absent from Pakistan.

Quorum

90. The quorum necessary for the transaction of the business of the Directors may be determined by the Directors and unless so determined, shall be not less than one-third of the number of Directors for the time being or two whichever be higher.

Matters to be decided by majority vote

91. All questions arising at any meeting of Directors shall be decided by a majority of votes. In the case of an equality of votes, the Chairman of the meeting shall have a second or casting vote.

Procedure of continuing Directors when there are vacancies to be filled

92. The continuing Directors may act notwithstanding any vacancy in their body, but if and so long as their number is reduced below the quorum required under these Articles, the continuing Directors may act only for the purpose of filling vacancies in their body or summoning a General Meeting of the Company, as the case may be.

Acts of Directors to be valid if defect discovered afterward

93. All acts done at any meeting of the Directors or of committee of Directors or by any person acting as a Director, shall, notwithstanding that it be afterwards discovered that there was some defect in the appointment of any such Directors or persons acting as aforesaid, or that they or any of them were disqualified, be as valid as if every such person had been duly appointed and was qualified to be a Director.

Resolution by Circulation

94. A resolution consented to in writing or by e-mail, telex or facsimile signed by all the Directors or their alternatives, shall be as valid and effectual as if it has been passed at a meeting of the Directors duly called and constituted. The consent may be in the form of counterparts.

Election of Chairman for the meeting

95. If at any meeting the Chairman is absent, or is unwilling to act, the Directors may elect one of their number to act as the Chairman of the meeting.

CHIEF EXECUTIVE

Company to have chief executive

96. The Directors shall within 15 days of the incorporation of the Company or 14 days from the date of election of Directors or the office of the Chief Executive falling vacant, as the case may be, appoint, subject to the provisions of Section 198 of the Ordinance, a Chief Executive of the Company.

Tenure of chief executive

97.(a) The period for which the Chief Executive shall be appointed shall not exceed three years, unless he ceases to hold office or a shorter time of appointment is fixed by the Directors, or he earlier resigns or his services as Chief Executive has been terminated by the Board in accordance with the provisions of the Ordinance. On the expiry of his term of office, the Chief Executive shall be eligible for re-appointment in the manner provided in these Articles and in accordance with the provisions of the Ordinance. The terms and conditions of appointment of the Chief Executive, including his powers, duties, obligations and remuneration, shall be determined by the Directors, subject to the provisions of the Ordinance and these Articles.

Terms, conditions, power & duties of chief executive

(b) The Chief Executive shall exercise such powers, duties, obligations and privileges as the Directors may confer upon him from time to time and shall accordingly in exercise of such powers delegated to him, conform to any limits and restrictions which may be imposed by the Directors from time to time in this respect.

Emoluments of the Chief Executive removal of chief executive

98. The Chief Executive shall be entitled to remuneration, perquisites and benefits as may be determined by the Directors from time to time.

99. The Chief Executive may be removed in accordance with the provisions of Section 202 of the Ordinance.

SECRETARY

Secretary

100. A Secretary may be appointed by the Directors for such term, at such remuneration and upon such conditions as they may think fit, and any Secretary so appointed may be removed by them. Where there is no Secretary capable of acting, the Directors may appoint an Assistant or Deputy Secretary or any other officer of the Company to perform the duties of Secretary.

THE SEAL

Common seal of Company

101. The Directors shall provide for the safe custody of the seal which shall only be used by the authority of the Directors, and every instrument to which the seal shall be affixed shall either be signed by one Director and countersigned by the Secretary or by a second Director or by some other person appointed by the Directors for the purpose.

DIVIDENDS AND RESERVES

Company may declare a

102. The Company in General Meeting may declare a dividend, but no

dividend shall exceed the amount recommended by the Directors. **dividend**

103. No dividend shall be paid by the Company otherwise than out of profits or reserves of the Company or in contravention of Section 248(2) of the Ordinance. **Dividend payable from profits only**

104. The Directors may from time to time pay to the Members such interim dividend as appear to the Directors to be justified by the profits of the Company. **Interim dividend**

105. The profits of the Company available for appropriation / distribution after making such provisions and transfers to reserve as shall be required to meet expenses or anticipated expenses of the Company, subject to the provisions of the Ordinance, shall be appropriated and distributed periodically and/or annually by way of dividend, in cash or specie subject to the needs and liquidity position of the Company as recommended/determined by the Directors to the Members of the Company in accordance with respective shareholding. **Reserve fund**

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106. When any shareholder is indebted to the Company, all dividends payable to him or a sufficient part thereof, may be retained and applied by the Directors in or towards satisfaction of the debt. **Dividends to shareholder, indebted to the Company**

107. Any dividend, interest or other moneys payable in cash in respect of shares may be paid by cheque or warrant sent through the post direct to the registered address of the holder or, in the case of joint-holders, to the registered address of that one of the joint-holders who is first named in the Register or to such persons and to such address as the holder or joint-holders may in writing direct. Every such cheque or warrant shall be made payable to the order of the person to whom it is sent. Any one or more joint-holders may give effectual receipt for any dividends, bonuses, or other moneys payable in respect of the shares held by them as joint-holders. The dividend shall be paid within the period laid down in Section 251 of the Ordinance. **Payment of dividends**

108. Unpaid dividends shall not bear interest against the Company. **Unpaid dividend shall not bear interest**

CAPITALIZATION OF PROFITS

109. The Company in General Meeting may, upon the recommendation of the Directors, resolve that it is desirable to capitalize any part for the time being of the Company's reserves or accumulated profits otherwise available for distribution, and accordingly that such sum be set free for distribution amongst the Members who would be entitled thereto if distributed by way of dividend and in the same proportion on condition that the same be not paid **Capitalization of profits**

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in cash but be applied in paying up in full un-issued shares of the Company to be allotted and distributed/credited as fully paid up to and amongst such Members in the proportion aforesaid, or partly in the one way and partly in the other, and the Directors shall give effect to such resolution.

ACCOUNTS

110. The Directors shall cause proper books of account to be kept as required by Section 230 of the Ordinance. **Books of account**

111. The books of account shall be kept at the registered office of the Company subject to Section 230 of the Ordinance and shall be open to inspection by the Directors during business hours. **Location of books of account**

112. The Directors shall from time to time determine whether and to what extent and at what time and place and under what conditions or regulations the accounts and books or papers of the Company or any of them shall be open to the inspection of Members not being Directors, and no Member (not being a Director) shall have any right of inspecting any account and book or papers of the Company except as conferred by law or authorized by the Directors or by the Company in General Meeting. **Inspection of books of account**

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113. The Directors shall, as required by Sections 233, 234 and 236, cause to be prepared and to be laid before the Company in General Meeting such financial statements duly audited and reports as are referred to in those sections. **Preparation of annual financial statements and reports**

114. The financial statements and other reports referred to in Article 113 shall be made out in every year and laid before in the Company's Annual General Meeting made up to a date not more than four months before such meeting. The financial statements shall be accompanied by a report of the auditors of the Company and the report of the Directors. **Presentation of financial statements and reports before the Company at the Annual General Meeting**

115. The financial statements shall be audited by the Auditors of the Company and shall be accompanied by a report of the Directors under Section 236 of the Ordinance as to the state of affairs of the Company and as to the amount which they recommend to be paid out of the profits by way of dividends to the Members, and the amount, if any, which they propose to carry to one or more reserves according to the provisions in that behalf herein contained. Every report of the Directors, shall be signed by the Directors in accordance with Sections 236 and 241 of the Ordinance. **Directors' reports**

116. A copy of the financial statements together with reports of Directors and auditors shall, at least twenty one days preceding the Annual General **Copy of financial statements and reports**

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Meeting, be sent to the persons entitled to receive notices of General Meetings, in the manner in which notices are to be given hereunder and a copy thereof shall be deposited at the registered office of the Company for the inspection of Members for a period of twenty one days prior to such meeting.

to be served on registered holder

AUDIT

117. Auditors shall be appointed and their duties regulated in accordance with Sections 252 to 255 of the Ordinance or any statutory modifications thereof for the time being in force. **Auditors**

NOTICES

118. A notice may be given by the Company to any Member either personally or by sending it by post, courier, e-mail, telefax or telex to his registered address. Where a notice is sent in any manner aforesaid, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting, delivering, transmitting, as the case may be, a letter containing the notice, and unless the contrary is proved, to have been effected at the time at which the letter would be delivered in the ordinary course of post/delivery/transmission. **How notice to be served on Members**

119. A notice may be given by the Company to the joint-holders of a share by giving the notice to the joint-holder named first in the Register in respect of the share and a notice so given shall be sufficient notice to all the holders of such shares. **Notice to joint holders**

120. A notice may be given by the Company to the persons entitled to a share in consequence of the death or insolvency of a Member through the post in a prepaid letter addressed to them by name or by the title or representatives of the deceased, or assignee of the insolvent or by any like description, at the address (if any) in Pakistan supplied for the purpose by the persons claiming to be entitled, or (until such an address has been so supplied) by giving the notice in any manner in which the same might have been given if the death or insolvency had not occurred. **Notice to persons entitled by transmission**

121. Notice of every General Meeting shall be given at least 21 days before the date fixed for the meeting in the manner herein before authorized to (a) every Member of the Company, except those Members who have no registered address or have not supplied to the Company an address for the giving of notice to them, and also (b) every person entitled to a share in consequence of the death or insolvency of a Member, who but for his death or insolvency would be entitled to receive notice of the meeting (c) by publication as required under Section 158(3) of the Ordinance if the **Notice of General Meeting**

Company becomes a listed Company; and (d) to the auditors of the Company.

WINDING UP

122(1) Subject to the provisions of the Ordinance, if the Company is wound up, the liquidator may, with the sanction of a special resolution of the Company and any other sanction required by the Ordinance, or by the Court divide amongst the Members, in specie or kind the whole or any part of the assets of the Company, whether they consist of property of the same kind or not. **Division of assets**

(2) For the purpose aforesaid, the liquidator may set such value as he deems fair upon any property to be divided as aforesaid and may determine how such division shall be carried out as between the Members or different classes of Members.

(3) The liquidator may, with the like sanction vest the whole or any part of such assets in trustees upon such trusts for the benefit of the contributories as the liquidator, with the like sanction, thinks fit, but so that no Members shall be compelled to accept any shares or other assets, securities whereon there is any liability.

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SECRECY

123. Save as otherwise provided in the Ordinance no Member or other person (not being a Director) shall be entitled to visit and inspect any of the Company's premises or properties of the Company without the permission of the Directors or to require discovery of or information respecting any detail of the Company's operations, trading or manufacturing or any matter whatsoever which may relate to the conduct of the business of the Company and which in the opinion of the Directors will be expedient in the interest of the Members of the Company not to be communicated to the public. **Secrecy**

INDEMNITY

124. Every Director or officer of the Company and every person employed by the Company as auditors shall be indemnified out of the funds of the Company against all liability incurred by him as such Director, officer or auditor in defending any proceedings, whether civil or criminal, in which judgment is given in his favour, or in which he is acquitted, or in connection with any application under Section 488 of the Ordinance in which relief is granted to him by the court or otherwise permitted by law. **Indemnity**

ARBITRATION

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Arbitration

125. Whenever any difference arises between the Company on the one hand, and any of the Members, their executors, administrators, or assigns on the other hand, in connection with the true intent or construction, or the incidents or consequences of these presents, or of the statutes, or regarding anything then or thereafter done, executed, omitted or suffered in pursuance of these presents, or of the statutes or with regard to any breach or alleged breach of these presents, or any claim on account of any such breach or alleged breach, or otherwise relating to the premises, or to these presents, or to any statute affecting the Company, or to any of the affairs of the Company, every such difference shall be referred under the Arbitration Act 1940 or any other legal enactment in lieu thereof for the time being in force, to the decision of an arbitrator to be appointed by the parties in differences, or if they cannot agree upon a single arbitrator, to the decision of two arbitrators, of whom one shall be appointed by the Company and the other by the parties in difference, or an umpire to be appointed by the two arbitrators. The cost of, and incident to, any such reference and award shall be in the discretion of the arbitrators, or umpire respectively, who may determine the amount thereof, or direct the same to be allocated between attorney and client or otherwise, and may award by whom, and to whom, and in what manner the same shall be borne and paid.

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DISPUTE RESOLUTION

Dispute Resolution

126. In the event that a dispute, claim or controversy arises between the Company, its management of its shareholders, or between the shareholders inter-se, or the directors inter-se, all steps may be taken to settle the dispute and resolve the issue through mediation by an accredited mediator before taking recourse to formal dispute resolution such as arbitration or litigation.

MISCELLANEOUS

Companies Ordinance to prevail

127. If the provisions of these Articles are in any way inconsistent with the provisions of the Ordinance, or any other law for the time being in force, the provisions of the Ordinance or that other law shall prevail, and these Articles shall be read subject to that Ordinance or that other Law.

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We, the several persons whose names and addresses are hereunder subscribed, are desirous of being formed into a Company, in pursuance of this **Articles of Association**, and we respectively agree to take the number of shares in the capital of the Company set opposite our respective names:

S. No.	Name, Surname and Father's Name (present & former) in full (in Block Letters) and CNIC/ PASSPOART No.	Occupation & Nationality (ies) with any former Nationality	Residential address in full	Number of shares taken by each subscriber	Signatures
1	**NASSER ABDULLAH HUSSAIN LOOTAH S/o. ABDULLAH HUSSAIN LOOTAH** **PASSPORT # [illegible]**	**BUSINESS EXECUTIVE** **UNITED ARAB EMIRATES (UAE)**	**H. NO. 55, AL-MAMZAR PARK, AL-HAMRIAH, DERA DUBAI. (UAE)**	80 (Eighty)	
2	**KHALID MASOOD S/o. MASOOD HASAN ZAIDI** **CNIC #. 42301-3778143-9**	**BUSINESS EXECUTIVE** **PAKISTANI**	**H. NO. 80/2, 25TH STREET, KHYABANA-E-HILAL, PHASE-6, DHA, KARACHI.**	20 (Twenty)	
			Total number of shares taken	100 (Hundred)	

Dated the **09** day **February** of **2016**
Witness to above signatures.

Signatures:

Full Name. MUHAMMAD ABDUL ALEEM

Father's/Husband's Name MUHAMMD ABDUL HALEEM

Full Address: FLAT NO. A-212, LARAIB GARDEN, GULSHAN-E-IQBAL, BLOCK-I, KARACHI.

CNIC Number: 42201-5695328-1

Occupation: PRIVATE SERVICE

9/8/17

Registrar, Karachi
Company Registration Office
Securities and Exchange Commission of Pakistan

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لوتاه إنيرجي (بيت) لمتد.

Lootah Energy (Pvt) Ltd.

Company Profile

His Excellency Nasser Abdulla Lootah - Chairman

His Excellency Nasser Abdulla Lootah is the chairman of Nasser Abdulla Lootah Group. Headquartered in Dubai, Nasser Abdulla Lootah Group is one of the largest diversified groups in the Middle East region founded more than 25 years ago. H.E. Nasser Abdulla Lootah is also the chairman of Summit Bank (Pakistan) and of Emirates Park Limited (a 50 000 acre horse breeding facility in Australia). Dubai Islamic Bank was founded by the Lootah family and he is a major shareholder.

His Excellency was also the head of the Ruler's Court of Dubai for more than 35 years.

Nasser Abdulla Lootah Group provides innovative technologies and comprehensive know-how to benefit customers in the Gulf countries, and is active in the areas of Travel, Shipping, Cargo, Logistics, Mineral Water, Real Estates, Trading, Finance, Information Technology, Interactive Media, Production and Brand Media Communication. Guided by the visionary leadership of His Excellency Nasser Abdulla Lootah, the group has continued to develop, innovate, fortify and find new ways to gain greater confidence in their clients, associates and employees.

His Excellency is a sponsor(local UAE partner) for numerous international brands and prestigious multinational companies like Brookfield Multiplex (Real Estate Construction), Dubai Lagoon (Real Estate Developer), Mediclinic - Middle East Hospitals, Wilhemsen Shipping Company, Zurich International and Qatar General Insurance Company.

His net worth encompasses various real estate properties including hotels, hospitals and residential units worldwide. Soon a 53 storey Tower belonging to His Excellency will fancify the skyline over Sheikh Zayed Road within close proximity of Downtown Dubai, Burj Khalifa.

لوتاه إنيرجي (بت) لت.

Lootah Energy (Pvt) Ltd.

Chairman's Message

It has always been my vision to provide better lives for the people of United Arab Emirates & Pakistan by touching every facet of human existence. Today, 35 years later, this humble mission has extended beyond the borders of this country, far more than I've ever imagined. Nasser Abdulla Lootah Group was established to serve and make life easier and more comfortable for people from all walks of life by offering total solutions for travels and tours; providing unequalled service in the cargo and logistics industry; improving the quality of life through education, health, comfortable and economical domicile, manufacture and distribution of pure and safe drinking water and other consumer goods; and finally, offering relaxation and leisure through falconry, horse breeding and racing. The Management and Staff of Nasser Abdulla Lootah Group strive to create more services and goods, set higher standards and to continue the Groups commitment towards an improved and enhanced way of life. As the Chairman of the Group, I would like to take this opportunity to thank all our partners, customers, associates and staff for their continuous and dedicated effort, trust and support, which has propelled Nasser Abdulla Lootah Group to where it is today.

H.E. Nasser Abdulla Hussain Lootah

لوتاه إنرجي (بت) لت.

Lootah Energy (Pvt) Ltd.

CEO Message

Nasser Abdulla Lootah Group has a rich history of accomplishments and achievements never before encountered in the various industries we are part of. Our leading pace has always been accredited to our culture, with a deep understanding that in order to improve the lives of our clients it must reflect in our internal working culture. Our teams understand that how we operate is just as crucial as what we accomplish. It is through the spirit of teamwork and strong sense of vision that we stride towards our goals.

Operational agility and adaptability are essential in order to keep up with the speed of change in the modern world and pivot across all areas of business.

From here on our endeavor is to become a truly global company, with the goal of entering a new growth stage identifying industries and countries in need to assistance to develop untapped resources, be it energy or real estate, while carrying on our commitment to innovation as a customer-oriented, development-driven company.

Hand in hand we stride ahead in the journey as pioneers in this fast paced environment as we pave the way towards creating value for all our stakeholders and truly honor our vision towards creating a culture based on our heritage of hospitality, collaboration and professional approach, hence paving a pathway for the progression and advancement of clients, employees and our resources.

Lootah Energy (Pvt) Ltd.

ABOUT US:

Lootah Energy Pvt. Ltd. is an incorporated company based in Pakistan under Nasser Abdulla Lootah Group Dubai UAE. Lootah Energy Pvt. Ltd. is engaged in wind energy development.

The wind farm will be located at a wind corridor in Jhimpir Thatta Sindh, on a 1000 acre of land. Lootah energy has obtained government approvals and is now in the process of developing this area with the intent of putting it to the purpose of generation of renewable energy.

Plans are underway to make 50 megawatts wind farm project on 1000 acres, the initial plan of the business is to mount 15 wind turbines, for this purpose the required consultants are on board to facilitate.

OUR OBJECTIVE

Our challenge is to look beyond and never be complacent with our achievements, we have created a lasting legacy guided by visionary leadership. Nasser Lootah Group, will continue to develop, innovate, fortify and find new ways to gain greater confidence. Constantly seeking out to build new partnership while secure higher levels of trust in our clients, associates & employees.

OUR VISION AND FOCUS

Our Mission

To accentuate our golden era of professional services in every field, resulting in satisfied clients.

Our Vision

To create a culture based on our heritage of hospitality, collaboration and professional approach, hence paving a pathway for the progression and advancement of clients, employees and our resources.

Our Values

N–Nurture
A–Accomplishments
L–Leadership
G – Growth

MANAGEMENT TEAM IN THE PROJECT

1. H.E. Nasser Abdulla Lootah (Chairman)
2. Khalid Masood (Chief Executive Officer)
3. Najam Farooqui (Technical Advisor)
4. Umer Yousuf (Project Manager)
5. Murtaza Aftab (Chief Financial Officer)
6. Danish Ahmad (Project Coordinator)
7. M. Aleem (Company Secretary)
8. Abdul Samad (office Assistant)

CURRENT STATUS:

- Generation Lincense Applied
- GIS Report Received.
- IEE Study Received.
- NOC from SEPA Received.

Nasser Abdulla Lootah Group

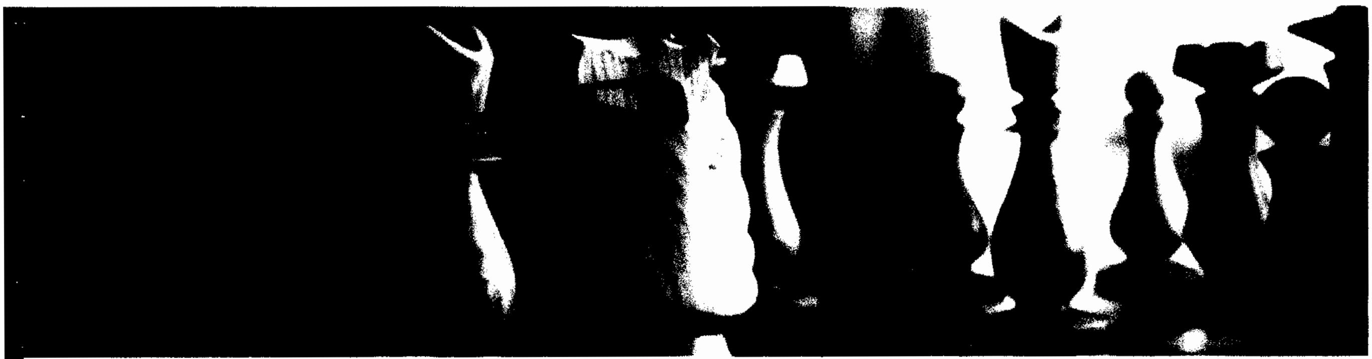
Founded more than 25 years ago, headquartered in Dubai, Nasser Abdulla Lootah Group is one of the largest diversified groups in the Middle East region. The Group provides innovative technologies and comprehensive know-how to benefit customers in the Gulf countries, active in the areas of Travel, Shipping, Cargo, Logistics, Mineral Water, Real Estates, Trading, Information Technology, Interactive Media, Production and Brand Media Communication.

Chairman's Message

It has always been my vision to provide better lives for the people of United Arab Emirates by touching every facets of human existence. Today, 35 years later, this humble mission has extended beyond the borders of this country, far more than I've ever imagined. Nasser Abdulla Lootah Group was established to serve and make life easier and more comfortable for people from all walks of life by offering total solutions for travels and tours; providing unequalled service in the cargo and logistics industry; improving the quality of life through education, health, comfortable and economical domicile, manufacture and distribution of pure and safe drinking water and other consumer goods; and finally, offering relaxation and leisure through falconry, horse breeding and racing. The Management and Staff of Nasser Abdulla Lootah Group strive to create more services and goods, set higher standards and to continue the Groups commitment towards an improved and enhanced way of life. As the Chairman of the Group, I would like to take this opportunity to thank all our partners, customers, associates and staff for their continuous and dedicated effort, trust and support, which has propelled Nasser Abdulla Lootah Group to where it is today.

H.E. Nasser Abdulla Hussain Lootah

Our Objective



Our challenge is to look beyond and never be complacent with our achievements, we have created a lasting legacy guided by visionary leadership. Nasser Lootah Group, will continue to develop, innovate, fortify and find new ways to gain greater confidence. Constantly seeking out to build new partnership while secure higher levels of trust in our clients, associates & employees.

Our Vision and Focus

Our Mission

To accentuate our golden era of professional services in every field, resulting in satisfied clients.

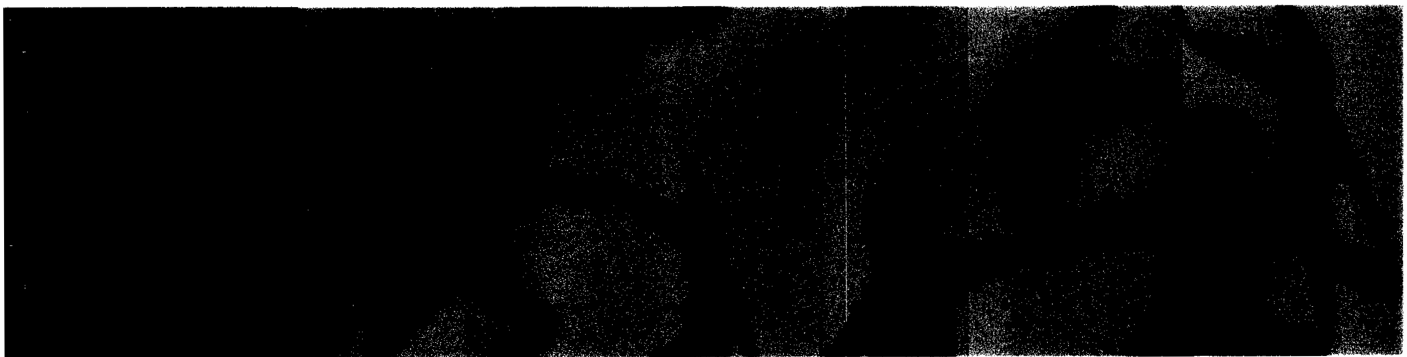
Our Vision

To create a culture based on our heritage of hospitality, collaboration and professional approach, hence paving a pathway for the progression and advancement of clients, employees and our resources.

Our Values

N – Nurture
A – Accomplishments
L – Leadership
G – Growth

Our Companies



Our values are more powerful than ever, we have made progress through out the years in focusing on three key areas Customers, Creativity and Results, all aimed at simplifying our Products and Services and giving us a competitive advantage in moving forward.
We have invested in initiatives that will help drive traffic, deliver inspiring and exceptional services, and enhance our services. We have improved our segments and created distinct products and services for our customers. Each segment is focused on ensuring that the product or service is right from the first point until the end.

EMIRATES

SINCE 1979

One of the earliest entrants in UAE's burgeoning sector, Emirates Natural Drinking Water was established in 1979 with the setting up on an intergraded plant for bottling Natural Mineral Water at Al Bidia, Dibba in Al Fujairah. We started out our production at 4000 cartons a day, and today the capacity has increased to 15,000 a day in 7 sizes. We also manufacture Pet cups specially packed for Airlines, Supermarkets, Clubs, Schools and Hospitals.
Emirates Natural Drinking Water is a local company dedicated to the development of a healthy lifestyle and well being of the people of the UAE and all the other countries where Emirates Water is distributed. Our Water is sold through out the United Arab Emirates and exported to other countries.
As a producer, Emirates Natural Drinking Mineral Water Company pursues efficiency and safety in processing bottled spring water by using advanced technologies and using the finest ingredients to ultimately provide safety and unparalleled health to the residents, expatriates and tourist.

www.emirateswater.ae

NASSER LOOTAH

REAL ESTATE

Nasser Lootah Real Estate believes in delivering extraordinary value & assurance its clientele to find the right property and value for their investment. It offers real estate management, leasing and acting as a broker. Being in the industry for years it has built a reputation, for integrity, trust and confidence among its clients.

www.nlre.ae

وكالات ناصر الجوية والبحرية
NASSER AIR TRAVEL & SHIPPING AGENCIES

Xperienz Holidays

Established in the year 1976, Nasser Travel has been included among the top 20 Travel Agencies in Middle East Region in 2011, according to recent rankings issued by The Arabian Travel News 2011 Power List. Over the years the company has built a formidable reputation with its experience, professionalism and high standards of service.
Nasser Air Travel Agency has further strengthened its hold in the industry by improving its services, updating technologies and adding a new team to serve the growing client base.
With a marketing presence in the whole of middle east and urge to grow worldwide. We will be the most trusted group of services across all the constituencies. We will provide a constant source of original and empowering products and services. We will redefine category norms when it comes to offering the best value. For more information please log on to our web site

www.nasa-travel.ae

LOOTAH
PREMIUM FOODS
SINCE 2012

Lootah Premium Foods has a complete sourcing with the best products to achieve the best of the gastronomy. We are specialized in Fresh food, Organic food, Molecular food and Food services.
We provide the best products and services quality to Five Star Hotels and Palaces.
Sourcing, Purchasing, Logistics and all processes are designed to bring the best gastronomy for chefs and all gourmet customers! Lootah Premium Foods supplies Mass Grocery retail and Hypermarket according to their supply chain process and their strategy.
As well as provides the best services quality to its clients working in the preparation of special events and in transportation such as Airlines companies.

www.lootahpremiumfoods.ae

N-FREIGHT

Nasser Air Travel & Shipping Agencies (NASA) was established in 1976 under the dynamic leadership of His Excellency Nasser Abdulla Lootah. In 2007 company restructured and changed the name to N-FREIGHT. Today it has grown into one of the major shipping and freight forwarding company in United Arab Emirates.
N- FREIGHT offers its clients the kind of flexibility no other forwarder can match. Our wide knowledge of total freight solution gives us an edge that makes transporting your cargo safe, easy and on time. Over the years N- FREIGHT has developed close networking partnerships with likeminded professional freight forwarders in key market worldwide specializing in Air, Sea and Road. Our sound infrastructure consists of efficient handling of equipments and spacious open storage facility for odd size cargo.
N- FREIGHT will deliver highest quality Freight solutions and services, with passion, integrity and innovation. We believe that only through the continuous development of the potential of our people and embracing of their diversity, we can succeed.

www.nfreight.ae

Associated Companies

As a trusted partner, Nasser Abdulla Lootah Group is committed to giving the support required; an unrivalled blend of real-world experience and expertise; and multi-tiered offers and service options.
Our professional services team brings leading practices across multiple industries and functional disciplines, to address your business requirements. Our team will work with you to design the right solution and support the business benefits.
We thrive to progress in excellence in today's highly-competitive market ,delivered by our local teams and support professionals with world-class experience and expertise. Our plans are designed to ensure the highest standard of operational effectiveness.

NASA Structural Systems L.L.C

H.E Nasser Abdullah Hussain Lootah is the Sponsor of NASA Structural Systems. L.L.C Established since 1959 Structural Systems is Australia's leading provider of specialist Engineering and Contracting Services to the construction and Mining industries. Providing services in Formwork, Remedial / Repair, Engineering Design, Mining Ground Support and Environment services to a common client base.

Brookfield Multiplex

In 1997, Nasser Abdulla Lootah Group signed a partnership with Brookfiled Multiplex, Australia's largest commercial contractor. NASA Multiples secured a contract for the construction and finishes of the office tower, car park and podium on the prestigious Emirates Tower project.
Founded 36 years ago, Multiples constructions has several prestigious contracts to its credit, including the Sydney Olympic Stadium. Also the first Australian companies to win major construction contracts across Asia.

Qatar General Insurance & Reinsurance Co.

H.E Nasser Abdullah Husain Lootah is the Sponsor of Qatar General Insurance & Reinsurance Company S.A.Q.
In Dubai, QGIR started operations since 1983 and is registered in the UAE Insurance companies Register in 1984 under the number 43. Since then, QGIR – Dubai has became an effective, reliable, credible and highly imaged insurance player in the UAE, and was and continue to being fully capable of servicing many major accounts and clients in the UAE

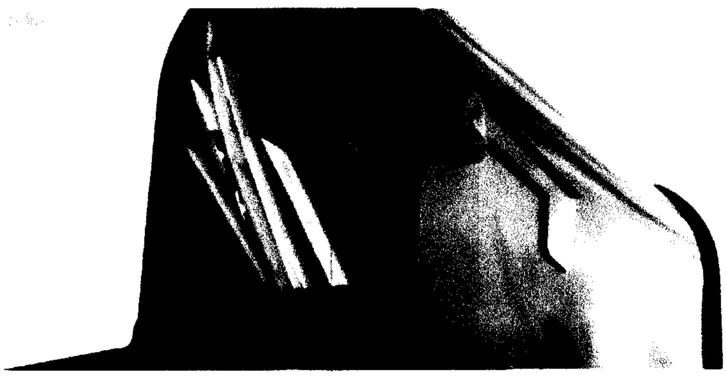
Wilhelmsen Ships Service

H.E Nasser Abdullah Hussain Lootah is a Shareholder of Barber Shipping Dubai Company. Wilhelmsen is one of the leading worldwide shipping agency chains serving over 1500 bulk/tank/gas/chemical cruise principals and insurance companies as well as large number of well-know liner operators.

Mediclinic Welcare Hospital

H.E Nasser Abdullah Hussain Lootah is the Sponsor and Property Owner of Welcare Hospital L.L.C. It was inaugurated by H.H Sheikh Hamdan Bin Rashid Al Maktoum, Deputy Ruler of Dubai & U A E. Minster of Finance & Industry: on May 2, 1998. Centrally located in Al Garhoud, the hospital is managed by internationally qualified, experienced, healthcare professionals and is equipped with state-of-the art technology.

Contact Us



Nasser Abdulla Lootah Group
NASA Building, Al Maktoum Road, Deira Area
P.O. Box 1520, Dubai, United Arab Emirates
Tel: +971 (4) 223 1520, Fax: +971 (4) 223 2348

Email: nalginfo@nalg.ae

www.nalg.ae