



MASTER GREEN ENERGY LTD.

Lahore Office: 82 – C -1, Gulberg III, Lahore.
Tel: +92-42-35752620-22, +92-42-35758524-26
UAN: +92-42-111-666-555, Fax: +92-42-35751905

MGEL/NEPRA/TARIFF/005
May 16, 2017

The Registrar,
National Electric Power Regulatory Authority
NEPRA Tower Attaturk Avenue (East),
Sector G-5/1, Islamabad.

Subject: Submission of application for Generation License for Master Green Energy Limited 50 MW Wind Power Project

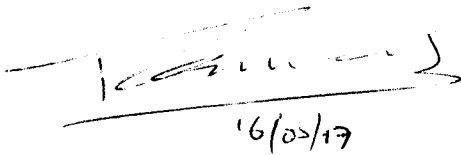
Dear Sir,

We would like to submit herewith our Application for Issuance of Generation License to Master Green Energy Limited. Documents required pursuant to the provisions of National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999 are also attached herewith this application.

The application for Generation License (including its Annexures) is submitted in triplicate.

Yours sincerely,

For and on behalf of
Master Green Energy Limited



'6/05/17

Rumman Arshad Dar
Chief Operating Officer

1 REQUEST FOR GENERATION LICENSE

Under the Regulation of Generation, Transmission and Distribution of Electric Power Act (XL of) 1997 (the **NEPRA Act**) and the National Electric Power Regulatory Authority Licensing (Generation) Rules 2000 (the **Licensing Rules**), the National Electric Power Regulatory Authority (**NEPRA**) is responsible for and has the authority to *inter alia* grant licenses for the generation of electric power and other terms and conditions for the supply of electricity through generation.

Pursuant to Sections 7(2)(a) and 15 of the NEPRA Act, read with other enabling provisions of the NEPRA Act and the Licensing Rules, and in accordance with the RE Policy 2006; Master Green Energy Limited (the **Project Company** or the **Applicant**) hereby submits for NEPRA's kind and gracious consideration, the application for the grant of a generation license along with supporting documents (the **Generation License Application**) for its 50 MW wind power generation facility to be located at District Jamshoro, Sindh, Pakistan (the **Project**).

Given the advanced stage of the Project, NEPRA is kindly requested to process this Generation License Application at the earliest, thereby enabling the Project Company to proceed further with the development process.

This Generation License Application is submitted in triplicate.

2 THE PROJECT

2.1 Project Status

Letter of Intent		✓
Land Allocation		✓
Soil and Topographical Survey		✓
Energy Yield Assessment		✓
Grid Interconnection Study		✓
Arrangement of Financing		Jun 2017
EPC and O&M Contract		Aug 2017
Tariff and Generation License		Dec 2017
Letter of Support		Jan 2018
EPA & IA		Jun 2018
Financing Agreements		Jun 2018

2.1.1 Issuance of Letter of Intent

Master Green Energy Limited, a company duly incorporated and existing under the laws of Pakistan, with its office located at 82 C-1 Gulberg III, Lahore was incorporated on May 12, 2015 to develop, own and operate an approximately 50 MW wind power project in District Jamshoro pursuant to a Letter of Intent dated October 1, 2015 issued by Energy Department Government of Sindh (**EDGOS**) vide its letter No. DAE/Wind/79/2015 (the **LOI**).

2.1.2 Land Allocation

After issuance of LOI, the Project Company identified suitable land for the Project in District Jamshoro, Sindh. The allocation process was completed in January 2016 and a land allocation letter was issued to the Project Company by EDGOS on January 15, 2016. Details of the location of the land are included as part of Schedule I, attached as section 4.1 to this document.

2.1.3 Completion of LOI related milestones

Pursuant to the relevant provisions of the Policy for Development of Renewable Energy for Power Generation 2006 and the LOI, the Project Company completed the detailed technical feasibility study (including soil investigation, topographic survey, transport study and wind resource assessment) and submitted the same to EDGOS for review vide letter dated February 22, 2016. The feasibility study was prepared by Renewable Resources (Pvt.) Limited, the technical consultants hired by the Project Company. A copy of the the feasibility study report is attached as Section 3.11 to this document for reference.

As required under the LOI, a comprehensive Initial Environmental Examination (**IEE**) of the Project was also carried out and the Project Company submitted the same to Sindh Environmental Protection Agency (**SEPA**) on December 15, 2015 for review. After careful analysis of the IEE, SEPA accorded its approval to the Project through its letter No. EPA/2015/12/31/IEE/1001 dated March 22, 2016. A copy of the IEE approval letter from SEPA is attached as section 3.15 to this document.

2.1.4 Grid Interconnection Study

The Project Company was granted permission by National Transmission and Despatch Company (**NTDC**) to use its system data to carry out a grid interconnection study (**Grid Study**) for the Project on July 1, 2017. The Grid Study was carried out by renowned grid consultants Power Planners International and submitted to NTDC for review. A copy of the final Grid Study report is attached as section 3.13 to this document.

The Grid Study was approved by NTDC on April 12, 2017 and Power Evacuation Certificate was issued to the Project Company on April 28, 2017. A copy of both are attached as section 3.14 to this document.

2.1.5 Way forward

The Project is currently at an advanced stage of development and is expected to proceed further on an expedited basis. Once generation license is issued to the Project Company, the Project Company will file for a tariff application pursuant to the tariff regime prevailing at the time.

2.2 The Sponsors

Master Group, the main sponsor of the Applicant (the **Sponsors**), is one of the most dynamic and diverse business groups of Pakistan. The Sponsor started its operations by entering into the bedding industry in 1963 as a licensee of Bayer A.G. (Germany) to manufacture foam mattresses in Pakistan and became a pioneer in the bedding industry.

In the year 1988, the Sponsor entered into the manufacturing and supply of automobile interiors including seats with reclining mechanism and assembly, roof headlining and door trims to renowned OEMs such as Honda, Toyota, Suzuki, Nissan, Daihatsu, Hino and Volvo and today fulfils 70% of the requirements of the OEMs in Pakistan. In 1993, the Sponsor installed its first state of the art weaving unit marking its entry into the textile business.

Today, Master Group has a strong asset base of over USD 300 million and an annually increasing group turnover of more than USD 300 million. The Sponsor is not only the leading player in the bedding market, but has also diversified over the period into the textile, auto and engineering sectors.

The Sponsor is committed to play its part in the development of Pakistan's various sectors. Realizing the role of clean energy in development of the nation, the Sponsor ventured into the power generation sector by developing a 52.8 MW wind power project in Jhimpir, Sindh. Master Wind Energy Limited successfully commenced commercial operation in October 2016. Master Green Energy Limited is the Sponsor's second project in the wind power sector, which is expected to achieve financial close by end 2018.

2.3 Project Costs and Funding Plan

An estimate of the assumed project costs has been determined, based on quotes from market participant and prevailing conditions. The tentative project costs project costs below are in line with the benchmark tariff recently announced by NEPRA for development of wind power projects.

Tentative Project Costs	Mil. USD	Source of Funds	Mil. USD
EPC	82.00	DEBT (75%)	
Interest During Construction	3.00	Foreign	25.00
Project Development Cost	4.00	Local	44.23
Insurance	0.80	EQUITY (25%)	
Financial Charges	2.50	Master Group	23.08
Total	92.30	Total Financing	92.30

25% of the project costs will be injected by Master Group as Equity, while the remaining 75% will be financed through debt. Master Group has adequate resources and financial strength to take on development of the Project, as evidenced in section 3.9.1 of this document. On the debt financing front, National Bank of Pakistan and Meezan Bank Limited have been appointed as Mandated Lead Arrangers for the Project (See attached term sheet attached in section 3.9.6 of this document) . The MLAs have received in- principal commitments for the entire debt amount from the local debt market. Foreign financiers have also shown interest in the project, with USD 25 million of the debt already being committed to be funded by a foreign DFI.



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BOARD RESOLUTIONS

The following resolutions were discussed in detail by the Board and approved unanimously on 15th of April, 2017:

"RESOLVED THAT Master Green Energy Limited (a company incorporated under the laws of Pakistan with its registered office located at 82-C-1, Gulberg III, Lahore, Pakistan) (the Company) be and is hereby authorized to application for Generation License (including any subsequent modifications) for submission to National Electric Power Regulatory Authority for grant of Generation License in respect of its 50 MW wind power generation project to be located at Jamshoro, Province of Sindh, Pakistan (the Project) and in relation thereto, enter into and execute all required documents, make all filings and pay all applicable fees, in each case, of any nature whatsoever, as required."

"FURTHER RESOLVED THAT in respect of filing of application for Generation License (including any subsequent modifications) for submission to National Electric Power Regulatory Authority, **MR. RUMMAN ARSHAD DAR** (Chief Operating Officer) be empowered and authorized for and on behalf of the Company to:

- (i) review, execute, submit, and deliver the application for Generation License (including any subsequent modifications) and any related documentation required by National Electric Power Regulator Authority for the determination of the reference to application for generation license, including any contact, documents, power of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memoranda, amendments, letters, communications, notices, certificates, requests, statements and any other instruments of any nature whatsoever;
- (ii) represent the Company in all negotiations, representations, presentations, hearings, conferences and /or meetings of any nature whatsoever with any entity (including, but in no manner limited to National Electric Power Regulatory Authority, any private parties, companies, partnerships, individuals, governmental and/or semi-governmental authorities and agencies, ministries, boards, departments, regulatory authorities and/or any other entity of any nature whatsoever);
- (iii) sign and execute the necessary documentation, pay the necessary fees, appear before the National Electric Power Regulatory Authority as needed, and do all acts necessary for completion and processing of the application for Generation License including any modifications;
- (iv) do all such acts, matters and things as may be necessary for carrying out the purposes aforesaid and giving full effect to the above resolutions/resolution.



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IN WITNESS THEREOF, I hereunder set my hands as such Secretary and affixed the corporate seal of said company.



Company Secretary



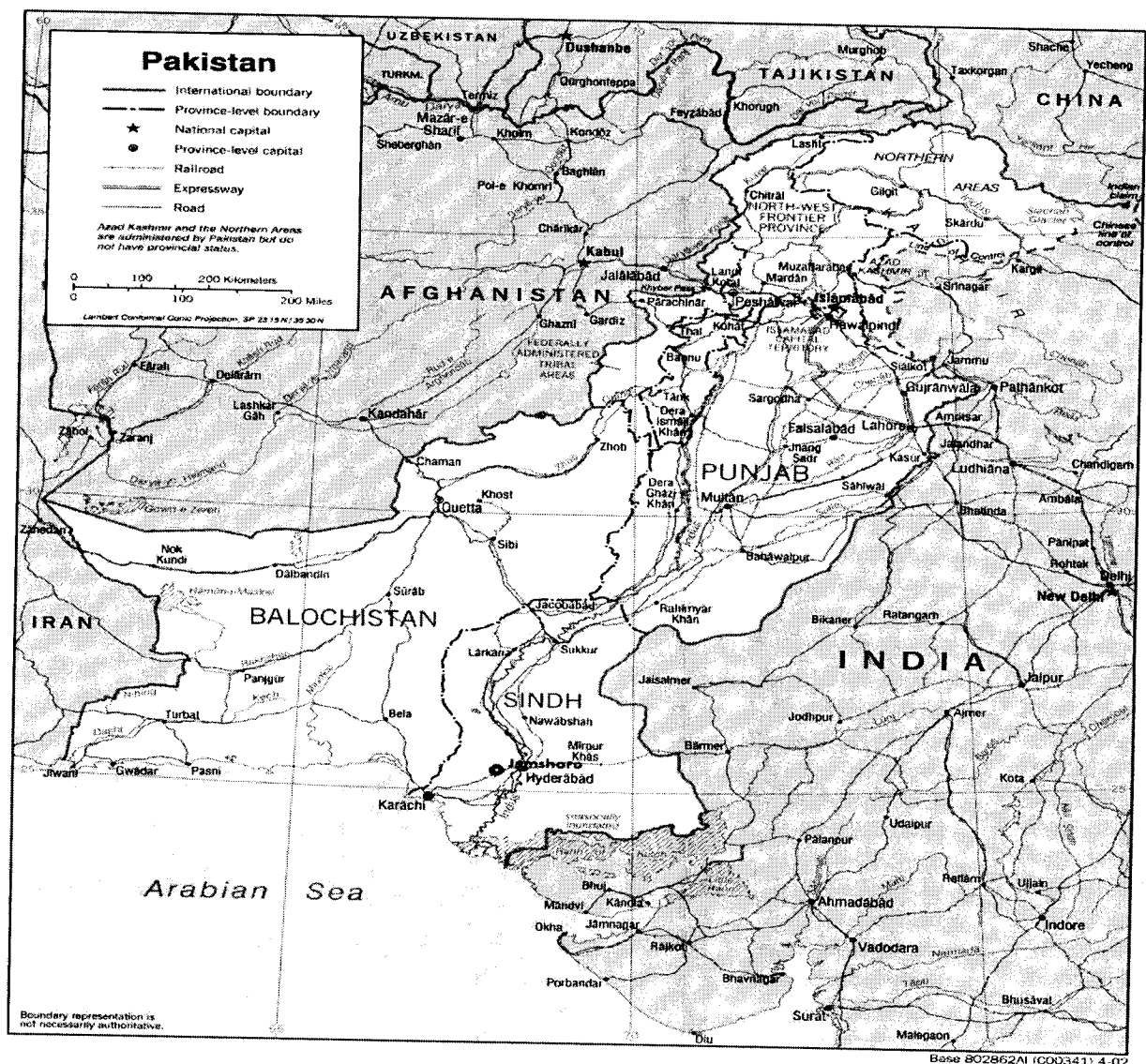
4 TECHNICAL SCHEDULES

4.1 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 Facilities of the License are described in this Schedule.

Site Location of the Generation Facility/Wind Power Plant for Master Green Energy Limited

The Project is located in Jamshoro, which is located approximately 130 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site. The Jamshoro wind corridor is identified as potential area for the development of wind power projects. The geographical location of the project is shown in figure below.



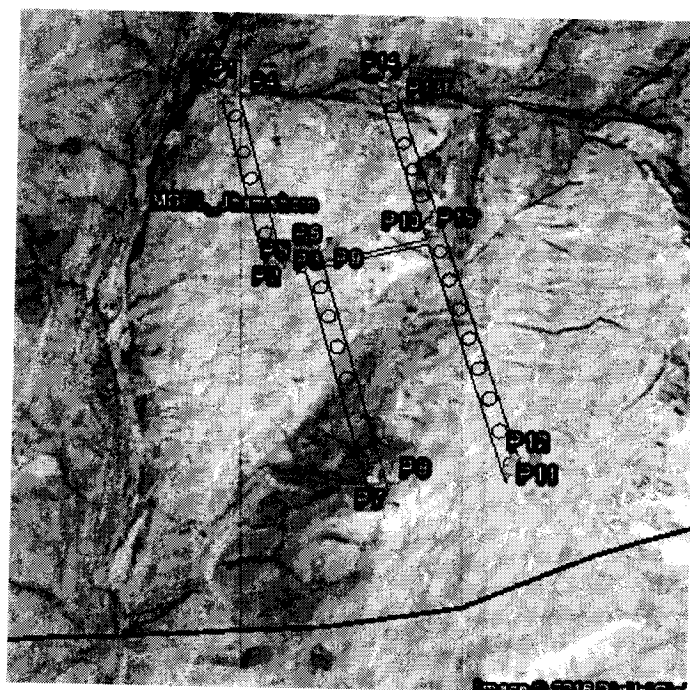
Layout of Generation Facility/ Wind Power Plant of Master Green Energy Limited

The general layout along with neighboring Wind Farms of 50 MW MGEL is shown in figure below.



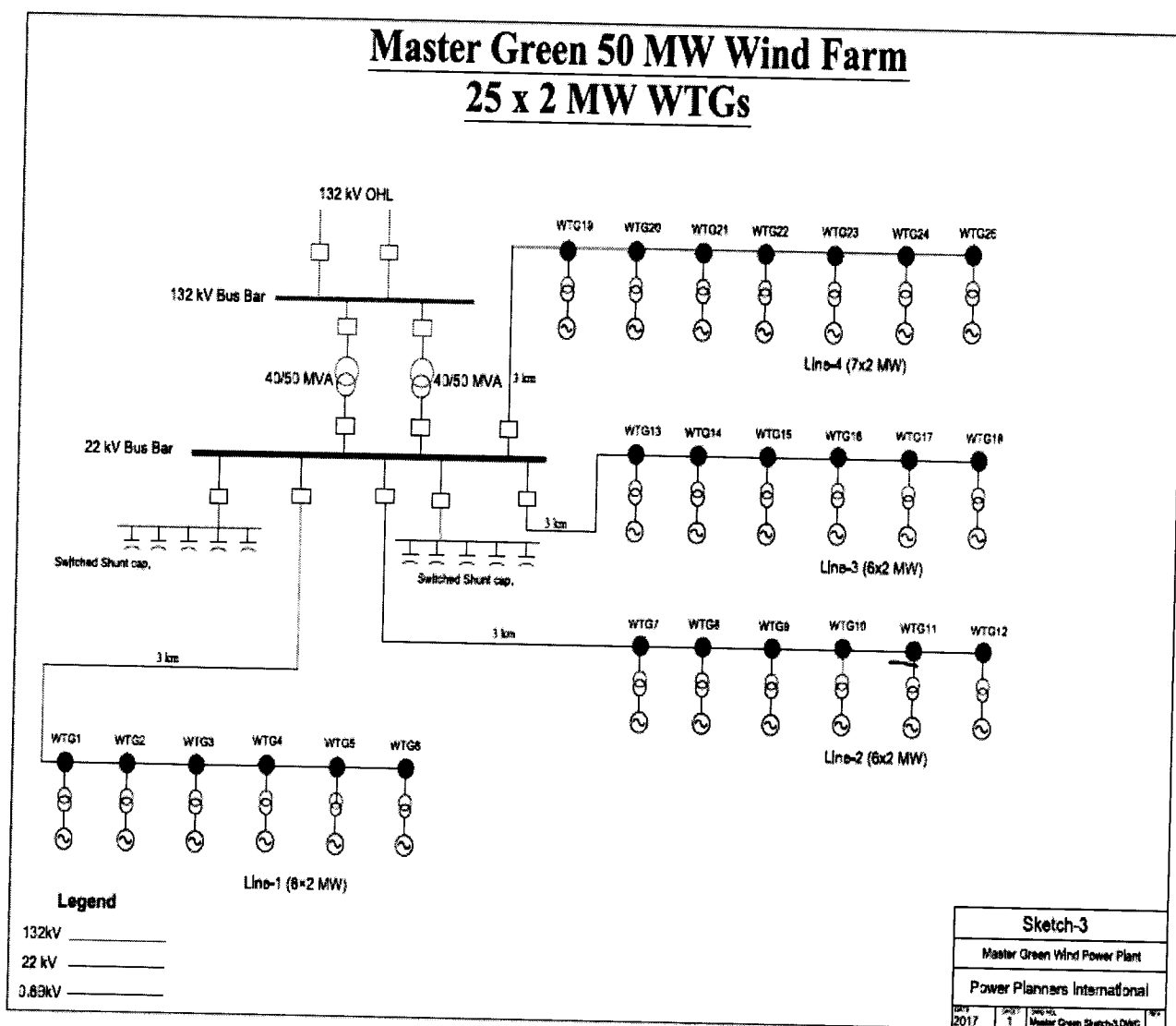
Land Coordinates and Micro-sitting of the Generation Facility/Wind Power Plant of Master Green Energy Limited

P1	25°23'34.31"N	68° 7'28.61"E
P2	25°22'53.25"N	68° 8'13.48"E
P3	25°22'55.71"N	68° 8'18.34"E
P4	25°23'36.78"N	68° 7'33.47"E
P5	25°22'56.02"N	68° 8'22.59"E
P6	25°22'57.58"N	68° 8'24.62"E
P7	25°22'11.05"N	68° 9'16.73"E
P8	25°22'13.53"N	68° 9'21.47"E
P9	25°23'0.77"N	68° 8'28.90"E
P10	25°23'19.14"N	68° 8'53.22"E
P11	25°22'28.33"N	68° 9'49.58"E
P12	25°22'30.87"N	68° 9'54.41"E
P13	25°23'58.45"N	68° 8'17.21"E
P14	25°23'55.98"N	68° 8'12.33"E
P15	25°23'20.28"N	68° 8'51.95"E
P16	25°22'57.41"N	68° 8'21.74"E



Electrical System Single Line Diagram of Generation Facility/Wind Farm

The project will install 25 WTGs (Gamesa G114-2.0). There shall be four (04) WTG collector group.



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

Master Green WPP which is the plant under study has been located in Jamshoro district. Master Green Wind Power Plant would be connected by loop in-loop out configuration of the newly proposed Nooriabad - Jamshoro old 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.

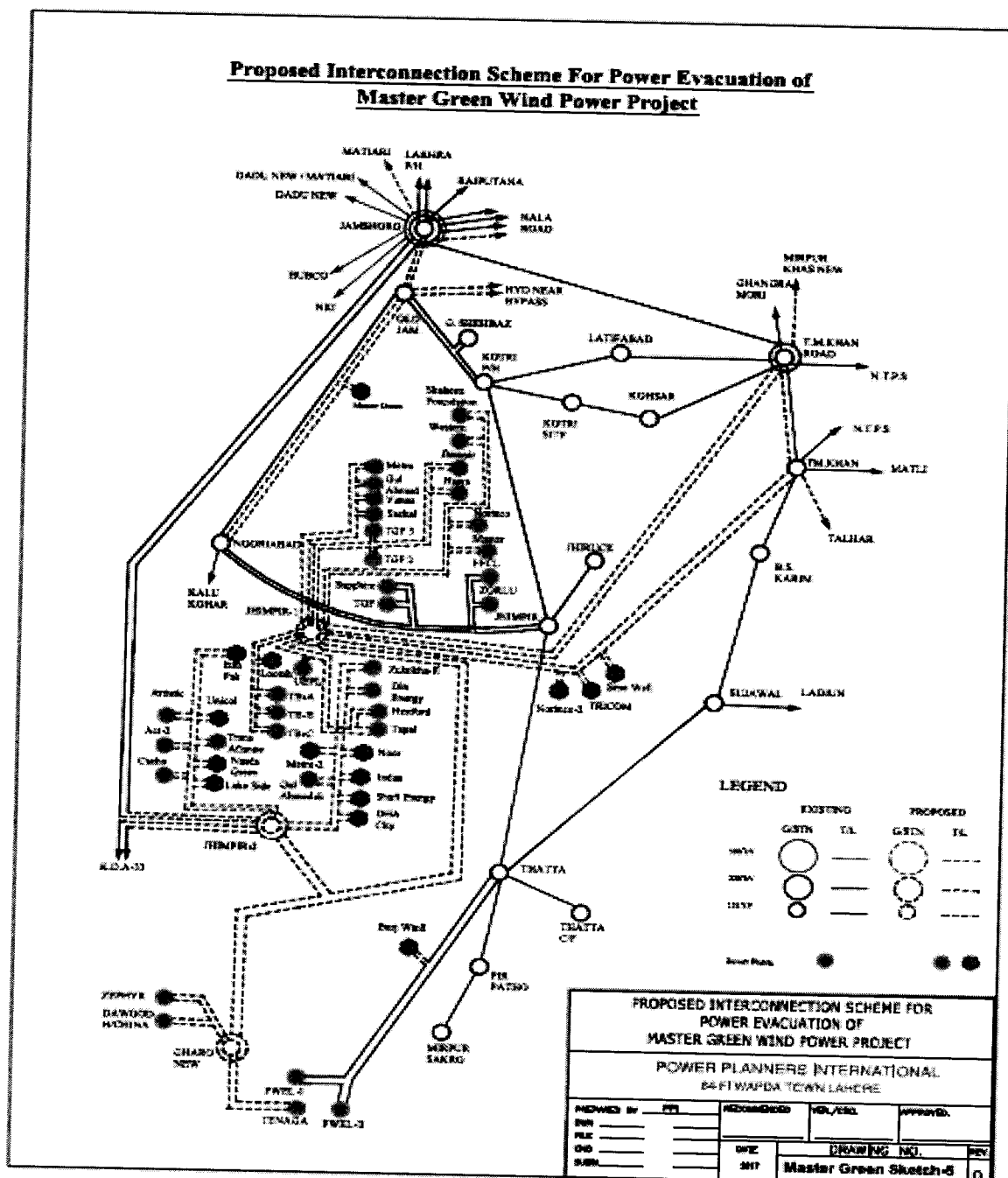
They may change slightly during the implementation of the project. In addition, the connectivity of Master Green WPP with neighboring wind power plants may change, depending upon the COD of the project.

➤ 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 Master Green WPP includes 132 kV D/C transmission line approx. 7 km long, on Greeley conductor for looping in/out on the 132kV single circuit from Nooriabad to Jamshoro-old grid station.

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

Schematic Diagram for Interconnection Arrangement/Transmission Facilities for Dispersal of Power from Master Green Energy Limited



Detail of Generation Facility/Power Plant/ Wind Farm

(A). General Information

(i).	Name of Applicant/Company	Master Green Energy Limited
(ii).	Registered/Business Office	82-C/1 Gulberg-III, Lahore, Pakistan
(iii).	Plant Location	Jamshoro, Sindh - Pakistan
(iv).	Type of Generation Facility	Wind Power

(B). Wind Farm Capacity & Configuration

(i).	Wind Turbine Type, Make & Model	Gamesa G114-2.0 MW
(ii).	Installed Capacity of Wind Farm (MW)	50 MW
(iii).	Number of Wind Turbine Units/Size of each Unit (kW)	25 x 2.00 MW

(C). Wind Turbine Details

(a). <u>Rotor</u>		
(i).	Number of blades	3
(ii).	Rotor diameter	114 m
(iii).	Swept area	10207 m ²
(iv).	Power regulation	Combination of blade pitch angle adjustment, and generator / converter torque control.
(v).	Cut-in wind speed	3 m/s

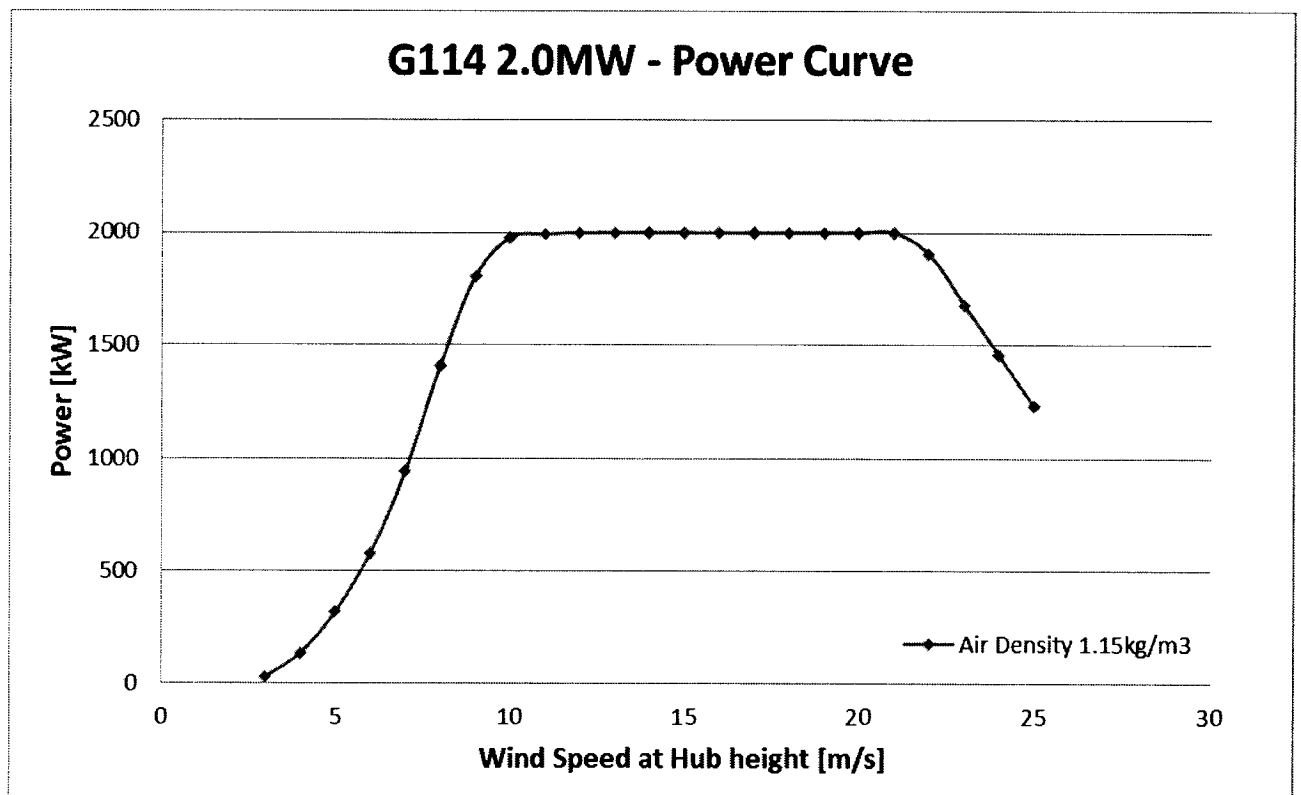
(vi).	Cut-out wind speed	25 m/s
(vii)	Rated wind speed	13.07 m/s
(viii)	Survival wind speed	59.5 m/s (Maximum 3 sec)
(ix)	Pitch regulation	Electric motor drives a ring gear mounted to the inner race of the blade pitch bearing.
(b). <u>Blades</u>		
(i).	Blade length	56 m
(ii).	Material	Composite material reinforced with fiberglass through resin infusion technology.
(c). <u>Gearbox</u>		
(i).	Type	3 combined stages: 1 stage planetary, 2 parallel shift gears.
(ii).	Gear ratio	1:128.5
(iii).	Main shaft	Cast shaft
(d). <u>Generator</u>		
(i).	Nominal Power	2040 (kVA)
(ii).	Voltage	690 V
(iii).	Type	Doubly fed with 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
(e). <u>Control System</u>		
(i).	Type	Automatic or manually controlled.
(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). <u>Brake</u>		
(i).	Design	Mechanical brakes
(ii).	Operational brake	Aerodynamic brake achieved by feathering blades.
(iii).	Secondary brake	Mechanical brake on (high speed) shaft of gearbox.
(g). <u>Tower</u>		
(i).	Type	Conical barrel tube
(ii).	Hub heights	93 m
(h). <u>Yaw System</u>		
(i).	Yaw bearing	PETP
(ii).	Brake	Active Yaw
(iii).	Yaw drive	Motor Drive
(iv).	Speed	0.42/s controlling speed
(i). <u>Other Details</u>		
(i).	Project Commissioning Date (Anticipated)	September 30, 2019
(ii).	Expected Life of the Project from Commercial Operation Date (COD)	20 Years

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

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)



4.2 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) and Annual Energy Generation (GWh) of the Generation Facility/Wind Farm of Licensee is given in this Schedule.

SCHEDULE-II

(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 GWh
(5).	Array & Miscellaneous Losses GWh	12.58 GWh
(6).	Availability Losses GWh	4.72 GWh
(7).	Balance of Plant Losses GWh	3.14 GWh
(8).	Annual Energy Generation (20 year equivalent Net AEP) GWh	153.3 GWh
(9).	Net Capacity Factor	35 %

Note

All the above figures are indicative as provided by the Licensee. The Net energy available to NTDC for dispatch will be determined through procedures contained in the Energy Purchase Agreement.

A009293



SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN
COMPANY REGISTRATION OFFICE, LAHORE

CERTIFICATE OF INCORPORATION

[Under section 32 of the Companies Ordinance, 1984 (XLVII of 1984)]

Corporate Universal Identification No. **0093378**



I hereby certify that **MASTER GREEN ENERGY 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 **Lahore** this **Twelfth** day of **May**, Two **Thousand**
and **Fifteen**.

Fee Rs. **104,000/-**

Shahid
18/5/16

L
(LIAQAT ALI DOLLA)
Additional Registrar



No.ARL/ **28877** DATED: **12/5/2016**

3.6 Certified copy of Memorandum and Articles of Association

PUBLIC COMPANY LIMITED BY SHARES
INCORPORATED UNDER THE COMPANIES ORDINANCE, 1984

MEMORANDUM OF ASSOCIATION

MASTER GREEN ENERGY LIMITED

NAME

- I. The name of the Company is "MASTER GREEN ENERGY LIMITED".

REGISTERED OFFICE

- II. The Registered Office of the Company will be situated in the Province of the Punjab.

OBJECTS

- III. The objects for which the Company is established are all or any of the following :
1. To carry on the business of electric power supply company and to conduct, lay down, establish, fix and out all necessary power stations, cables, wires, lines, accumulators, lamps and works, and to set up, operate wind power generation projects to generate, accumulate, distribute and supply electricity and light to sister concern companies branches, W.A.P.D.A., K.E.S.C., industries, cities, towns, streets, docks, markets, theatres, buildings and places both public and private subject to permission from NEPRA.
 2. To carry out the construction of Projects of wind, gas, hydroelectric and thermal energy fueled by various fuels such as gas energy, solar energy, bio-thermal energy and to construct, establish and fix necessary power stations.



3. To carry on the business of establishing, operating and managing transmission systems for electricity generation, steam process, air and suppliers of and dealers in electrical and related appliances, generators, cables, wire lines, dry cells, accumulators lamps and to generate, accumulate, distribute and supply electricity. For the purpose of light, heat, motive power and for all other purposes for which electrical energy can be employed.
4. To import, purchase, supply and acquire all kinds of raw and other materials for generation of energy electricity and sell, transmit and deliver the same thus generated anywhere in Pakistan.
5. To initiate, organize and to carry on the business of manufacturer, importer, exporter, assembler and supplier of all kinds of heavy and light apparatus for the purpose of electric generation and also manufacture, import, export, supply and assemble accumulator wire, lumps, meters, batteries and all kind of engineering goods.
6. To carry on all kinds of business as manufacturers, importers, exporters, dealers, assembler and distributors of gas generators, humidifying, ventilating, cooling plant and all types of tools and equipment for industrial and commercial use.
7. To carry on the business of manufacturer, importer, fabricator, assembler, developer, designer, supplier, distributor, tabulator, seller, and to market, repair, service, replace, process and deal in all kinds of diesel, gas, petrol and kerosene generating sets, frequency, converters, UPS, spare parts, air and gas treatment plants and equipment, air-conditioning plants, industrial fans, steam heaters, air filters, spray painting booths power plants, and complete systems of all kinds and description relating to generator, air technology and solar energy heat radiator, machineries, units, parts and allied products.
8. To carry on the business of manufacturers, importers, exporters, sellers, buyers and dealers whether as wholesalers or retailers of all kinds of electric motors and in particular fractional horsepower electric motors.
9. To manufacture, repair, purchase, sell, import, export or otherwise deal in generators, switchgears, meters, transformers, wire and cables, lamps, fans, fittings, electromedical and X-ray apparatus, heaters, radiators, ovens, refrigerators and air conditioning equipment.
10. To set up and establish undertakings for manufacturing of molds, dyes and other engineering items and to carry on the business as contractors in the field of civil, electrical and mechanical engineering.

11. To carry on, directly or indirectly, the business of mechanical, electrical, civil engineers, petrochemical engineers, drillers of soil and water wells, oil and gas wells, rock querrings, metals, minerals and precious stones; and to further carry on the business as engineers, consultants, contractors, planners, designers, surveyors, estimators and supervisors in any matter related to the above branches in or outside Pakistan.
12. To carry on the business of electrical, engineering and manufacturing of all kinds of heavy and light electrical machinery and electrical apparatus for any purpose whatsoever and to manufacture, install, sell and construct for the supply of electricity, wires, lamps, engines, meter, dynamos, batteries, or telephonic apparatus.
13. To carry on the business of manufacturer and assemblers of agriculture tractors, components parts, agriculture machineries and equipment and to buy, sell and deals in tractors of all kinds.
14. To acquire or construct, maintain and alter any building or works necessary or convenient for the purpose of the company and to sale any such property as an when deemed fit.
15. To carry on the business of constructions of residential and town houses, bridges, markets, shops, showrooms, arcades, shopping centres, flats, offices, paint houses, townships, water-works, electric generating stations, roads, tramways, underground rail roads, seaports, airports, heat, light, gas supply works, telegraphs works, hotels, cafeteria, refreshment rooms, lodging houses, huts, clubs, tanks, hospitals, restaurants, baths, places of worship, amusement, cremation and burial grounds, parks, gardens, libraries, reading rooms, orchestra stands, pavilions, taxi rickshaw and other vehicles stands, garages, dairy farms and all kinds of civil works.
16. To borrow or raise money or for the payment of money in any manner as the Company shall think fit and to secure the repayment of any money borrowed, raised or owing by mortgage, charge, standard security, lien or other security upon the whole or any part of Company's personal property and assets, present or future, and also to issue and deposit any securities which the Company has authority to issue by way of mortgage, charge, standard security, lien or other security to secure and guarantee the performance by the Company of any obligation or liabilities it may undertake or which may become binding on it.
17. To borrow funds by means of loans from commercial banks and government financial institutions for the Company's construction or manufacturing business in such manner as the company shall think fit and in particular by issue of debentures or debenture stock, perpetual or otherwise, charged upon all or any

the Company's property (both present and future) and to purchase, redeem and pay of any such securities.

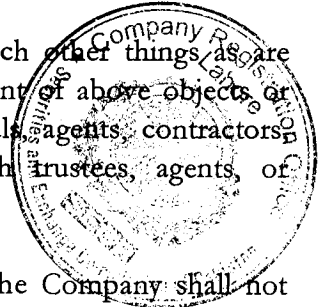
18. To invest or deposit monies of the Company, not immediately required, in such shares, stocks, debentures, debenture stocks or in any investments, movable or immovable, in such manner as may from time to time be decided by the directors, but not to act as Investment Company.
19. To guarantee performance of contracts by members having dealings with the Company.
20. To amalgamate with any other company having objects altogether or in part similar to those of this Company, and to enter into partnership or any arrangement for sharing profits, union of interest, co-operation, joint-venture, reciprocal concession or otherwise with any person or company carrying on or engaged in, or about business or transaction which this Company is authorized to carry on or engage in, or about business or transaction capable of being conducted so as directly or indirectly to benefit this Company.
21. To enter into arrangement for sharing profits or into any union of interest, joint-venture, reciprocal concession or co-operation with any person or persons or local and foreign company or companies carrying on or engaged in communication related business or transaction which this company is authorized to carry on or engage in or any business or transaction capable of being conducted so as to directly or indirectly benefit the company.
22. To sell or dispose of any undertaking of the Company or and in particular for shares, debentures or securities of any other company having objects altogether or in part similar to those of this Company.
23. To distribute any of the Company's property among the members in specie or in kind or in any manner whatsoever, in case of winding up or dissolution of the Company.
24. To subscribe for, take or otherwise acquire and hold shares in, or any securities any other company having objects altogether or in part similar to those of this Company or carrying on any business capable of being conducted so as directly or indirectly benefit this Company or enhance the value of any of its property or for investment of additional Funds.
25. To purchase or otherwise acquire the whole or any part of the business, goodwill and assets of the company, firm or person carrying on or proposing to carry on any of the businesses which the Company is authorized to carry on and to give

and receive consideration For such acquisition and to undertake all or any of the liabilities of such company, firm or person.

26. To receive payment on the sale or disposal of the whole or any part of the business or property of the Company, either in cash, by installments or otherwise, For such consideration as the Directors of the Company may think fit, and in particular for shares, debentures or otherwise in securities of any company and generally to dispose, hold or otherwise deal with any shares, stocks or securities so acquired.
27. To purchase, register, apply for or otherwise acquire and use any patent, patent right, design, copyright, license, concession, convenience, innovation, invention, trade marks, or process, rights or privileges, plants, tools or machinery and the like in Pakistan or elsewhere, which may For the time being appear to be useful or valuable for adding to the efficiency or productivity of the company' work or business, with the permission of the concerned authorities and to expend money for their improvement as may be necessary or convenient for the purposes of the business or businesses of the Company.
28. To open any current, overdraft, cash credit account of fixed account with any bankers and to pay money into and draw money from any such account.
29. To make, draw, accept, endorse, discount, execute or negotiate and issue, negotiate and discount cheques, promissory notes, bills of exchange, bills of lading, warrants, deposit notes, debentures, letter of credit and other negotiable or transferable instruments or securities concerning this Company.
30. To undertake and execute any trusts, undertaking whereof may seem desirable and either gratuitously or otherwise.
31. To subscribe, donate money for any national, charitable, benevolent, public, general or useful object including any educational institution, hospital, flood or famine relief fund and other institution or fund established for religious or charitable purpose.
32. To establish and support, or aid in establishment and support of associations, institutions, funds, trusts, and conveniences calculated to benefit persons who are or have been Directors of or who are or have been employed by or who are serving or have served the Company or any company which is a subsidiary or associate of the Company or dependents or connections of such persons and to grant pensions and allowances and to make payments towards insurance etc.
33. To adopt such means of making known the business and products of the Company as may seem expedient, and in particular by advertisement in press, by

circulars, by exhibition of works of art or interest, by publication of books and periodicals and by granting prizes, rewards, and also giving advertisement as permissible under law.

34. To apply for and obtain necessary consents, permissions and licence from any Government, state, local and other authorities for enabling the Company to carry on any of its objects effectively as and when required by law.
35. To establish and maintain offices, branches and local registers and to procure registration of the Company and to carry on business in any part of the world and to take such steps as may be necessary to give the Company such rights and privileges in any part of the world as are possessed by local companies or partnerships or as may be thought desirable.
36. To remunerate any company, person or firm by way of consideration for rendering services received by the Company either by cash payment or by allotment to him or them of shares or other securities of the Company credited as paid up in full or otherwise as may be thought expedient.
37. To do and perform all or any of above things and such other things as are incidental or may be thought conducive to the attainment of above objects or any of them in any part of the world, and as principals, agents, contractors, importers, exporters or otherwise and by or through trustees, agents, or otherwise, and either alone or in conjunction with others.
38. Notwithstanding anything stated in any object clause, the Company shall not engage in banking or the business of an investment company, leasing, insurance, managing agency or any unlawful business and shall not by advertisement, pamphlets, other means or other negotiation, offer for sale or take advance money for the further sale of plots, houses, flats etc., are acquired and have been developed by the company and that nothing in the object clause shall be construed to entitle it to engage in such business. The Company shall not launch multilevel marketing, pyramid and ponzi schemes. It is further declared that the company would not indulge in any sort of real estate business, housing colonies, purchase and sale of plots and development of land and housing finance company business as mentioned in NBFC Rules, 2003.
39. Notwithstanding anything stated in any object clause, the Company shall obtain such other approval or license from the competent authority, as may be required under any law for the time being in force to undertake a particular business.



LIABILITY

- IV. The liability of the members is limited.

CAPITAL

- V. The authorised capital of the company is Rs. 10,000,000- (Rupees Ten Million) divided into 10,000 (Ten Thousand) Ordinary shares of Rs.1,000 (Rupees One Thousand) each with the rights, privileges and conditions attaching thereto as are provided by the regulations of the Company for the time being, with powers to increase, reduce, sub-divide, consolidate or reorganise the capital of the Company and to divide the shares in the capital of the Company for the time being into several classes in accordance with the provisions of the Companies Ordinance, 1984 and to attach thereto respectively such special rights, privileges or conditions as may be determined by or in accordance with the regulations of the Company, provided however, that rights, as between various classes of ordinary shares, if any, as to profits, votes and other benefits shall be strictly proportionate to the paid up value of the shares.

We the several persons, whose name and addresses are subscribed, are desirous of being formed into a Company, in pursuance of this Memorandum of Association and to take the number of shares in the capital of the Company set opposite to our respective names.

Sr. No.	Name and Surname (Present and former) In full block letters	Father's/ Husband's Name in full	Nationality with any former Nationality	Occupation	Residential Address in Full	Number of shares taken by each subscriber	Signature of the subscriber
1	Mr. NADEEM MALIK CNIC No. 42301-8656497-9	S/o Riaz Malik	Pakistani	Business Foam Manufacturing	Plot No. 75, Khayaban-e-Shaheen, Phase VI, D.H.A, Karachi	300	<i>Nadeem Malik</i>
2	Mr. NAJEEB MALIK CNIC No. 35201-7088787-3 <i>Najeeb Malik</i>	S/o Riaz Malik	Pakistani	Business Foam Manufacturing	Plot No. 321, Block K, Phase 1, Lahore Cantt Cooperative Housing Society, Lahore	300	<i>Najeeb Malik</i> X
3	Mr. SHAHZAD MALIK CNIC No. 352019-295415-7	S/o Naveed Malik	Pakistani	Business	126- Y Block, Street No. 18, D.H.A. Lahore	<u>300</u>	<i>Shahzad Malik</i>
					Total	<u>900</u>	

Dated 8th day of April, 2015

Amir Mushtaq Butt
Witness to above signature

MR. AMIR MUSHTAQ BUTT S/O
MUSHTAQ AHMED BUTT

CNIC: 35202-3058104-1

82 - C-1, Gulberg III, Lahore.

PUBLIC COMPANY LIMITED BY SHARES
INCORPORATED UNDER THE COMPANIES ORDINANCE, 1984

ARTICLES OF ASSOCIATION

MASTER GREEN ENERGY LIMITED

PRELIMINARY

1. Company to be governed by the Articles & Table 'A' not to apply.

The Regulations contained in Table 'A' in the First Schedule to the Companies Ordinance, 1984 shall not apply to the Company except to the extent and as hereinafter, expressly incorporated. In case of any conflict between the provisions referred to and the provisions herein contained and the incorporated Regulations of Table 'A', the provisions herein contained shall prevail.

INTERPRETATION

- 2. In the interpretation of these Articles, words importing the singular shall include the plural, and vice versa and words importing the masculine gender shall include feminine gender and words importing persons shall also include corporate bodies.**

AEDB The 'AEDB' means the Alternative Energy Development Board, a statutory body corporate formed under the Alternative Energy Development Board Act, 2010.

Articles The 'Articles' means these Articles as originally framed or as from time to time altered in accordance with law.

Board The 'Board' means Board of Directors for the time being of the Company

Commission The 'Commission' means Securities and Exchange Commission of Pakistan.

Chief Executive The 'Chief Executive' means an individual who subject to the control and Executive directions of the directors, is entrusted with the whole, or substantially the whole, of the powers of management of the affairs of the company and includes a director

or any other person occupying the position of a chief executive, by whatever name called, and whether under a contract of service or otherwise.

Company	The name of the Company is "MASTER GREEN ENERGY LIMITED".
Directors	The 'Directors' means the Directors for the time being of the Company.
Dividend	The 'Dividend' includes bonus shares.
Document	'Document' includes summon, notice, requisition, order, other legal process, voucher and register.
Member	'Member' means a person whose name is for the time being entered in the Register of Members by virtue of his being a subscriber to the Memorandum and Articles of Association of the Company or of his holding by allotment or otherwise any share, scrip or other security which gives him a voting right in the Company.
Month	'Month' means the calendar month according to the English Calendar.
Office	'The Office' means the Registered Office for the time being of the Company.
Ordinance	'The Ordinance' means the Companies Ordinance, 1984.
Ordinary Share Capital	'Ordinary Share Capital' includes any shares of the Company with voting or other rights of management and control, and any securities of the Company that are convertible into such shares at the option of the holder.
Proxy	'Proxy' includes an Attorney duly constituted under a Power of Attorney.
Public Company	"Means a company which is not a private Company under Companies Ordinance, 1984"
Register	'The Register' means the Register of Members to be kept in pursuance to Section 147 of the Ordinance.

Registrar	'The Registrar' means the Registrar of Companies having jurisdiction on the Company.
Redeemable Capital	'Redeemable Capital' includes finance obtained on the basis of Participation Terms Certificate Musharika Certificate, Term Finance Certificate (TFC) or any other security or obligation not based on interest, other than an ordinary share of a company representing an instrument or a certificate of specified denomination called the face value or nominal value evidencing investment of the holder in the capital of the company on terms and conditions of the agreement for the issue of such instrument or certificate or such other certificate or instrument as the Federal Government may by notification in the official Gazette specify for the purpose.
Section	'Section' means Section of the Ordinance.
Seal	'The Seal' means the common seal of the Company
Security	'Security' means any share, scrip, debenture, Participation Term Certificate, Modaraba Certificate, Musharika Certificate, Term Finance Certificate, bond, pre-organisation certificate or such other instrument as the Federal Government may, by notification in the official Gazette, specify for the purpose.
Writing	'In Writing' and written include printing, lithography and other modes of representing or reproducing words in a visible form.
Expression	Words and phrases used herein but not defined shall be assigned the same meaning as given to them in the Ordinance.

BUSINESS

3. Object

The business of the company shall include the several objects expressed in Clause of the Memorandum of Association or any of them.

4. Commencement

The directors shall have regard to the restrictions on the commencement of business imposed by Section 146, if and so far as, those restrictions are binding upon the company.

SHARES

5. Share Capital

The authorised capital of the company is Rs. 10,000,000/- (Rupees Ten Million) divided into 10,000 (Ten Thousand) Ordinary shares of Rs.1,000/- (Rupees One Thousand) each with the rights, privileges and conditions attaching thereto as are provided by the regulations of the Company for the time being, with powers to increase, reduce, subdivide, consolidate or reorganise the capital of the Company and to divide the shares in the capital of the Company for the time being into several classes in accordance with the provisions of the Ordinance and to attach thereto respectively such special rights, privileges or conditions as may be determined by or in accordance with the regulations of the Company, provided however, that rights, as between various classes of ordinary shares, if any, as to profits, votes and other benefits shall be strictly to the paid up value of the shares.

6. Allotment of Shares under the control of the Directors

Subject to the provisions of these Articles and to the provisions of Section 86, the shares shall be under the control of the directors who may allot or otherwise dispose of the same to such persons, on such terms and conditions, and either at premium or at par and at such times, as the directors think fit and with full power to give to any person the right to call for the allotment of any shares either at par or at premium for such time and for such consideration as the directors think fit.

7. Issuance of shares at discount

With the prior approval of the shareholders in a General Meeting of the Company and with the sanction of the Securities and Exchange Commission of Pakistan and upon otherwise complying with the provisions of Section 84, it shall be lawful for the Directors to issue shares in the capital of the Company at discount.

8. Variation of shareholders rights

If at any time the share capital is divided into different classes of shares, the rights attached to any class (unless provided by the terms of issue of the shares of that class) may subject to the provisions of Section 108 be varied with the consent in writing of the holders of three fourths of the issued shares of that class, or with the sanction of a special resolution passed at a separate general meeting of the holders of the shares of the class. To every such separate general meeting, the provisions of these regulations slating to general meeting shall mutandis apply, but so that the necessary shall be three persons at least holding or representing by Proxy and having twenty five percent of the issued shares of that class.

9. Allotment and Minimum Subscription

The Directors shall in making the allotments duly observe the provisions of Section 68 to 73 as may be applicable to the Company. The minimum subscription upon which the Directors may proceed to allotment as defined in Section 68 is fixed at Rs. 900,000/-.

10. Trust not recognized

Save as herein otherwise provided, the company shall be entitled to treat the registered holder of any share as the absolute owner thereof and accordingly shall not, except as ordered by a court of competent jurisdiction or as by statute required, be bound to recognize equitable, contingent, future, partial or other claim to or interest in such share on the part of any other person.

11. Company and Corporate Body may hold shares

Shares may be registered in the name of any limited company or other corporate body. Unless the directors otherwise consent in any case, not more than four persons shall be registered joint-holders of any share.

12. Issue of shares to banks and financial institution

As provided in Section 87, the directors may issue ordinary shares, or grant option to convert into ordinary shares, the outstanding balance of any loans, advances or credits or other non-interest bearing securities and obligations outstanding or having a term of not less than three years in the manner provided in any contract with any schedule bank or a financial institution to the extent of twenty percent of such balance.

13. Issue of Redeemable Capital

The directors may issue to banks or financial institutions either severally, jointly or through a syndicate, Redeemable Capital in consideration of any funds, moneys, accommodations received or to be received by the company whether in cash or in specie or against promise, guarantee, undertaking or indemnity issued to or in favour or benefit of the company.

14. Offer for Subscription

No share shall be offered for subscription except upon the term that the amount payable on application shall be the full amount of the nominal value of the share.

CERTIFICATE

15. Certificate

Every person whose name is entered as a member in the Register shall, without payment, be entitled to receive, within two months after allotment or within forty-five days of the application or registration of transfer, a certificate under the seal specifying the share or shares held by him and the amount paid up thereon.

16. Joint holder

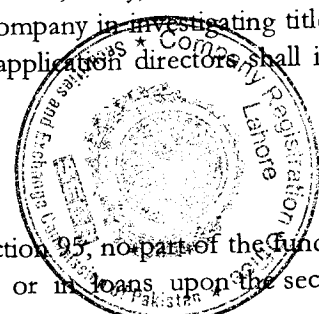
In respect of a share or shares held jointly by several persons, the company shall not be bound to issue more than one certificate and delivery of a certificate for a share to one of the several joint holders shall be sufficient delivery to all.

17. Duplicate Certificate

If a share certificate is defaced, lost or destroyed, it may be renewed on payment of such fee, if any, not exceeding one rupee, and on such terms, if any, as to evidence and indemnity and payment of expenses incurred by the company in investigating title, as the directors think fit. Within forty-five days of the application directors shall issue certificate to the applicant.

18. Prohibition on Purchase of its own Shares

Except to the extent and in the manner allowed by Section 95, no part of the funds of the company shall be employed in the purchase of, or in loans upon the security of the company's shares.



ISSUANCE AND TRANSFER OF SHARES

19. Registration of Transfer

The directors shall not refuse to transfer any fully paid shares unless the transfer deed is defective or invalid. The directors may also suspend the registration of transfers during ten days immediately by giving seven days previous notice in the manner provided in the Ordinance. The directors may decline to recognise any instrument of transfer unless :

- a. a fee not exceeding two rupees as may be determined by the directors is paid to the company in respect thereof; and
- b. the duly stamped instrument of transfer is accompanied by the certificate of the shares to which it relates, and such other evidence as the directors may reasonably require to show the right of the transferor to make the transfer.

If the directors refuse to register a transfer of shares, they shall within forty five days after the date on which the transfer deed was lodged with the company send to the transferee and the transferor notice of the refusal indicating the defect or invalidity to the transferee, who shall after removal of such defect or invalidity be entitled to re-lodge the transfer deed with the company.

20. Execution of Transfer

The instrument of transfer of any share in the company shall be executed both by the transferor and the transferee, and transferor shall be deemed to remain holder of the share until the name of the transferee entered in the register of members in respect thereof. No transfer shall be made to an infant or person of unsound mind.

21. Form of Transfer

Shares in the company shall be transferred in any usual or common form which the directors shall approve.

TRANSMISSION OF SHARES

22. Shares of Deceased

The executors, administrators, heirs or nominees, as the case may be, of a deceased sole holder of share shall be the only persons recognised by the company as having any title to the share. In the case of a share in the name of two or more holders, the survivor or survivors, or the executors or administrators of the survivor or survivors shall be the only persons recognised by the company as having any title to the share.

23. Nomination by Members

A member or shareholder may deposit with the company a nomination conferring on one or more persons the right to acquire the interest in the shares therein specified in the event of his death. Provisions of Section 80 will apply in case of all such nominations.

24. Entitlement of Shares

Any person becoming entitled to a share in consequence of the death or bankruptcy or insolvency of a member shall, upon such evidence being produced as may from time to time be required by the directors, have the right, either to be registered as a member in respect of the share or, instead of being registered himself, to make such transfer of the share as the deceased or insolvent person could have made; but the directors shall, in either case, have the same right to decline or suspend registration as they would have had in the case of transfer of the share by the deceased or insolvent person before the death or insolvency.

25. Entitlement of Dividend

A person becoming entitled to a share by reason of the death or bankruptcy or insolvency of the holder shall be entitled to the same dividends and other advantages to which he would be entitled if he was the registered holder of the share, except that he shall not, before being registered as a member in respect of the share, be entitled in respect of it to exercise any right conferred by membership in relation to meetings of the company.

ALTERATION AND FURTHER ISSUE OF CAPITAL

26. Increase in Share Capital

The company may, from time to time, by special resolution increase the share capital by such sum, to be divided into shares of such amount, as the resolution shall prescribe. The new shares shall be subject to the same provisions with reference to transfer, transmission and otherwise as the shares in the original share capital.

27. Consolidation, Division, Sub-division and Cancellation of Shares

The company may by special resolution:

- a. Consolidate and divide its share capital into shares of larger amount than its existing shares;
- b. Sub-divide its existing shares or any of them into shares of smaller amount than is fixed by the memorandum of association, subject nevertheless to the provisions of clause (d) of sub-section (I) of Section 92;
- c. Cancel any shares which, at the date of the passing of the resolution, have not been taken or agreed to be taken by any person.

28. Offer for new shares

Subject to the provisions of Section 86 all new shares shall, before issue be offered to such persons as at the date of the offer are entitled to receive notices from the company of general meetings in proportion, as nearly as the circumstances admit, to the amount of the existing shares to which they are entitled. The offer shall be made by notice specifying the number of shares offered, and limiting a time within which the offer, if not accepted will be deemed to be declined, and after the expiration of that time, or on the receipt of an intimation from the person to whom the offer is made that he declines to accept the shares offered, the directors may dispose of the same in such manner as they think most beneficial to the company. The directors may likewise

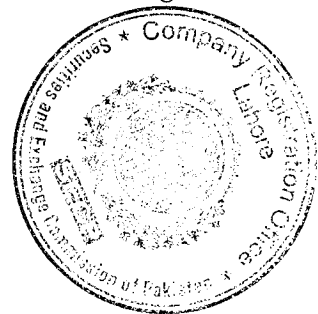
so dispose of any new shares which (by reason of the ratio which the new shares bear to shares held by persons entitled to an offer of new shares) cannot in the opinion of the directors, be conveniently offered under the regulation.

29. Reduction of Capital

The company may, by special resolution, reduce its share capital in any manner and with, and subject to, any incident authorised and consent required by Sections 96 to 106 provided the reduction so made shall not disturb the requirement of minimum paid up capital.

30. Surrender of Shares

Subject to the provisions of the Ordinance, the directors may accept from any member the surrender of all or any of his shares on such terms as shall be agreed.



A handwritten signature in black ink, appearing to be 'Muhammad Qasim' or similar, written in a cursive style.

GENERAL MEETING

31. Statutory Meeting

Subject to provisions of Section 157 the Statutory General Meeting of the company shall be held within a period of not less than three months and not more than six months from the date of entitlement of commencement of business.

32. Annual General Meeting

A general meeting, to be called annual general meeting, shall be held as may be determined by the directors, in accordance with the provisions of Section 158, within eighteen months from the date of incorporation of the company and thereafter once at least 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.

33. Extra ordinary General Meeting

All general meetings of a company other than the statutory meeting or an annual general meeting mentioned in Sections 157 and 158 respectively shall be called Extraordinary General Meetings.

34. Calling of an Extra ordinary General Meeting

The directors may, whenever they think fit, call an extraordinary general meeting. Extraordinary general meeting shall also be called on such requisition, or in default, may be called by such requisitionists, as is provided by Section 159. If at any time there are not within Pakistan sufficient directors capable of acting to form a quorum, any director of the company may call an extraordinary general meeting in the same manner as nearly as possible as that in which meetings may be called by the directors.

NOTICE AND PROCEEDINGS OF GENERAL MEETING

35. Notice

Twenty-one days' notice at the 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) specifying the place, the day and the hour of meeting and, in case of special business, the general nature of that business, shall be given in manner provided by the Ordinance for the general meeting, to such persons as are, under the Ordinance or the regulations of the company, entitled to receive such notices from the company but the accidental

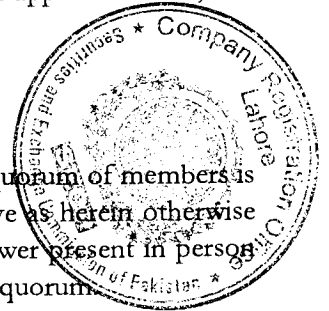
omission to give notice to, or the non-receipt of notice by, any member shall not invalidate the proceedings at any general meeting. In case of extraordinary general meeting, a shorter notice may be given with the consent of Registrar as provided in Section 159 and for passing a special resolution, meeting may be convened on a shorter notice with the consent of all the members as provided in Section 2 (1)(36) of the Ordinance.

36. Special Business

All business shall be deemed special that is transacted at an extraordinary general meeting, and also all that is transacted at an annual general meeting with the exception of declaring a dividend, the consideration of the accounts, balance sheet and the reports of the directors and auditors, the election of directors, the appointment of, and the fixing of the remuneration of the auditors.

37. Quorum

No business shall be transacted at any general meeting unless a quorum of members is present at that time when the meeting proceeds to business; save as herein otherwise provided, members having twenty five percent of the voting power present in person or through proxy and two members personally present shall be a quorum.



38. Adjourned Meeting

If within half an hour from the time appointed for the meeting a quorum is not present, the meeting, if called upon 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 the adjourned meeting a quorum is not present within half an hour from the time appointed for the meeting, the members present, being not less than two, shall be a quorum.

39. Chairman

The chairman of the board of directors, if any, shall preside as chairman at every general meeting of the company. but if there is no such chairman or if at any meeting he is not present within fifteen minutes after the time appointed for the meeting or is unwilling to act as chairman, any one of the directors present may be elected to be chairman, and if none of the directors is present, or willing to act as chairman, the members present shall choose one of their number to be chairman.

40. Power to Adjourn General Meeting

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; 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. When a meeting is adjourned for ten days or more notice of the adjourned meeting shall be given as in the case of an original meeting save as aforesaid, it shall not be necessary to give any notice of an adjournment or of the business to be transacted at an adjourned meeting.

41. Adoption of Resolution

At any general meeting a resolution put to the vote of the meeting shall be decided on a show of hands unless a poll is (before or on the declaration of the result of the show of hands) demanded. Unless a poll is so demanded, a declaration by the chairman 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 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, that resolution.

42. Demand for Poll

A poll may be demanded only in accordance with the provisions of Section 167.

43. Manner and Time of Taking Poll

If a poll is duly demanded, it shall be taken in accordance with manner laid down in Section 168 and the result of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded. A poll demanded on the election of chairman or on a question of adjournment shall be taken at once.

44. Casting Vote

In the case of an equality of votes, whether on a show of hands or on a poll, the chairman of the meeting, at which the show of hands takes place, or at which the poll is demanded, shall have and exercise a second or casting vote.

VOTES OF MEMBERS

45. Right to Vote

Subject to any rights or restrictions for the time being attached to any class or classes of shares, on a show of hands every member present in person shall have one vote except for election of directors in which case the provisions of Section 178 shall apply. On a poll every member shall have voting rights as laid down in Section 160.

46. Vote may be given either personally or by proxy and voting by Corporation Representative

Where a corporation or company is a member of the Company, a person duly appointed by resolution of directors to represent such corporation at a meeting of the Company in accordance with the provisions of Section 162 shall not be deemed to be as instrument of proxy or power of attorney and the production at the meeting of a copy of such resolution certified as being a true copy by a Director of such corporation or by the Chief Executive thereof (if any) shall on production at the meeting be accepted by the Company as sufficient evidence of the validity of his appointment.

47. Vote of Joint-holders

In case of joint-holders, the vote of the senior who tenders a vote, 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 by the order in which the names stand in the register of members.

48. Vote by member of unsound mind

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 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.

49. Proxy to be in writing

The instrument appointing a proxy shall be in writing under the hand of the appointer or of his attorney duly authorised in writing. A proxy must be a member.

50. Deposit of instrument of Proxy

The instrument appointing a proxy and the power-of-attorney or other authority (if any) under which it is signed, or a notarially certified copy of that power or authority, shall be deposited at the registered office of the company 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.

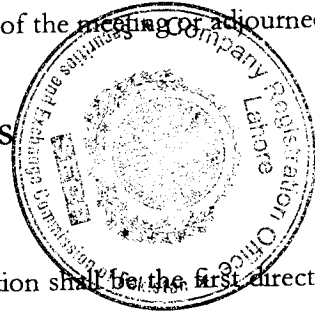
51. Form of Proxy

An instrument appointing a proxy may be in any usual or common form or as near thereto which the directors shall approve.

52. Validity of Proxy

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 share in respect of which the proxy is given, provided no intimation in writing of such death, insanity, revocation or transfer as aforesaid shall have been received by the company at the office before the commencement of the meeting or adjourned meeting at which the proxy is used.

DIRECTORS



53. Directors

The subscribers to the Memorandum of Association shall be the first directors of the Company namely:

-  1. ~~Mr. Naveed Malik~~
1 2. Mr. Najeeb Malik
2 3. Mr. Nadeem Malik
3 4. Mr. Shahzad Malik

54. Number of Directors

Subject to the provisions of Section 178 (I) of the Ordinance, the Company may from time to time in annual general meeting increase or decrease the number of directors. However, such number shall not in any case be less than three.

55. Nominated Directors

The company may have directors nominated by the company's creditors or other special interest by virtue of contractual agreements.

56. Alternate Director

A director who is about to leave or is absent from Pakistan may with the approval of the directors appoint any person to be an alternate director during his absence from the country provided such absence shall not be less than for a period of three months and such appointment shall have effect and such appointee whilst he holds office as an alternate director, shall be entitled to notice of the meeting of the directors and to attend and vote thereat accordingly but shall ipso facto vacate office when his appointer returns to the country or vacates office as director, if the company in General Meeting removes the appointee from office and any appointment and removal under the clause shall be affected by notice in writing under the hand of director making the same.

57. Remuneration of Director

The remuneration of a director for performing extra services, including holding of the office of Chairman, and the remuneration to be paid to any director for attending the meeting of the directors or a committee of directors shall from time to time be determined by the Board of Directors in accordance with the law.

POWER AND DUTIES OF DIRECTORS

58. Management of Business

The business of the company shall be managed by the directors, who may pay all expenses incurred in promoting and registering the company and 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 these regulations, required to be exercised by the company in general meeting, subject nevertheless to the provisions of the Ordinance or to any of these regulations, and such regulations, being not inconsistent with the aforesaid provisions, as may be prescribed by the company in general meeting shall invalidate any prior act of the directors which would have been valid if these regulations had not been made.

59. Power to appoint Attorney

The directors may from time to time by power of attorney under the Company's Seal, appoint any person or persons to be the attorney(s) of Company for such purposes and with such powers, authorities and discretions (not exceeding those vested in or exercisable by the directors under these presents) and for such period and subject to such conditions as the directors may from time to time think fit. Any such attorney(s) may, if authorised by the directors, delegate all or any of the powers vested in him/them.

60. Duties of Directors

The directors shall duly comply with the provisions of the Ordinance or any statutory modification thereof for the time being in force, and in particular with the provisions in regard to the registration of the particulars of mortgages and charges affecting the property of the company or created by it, to the keeping of a register of the directors, and to the sending to the registrar of an annual list of members, and a summary of particulars relating thereto and notice of any consolidation or increase of share capital, or sub-division of shares, and copies of special resolutions and copy of the register of directors and notifications of any changes therein.

61. Power to Borrow

Subject to the provisions of Section 196, the directors may from time to time at their discretion borrow such sum or sums as they may think fit for the purpose of the company including from any banks and Financial Institutions and secure the payment or repayment of such sum or sums in such manner and upon such terms and conditions as they think fit by mortgage or charge upon the whole or any part of the property present and future or any such other way as the directors may think expedient. The company may raise and secure payment of any sum by issue of Redeemable Capital. The Redeemable Capital may be issued at a discount, premium or otherwise with special privilege as to redemption, conversion into shares with voting rights and their subsequent reconversion into Redeemable Capital.

62. Mortgages and Charges

The directors shall cause a proper register to be kept in accordance with Section 135 of all mortgages and charges specifically affecting the property of the company and shall duly comply with the requirements of Sections 121, 122 and 129 in regard to registration of mortgages and charges and shall also duly comply with the requirements of Section 130 as to keeping a copy of every instrument creating any mortgage or charge and the requirements of Section 132 as to giving intimation of the payment or satisfaction of any charge or mortgage created.

63. Disclosure of interest by Directors

Every director or his relative who is in any way, whether directly or indirectly, concerned or interested in any contract or arrangement entered into, or to be entered into, by or on behalf of the company shall disclose the nature of his concern or interest at a meeting of the directors, as required by Section 214.

64. Minutes to be made

The directors shall cause minutes to be made in books provided for the purpose:

- a. of all appointments of officers made by the directors;
- b. of the names of the directors present at each meeting of the directors and of any committee of the directors;
- c. of all resolutions and proceedings at all meetings of the company and of the directors and of committees of directors;

and every director present at any meeting of directors or committee of directors shall sign his name in a book to be kept for that purpose. A copy of the minutes of the board of directors shall be furnished to every director within fourteen days of the date of meeting.

DISQUALIFICATION OF DIRECTORS

65. Ineligibility

No person shall become director of the Company if he suffers from any of the disabilities or disqualifications mentioned in Section 187 and if already a director, shall cease to hold such office from the date he so becomes disqualified or disabled. Provided, however, that no director shall vacate his office by reason only of his being a member of any company which has entered into contracts with, or done any work for the company of which he is a director but such director shall not vote in respect of any such contract or work, and if he does so vote, his vote shall not be counted.

PROCEEDINGS OF DIRECTORS

66. Meetings of Directors

The directors may meet together for the dispatch of business, adjourn and otherwise regulate their meetings, as they think fit. The quorum for a meeting of directors shall not be less than one-third of their number or two, whichever is greater. Questions arising at any meeting shall be decided by a majority of votes. In case of an equality of votes, the Chairman shall have and exercise a second or casting vote. A director may, and the secretary on the requisition of a director shall, at any time, summon a meeting of directors. It shall not be necessary to give notice of a meeting of directors to any director for the time being absent from Pakistan.

67. Minimum number of meetings

The directors shall meet at least once in each quarter of a year as required by Section 193 (2) of the Ordinance.

68. Delegation of Power to Committees

The directors may delegate any of their powers not required to be exercised in their meeting to committees consisting of such member or members of their body as they think fit; any committee so formed shall, in the exercise of the powers so delegated, conform to any restrictions that may be imposed on them by the directors.

69. Chairman

The directors may elect a chairman of their meeting and determine the period for which he is to hold office; but, if no such chairman is elected, or if at any meeting the chairman is not present within fifteen minutes after the time appointed for holding the same or is unwilling to act as chairman, the directors present may choose one of their number to be chairman of the meeting.

70. Chairman of Committee meetings

A committee may elect a chairman of its meetings, but, if no such chairman is elected, or if at any meeting the chairman is not present within fifteen minutes after the time appointed for holding the same or is unwilling to act as chairman, the members present may choose one of their number to be chairman of the meeting.

71. Proceedings of Committee Members

A committee may meet and adjourn as it thinks proper. Questions arising at any meeting shall be determined by a majority of votes of the members present. In case of an equality of votes, the chairman shall have and exercise a second or casting vote.

72. Validity of Director's Acts

All acts done by any meeting of the directors or of a 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.

73. Resolution in Writing

A resolution in writing signed by all the directors or affirmed by them through telex or telegram shall be as valid and effectual as if it had been passed at a meeting of directors duly convened and held.

ELECTION AND REMOVAL OF DIRECTORS

74. Period of Office

The First Directors of the company shall retire from their offices at the first Annual General Meeting of the Company, and directors shall be elected in their place in accordance with Section 178 for a term of three years, unless they resign earlier, become disqualified for being directors or otherwise cease to hold office.

75. Election

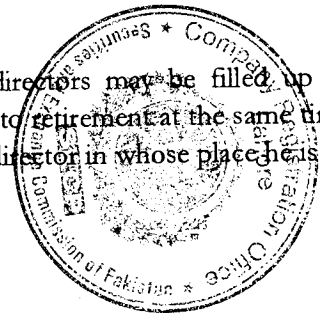
The directors shall comply with the provisions of Sections 178, 183 and 184 relating to election of directors and matters ancillary thereto.

76. Eligibility

A retiring director shall be eligible for re-election.

77. Casual Vacancy

Any casual vacancy occurring on the board of directors may be filled up by the directors, but the person so chosen shall be subject to retirement at the same time as if he had become a director on the day on which the director in whose place he is chosen was last elected as director.



78. Mode of Election

The number of directors determined by the Board shall be elected to hold office by the members in general meeting in the following manner:

- a. A member shall have such number of votes as is equal to the product of the number of voting shares or securities held by him and the number of directors to be elected;
- b. A member may give all his votes to a single candidate or divide them between more than one of the candidates in such manner as he may choose;
- 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.

79. Removal

The Company may 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.

Provided that a resolution for removing a director shall not be deemed to have been passed if the number of votes cast against it is equal to, or exceeds:

- a. 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 removal of a director elected in the manner provided in sub-section (5) of Section 178; or
- b. 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 a director appointed under Section 176 or Section 180.

80. Vacation of Office

A director shall ipso facto cease to hold office if:

- a. he becomes ineligible to be appointed a director on any one or more of the grounds enumerated in Section 187.
- b. he absents himself from three consecutive meetings of directors, or from all the meetings of the directors for a continuous period of three months, whichever is the longer, without leave of absence from the directors
- c. he or any firm of which he is a partner or any private company of which he is a director :
 - i. 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 legal or technical adviser or a banker: or
 - ii. accepts a loan or guarantee from the company in contravention of Section 195.

CHIEF EXECUTIVE

81. First Appointment

The directors of the company as from a not later than the fifteenth day after the date of its incorporation appoint any individual to be the chief executive, of the Company.

82. Form of Office

The chief executive appointed as aforesaid shall, unless he earlier resigns or otherwise ceases to hold offices, hold the first annual general meeting of the company or, if a shorter period is fixed by the directors at the time of his appointment, for such period.

83. Remuneration

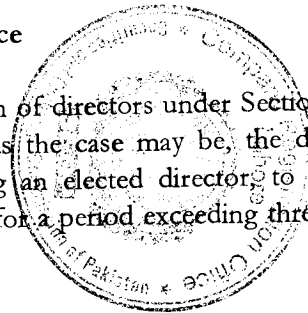
The remuneration of the Chief Executive shall be fixed by the directors from time to time.

84. Power of Chief Executive

The Chief Executive of the Company shall, subject to the provisions of Section 196 of the Ordinance, have such powers of financial, administrative and operational nature that are delegated by the Board of Directors.

85. Subsequent Appointment and Term of Office

Within fourteen days from the date of election of directors under Section 178 or the office of the chief executive falling vacant, as the case may be, the directors of a company shall appoint any person, including an elected director, to be the chief executive, but such appointment shall not be for a period exceeding three years from the date of appointment.



86. Eligibility for Reappointment

On the expiry of his term of office under Section 198 or 199, a chief executive shall be eligible for reappointment.

87. Continuation of office until appointment of Successor

The chief executive retiring under Section 198 or 199 shall continue to perform his functions until his successor is appointed unless non-appointment of his successor is due to any fault on his part or his office is expressly terminated.

88. Terms and Conditions

The terms and conditions of appointment of a chief executive shall be determined by the directors.

89. Deemed to be Director

The chief executive shall, if he is not already a director of the company, be deemed to be its director and be entitled to all the rights and privileges, and subject to all the liabilities, of that office.

90. Ineligibility

No person who is ineligible to become a director of a company under Section 187 shall be appointed or continue as chief executive of the company.

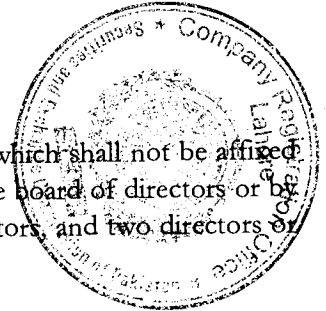
91. Removal

The directors of a company by resolution passed by not less than three fourths of the total number of directors for the time being, or the company by a special resolution, may remove a chief executive before the expiration of his of office notwithstanding anything contained in these Articles or in any agreement between the company and such chief executive.

SEAL

92. Common Seal

The directors shall provide a common seal of the company which shall not be affixed to any instrument except by the authority of resolution of the board of directors or by committee of directors authorised in that behalf by the directors, and two directors or one director.



93. Office Seal

The directors may provide for the use in any territory, district or place not situated in Pakistan, of an official seal which shall be facsimile of the common seal of the company, with addition on its face of the name of every territory, district or place where it is to be used. The provisions of Section 213 shall apply to the use of such official seal.

DIVIDENDS AND RESERVES

94. Declaration of Dividend

The company in a general meeting may declare dividends but no dividend shall exceed the amount recommended by the directors.

95. Interim Dividend

The directors may from time to time pay to the members such interim dividends as appear to the directors to be justified by the profits of the company.

96. Dividend out of Profits only

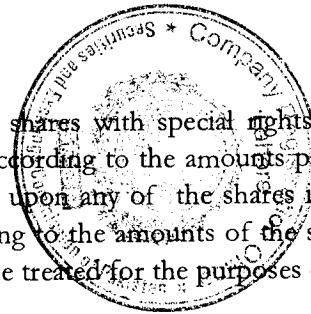
No dividends shall be paid otherwise than out of profits of the year or any other undistributed profits.

97. No Dividend out of Capital Profit

No dividend shall be declared or paid out of profits made from sale or disposal of any immovable property or assets of a capital nature comprised in the undertaking except after such profits are set off or adjusted against losses arising from the sale of any such immovable property or assets of capital nature.

98. Dividend in Proportion to Amount paid

Subject to the rights of persons (if any) entitled to shares with special rights as to dividends, all dividends shall be declared and paid according to the amounts paid on the shares, but if and so long as nothing is paid upon any of the shares in the company, dividends be declared and paid according to the amounts of the shares. No amount paid on a share in advance of calls shall be treated for the purposes of this regulation as paid on the share.



99. Dividend in Specie

Any general meeting declaring a dividend may resolve that such dividends be paid wholly or in part by the distribution of specific assets and in particular of paid up shares or debentures either of the company or in any one or more such ways.

100. Transfer to Reserve

The directors may, before recommending any dividend, set aside out of the profits of the company such sums as they think proper as a reserve or reserves which shall, at the discretion of the directors, be applicable for meeting contingencies, or for equalizing dividends, or for any other purpose to which the profits of the company may be properly applied, and pending such application may, at the like discretion, either be employed in the business of company or be invested in such investments (other than shares of the company) as the directors, may, subject to the provisions of the Ordinance, from time to time think fit.

101. Retention of Profit

The directors may carry forward any profit which they may think prudent not to distribute, without setting them aside as a reserve.

102. Capitalisation of Reserve

Any General Meeting may resolve that moneys, investment or other assets forming part of the Company standing to the credit of the Reserve Fund or in the hands of the Company and available for dividend or representing premiums received on the issue of shares and standing to the credit of the shares premium accounts be capitalised and distributed amongst such of the shareholders as would be entitled to receive the same if distributed by way of dividend and in the same proportions on the footing that they become entitled thereto as capital and that all or any part of such capitalised funds be applied on behalf of such shareholder in paying up in full any unissued shares of the Company which shall be distributed accordingly and that such distribution or payment shall be accepted by such shareholders in full satisfaction of their interest in the said capitalised sum.

103. Dividend to Registered holders only

Dividend shall be paid only to registered holders of such shares or to his banker or to his order to a financial institution nominated by the shareholder.

104. Effect of Transfer

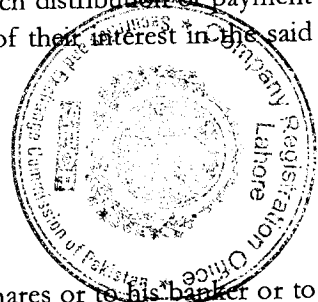
A transfer of shares shall not pass the right to any dividend declared thereon before the registration of the transfer.

105. Retention in certain cases

The Directors may retain the dividends payable upon shares in respect of which any person is under the transmission clause entitled to become a member or which any person under that clause is entitled to transfer until such person becomes a member in respect thereof or shall duly transfer the same.

106. Dividend to joint holders

Any one of the several persons who are registered as the joint holders of any share may give effectual receipt for all dividends and payments on account of dividends in respect of such share.



107. Mode of Payment

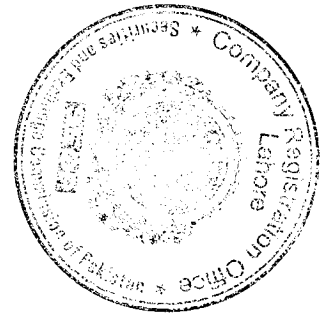
Unless otherwise directed any dividend may be paid by cheque or warrant sent through the post to the registered address of the member entitled, or in the case of joint holders to the registered address of that one whose name stands first on the register in respect of the joint holding and every cheque or warrant so sent shall be made payable to the order of the person to whom it is sent.

108. Unclaimed dividend

All dividends unclaimed for one year after having been declared may be invested or otherwise made use of by the directors for the benefit of the Company until claimed.

109. Time of Payment

The dividends shall be paid within the period laid down in Section 251.



BOOKS AND ACCOUNTS

110. Books of Account

The directors shall cause to be kept proper books of account as required under Section 230.

111. Place where Books of Account kept

The books of account shall be kept at the registered office of the company or at such other place as the directors shall think fit and shall be open to inspection by the directors during business hours.

112. Inspection by Members

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 authorised by the directors or by the company in general meeting.

113. Annual Accounts

The directors shall as required by Sections 233 and 236 cause to be prepared and to be laid before the company in general meeting such profit and loss accounts or income and expenditure accounts and balance sheets duly audited and reports as are referred to in those sections.

114. Presentation of Annual Accounts before Annual General Meeting

A balance sheet, profit and loss account, income and expenditure account and other reports referred to in clause 113 above shall be made out in every year and laid before the company in the annual general meeting made upto a date not more than four months before such meeting. The balance sheet and profit and loss account or income and expenditure account shall be accompanied by a report of the auditors of the company and the report of directors.

115. When Accounts Settled

Every account of the company when audited and approved by a general meeting shall be conclusive except as regards any errors discovered therein within three months next

after the approval thereof. Whenever any such error is discovered within that period, the account shall forthwith be corrected and thenceforth shall be conclusive.

116. Copies to be sent to Members

A copy of the balance sheet and profit and loss account or income and expenditure account and reports of directors and auditors shall, at least twenty one days preceding the meeting, be sent to the persons entitled to receive notices of general meeting in the manner in which notices are to be given hereunder.

117. Compliance with the Ordinance

The directors shall in all respect comply with the provisions of Sections 230 to 236.

AUDIT

118. Audit

Auditors shall be appointed and their duties regulated in accordance with Sections 252 to 255.

NOTICES

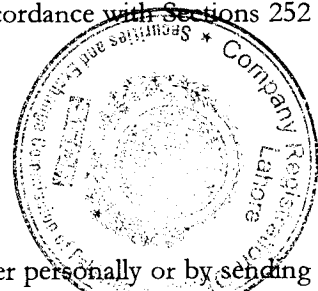
119. Mode of Service of Notice

A notice may be given by the company to any member either personally or by sending it by post to him to his registered address or (if he has no registered address in Pakistan) to the address, if any within Pakistan supplied by him to the company for the giving of notices to him. Where a notice is sent by post, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting 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.

120. Notice by Newspaper

If a member has no registered address in Pakistan, and has not supplied to the company an address within Pakistan for the giving of notices to him, the Company shall comply with the requirements of section of the Ordinance.

121. Notice to joint holders



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.

122. Notice to person entitled to transmission

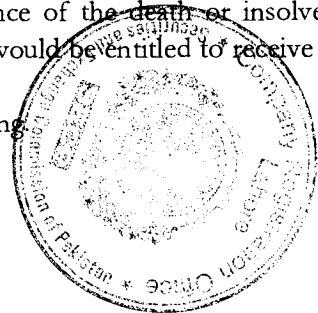
A notice may be given by the company to the persons entitled to a share in consequence of the death or insolvency of a member by sending it through post in a prepaid letter addressed to them by name, or by the title of representatives of the deceased, or assignee of the insolvent or by any like description, at the address if any) in Pakistan supplied for the purpose by the person claiming to be so 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.

123. Notice of General Meeting

Notice of every general meeting shall be given in same manner hereinbefore authorized to:

- a. every member of the company except those members who, having no registered address within Pakistan, have supplied to the company an address within Pakistan for the giving of notices to them, and also to;
- 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; and
- c. to the auditors of the company for the time being.

SECRECY



124. Secrecy

Every Director, Chief Executive, Secretary, Auditor, Trustee, Member of Committee, Officer, Servant, Agent, Accountant or other person employed in the business of the Company shall, if so required by the directors before entering upon his duties, sign a declaration pledging himself to observe a strict secrecy respecting all transactions of the company with the customers and the state of accounts with individuals and in matters relating thereto and shall by such declaration pledge himself not to reveal any of the matters which may come to his knowledge in the discharge of his duties except when required to do so by the directors or by any meeting or by a court of law or by the person to whom such matters relate and except so far as may be necessary in order to comply with any of the provisions in these presents.

125. Member's Access to Company Premises

No member or other person (not being a director) shall be entitled to enter the property of the company or examine the company's premises or properties without the permission of a director, subject to Article 125 to require discovery of or any information respecting any detail of the Company's trading or any matter which is or may be in the nature of a trade secret, mystery of trade or secret process or of 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 inexpedient in the interest of the members of the company, to communicate.

WINDING UP

126. Division of Assets in Specie

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, 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.

127. Valuation by Liquidator

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.

128. Assets in Trust

The liquidator may, with the like sanction, vest the whole or any part of such assets in trustees upon such trust for the benefit of the contributories as the liquidator, with the like sanction, thinks fit, but so that no member shall be compelled to accept any shares or other securities whereon there is any liability.

INDEMNITY

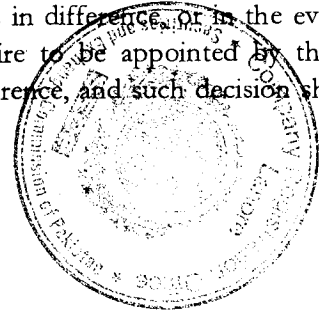
129. Director's and other's right to Indemnify

Every officer or agent for the time being of the company may be indemnified out of the assets of the company against any liability incurred by him in defending any proceedings, whether civil or criminal, arising out of his dealings in relation to the affairs of the company, except those brought by the company against him, in which judgment is given in his favour or in which he is acquitted, or in connection with any application under Section 488 in which relief is granted to him by the Court.

ARBITRATION

130. Differences to be referred to

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, the true intent or construction, or the incident or consequences of these Articles or of the statutes, or touching anything there or thereafter done, executed, omitted or suffered in pursuance of these Articles or of the statutes or touching any breach or alleged breach of these Articles, or any claim on account of any such breach or alleged breach, or otherwise relating to the premises, or to these Articles or to any statute affecting the company or to any of the affairs of the Company, every such difference shall, as a condition precedent to any other action at law be referred in conformity with the Arbitration Act, 1940, or any statutory modification thereof and any rules made thereunder, to the decision of an arbitrator to be appointed by the parties in difference or if they cannot agree upon a single arbitrator to the decision of two arbitrators of whom one shall be appointed by each of the parties in difference, or in the event of the two arbitrators not agreeing, then of an umpire to be appointed by the two arbitrators, in writing, before proceeding on the reference, and such decision shall be final and binding on the parties.



We the several persons, whose name and addresses are subscribed, are desirous of being form into a Company, in pursuance of this Articles of Association and to take the number of shares in the capital of the Company set opposite to our respective names.

Sr. No.	Name and Surname (Present and former) In full block letters	Father's/ Husband's Name in full	Nationality with any former Nationality	Occupation	Residential Address in Full	Number of shares taken by each subscriber	Signature of the subscriber
1	Mr. NADEEM MALIK CNIC No. 42301-8656497-9	S/o Riaz Malik	Pakistani	Business Foam Manufacturing	Plot No. 75, Khayaban-e-Shaheen, Phase VI, D.H.A, Karachi	300	<i>Nadeem Malik</i>
2	Mr. NAJEEB MALIK CNIC No. 35201-7088787-3 <i>3</i>	S/o Riaz Malik	Pakistani	Business Foam Manufacturing	Plot No. 321, Block K, Phase 1, Lahore Cantt Cooperative Housing Society, Lahore	300	<i>Najeeb Malik</i>
3	Mr. SHAHZAD MALIK CNIC No. 352019-295415-7	S/o Naveed Malik	Pakistani	Business	126- Y Block, Street No. 18, D.H.A. Lahore	<u>300</u>	<i>Shahzad Malik</i>
					TOTAL	<u>900</u>	

Dated 8th day of April, 2015

Witness to above signature

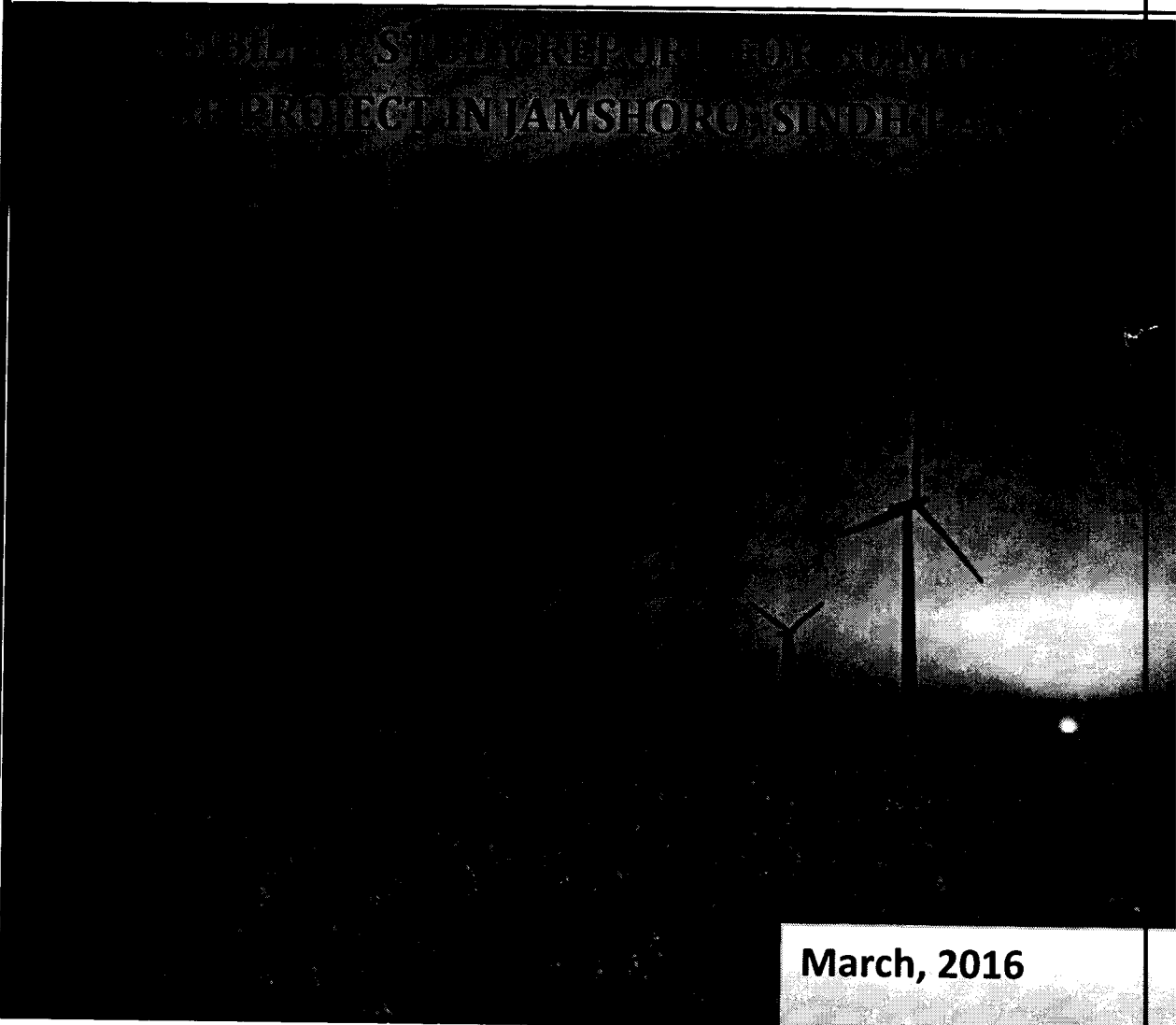
MR. AMIR MUSHTAQ BUTT S/O
MUSHTAQ AHMED BUTT

CNIC: 35202-3058104-1

82 – C-1, Gulberg III, Lahore.



Feasibility Study Report for Renewable Energy Project in Jamshoro, Sindh



March, 2016

Prepared by

Master Green Energy Limited

Consultants

Renewable Resources (Pvt.) Limited

APPROVAL SHEET

TITLE : Feasibility Study Report for 50 MW Wind Power
Project in Jamshoro-Sindh, Pakistan

DOCUMENT NUMBER : RE2-141-175-001 Issue: 01

CLASSIFICATION : **CONTROLLED**

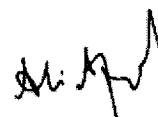
SYNOPSIS

This document is a feasibility study report of a 50 MW Wind Power Project sponsored by Master Group (Pvt.) Ltd. It contains the wind resource assessment, hardware specifications, energy yield estimates, electrical interface, civil works design and project cost. It also includes environmental impact assessment, soil investigations, site topography, grid interconnection studies and project management information. This report is prepared by RENEWABLE RESOURCES (Pvt.) Ltd Pakistan.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 2

DATE : April, 2016

PREPARED BY :



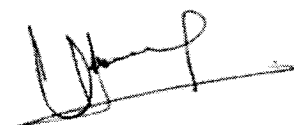
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Renewable Resources (Pvt.) Ltd

ali@renewableresources.com.pk

REVIEWED BY :



(Salman Nazir Raja)

Head of Projects

Renewable Resources (Pvt.) Ltd

salman@renewableresources.com.pk

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Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 4

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	14
DISCLAIMERS	14
COPY RIGHT NOTICE	14
COMPANY's CONTACT INFORMATION	15
CONSULTANT's CONTACT INFORMATION	15
DOCUMENT INFORMATION	16
1 EXECUTIVE SUMMARY	17
1.1 PROJECT OVERVIEW AND SITE	18
1.1.1 Project Size	20
1.1.2 Project Status and Calendar	20
1.1.3 Wind Resource Assessment (WRA)	22
1.1.4 Energy Yield Estimates	22
1.1.5 Geological Conditions	22
1.1.6 Design of Civil Works	23
1.1.7 Design of Electrical Works	23
1.1.8 Construction Management	23
1.1.9 O & M Management	24
1.1.10 Environmental Management	24
1.1.11 Health and Safety	25
1.1.12 CDM Aspect	25
1.2 LIST OF ANNEXURE	26
1.3 PROJECT TEAM	27
1.3.1 Master Green Energy Ltd. (MGEL)	27
1.3.2 Renewable Resources (Pvt.) Ltd – Project Consultant	27
1.3.3 Power Planners International– Electrical and Grid Studies (PPI)	28
2 COUNTRY AND INDUSTRY OVERVIEW	29
3 REGULATORY REGIME	30
3.1 MINISTRY OF WATER AND POWER	30
3.2 ALTERNATIVE ENERGY DEVELOPMENT BOARD	30
3.3 NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)	31
3.4 NATIONAL TRANSMISSION AND DISPATCH COMPANY (NTDC)	31
3.5 Directorate of Alternate Energy, Energy Department, Government of Sindh	32

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 5

4	CARBON CREDITS	32
4.1	EMISSION REDUCTION MECHANISMS	34
4.1.1	Emissions Trading	34
4.1.2	Clean Development Mechanism (CDM)	34
4.1.3	Joint Implementation (JI)	34
4.2	ROLE OF CDM IN MGEL PROJECT	35
5	WIND INDUSTRY IN PAKISTAN	36
5.1	CURRENT STATUS OF WIND IPPs IN PAKISTAN	36
5.1.1	Letter of Intent (LOI)	36
5.1.2	Land Allocation by AEDB / GOS	36
5.1.3	Projects at Advanced Stages	37
5.1.4	Projects at Advanced Development Stages	38
5.1.5	Projects at Initial Development Stages	38
5.2	TARIFF REGIME IN PAKISTAN	39
5.2.1	Negotiated Tariff for Wind IPPs	39
5.2.2	Upfront Tariff for Wind IPPs	39
6	PROJECT IN TERMS OF POLICY FRAMEWORK	40
6.1	LETTER OF INTENT (LOI)	40
6.2	ACQUISITION OF LAND	40
6.3	FEASIBILITY STUDY	40
6.4	GENERATION LICENSE	40
6.5	TARIFF DETERMINATION	40
6.6	LETTER OF SUPPORT (LOS)	41
6.7	ENERGY PURCHASE AGREEMENT (EPA)	41
6.8	IMPLEMENTATION AGREEMENT (IA)	41
6.9	FINANCIAL CLOSE	41
7	PROJECT SITE	42
7.1	WIND CORRIDOR OF PAKISTAN	42
7.2	SITE DETAILS	43
7.3	TRANSPORTATION AND ACCESS NETWORK	46
7.4	CLIMATIC CONDITIONS	48
7.5	TELECOMMUNICATION	49
7.6	EARTHQUAKES	49

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 6

8	WIND RESOURCE ASSESSMENT AND ENERGY YIELD ESTIMATES	50
9	SELECTION OF WTG AND EPC CONTRACTOR	51
10	GEOLOGICAL CONDITIONS	52
10.1	OBJECTIVES OF GEOTECHNICAL STUDIES	52
10.2	GEOLOGY OF KARACHI REGION AND SURROUNDINGS	52
10.3	SEISMOLOGY OF KARACHI REGION	56
10.4	FIELD WORK	58
10.4.1	Borehole Drilling	58
10.4.2	Rock Core Drilling	59
10.4.3	Location of Boreholes	60
10.4.4	List of Field and Lab Tests	61
10.5	CONCLUSIONS OF GEOTECHNICAL STUDIES	61
11	CIVIL ENGINEERING DESIGN	62
12	ELECTRICAL ENGINEERING DESIGN	63
13	CONSTRUCTION MANAGEMENT	65
14	Initial Environment Examination (IEE)	67
15	CONCLUSIONS OF FEASIBILITY STUDY	70
	LIST OF ANNEXURE	71

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 7

LIST OF FIGURES

Figure 1: Geographical Location of MGEL Site	18
Figure 2: MGEL Satellite Map	19
Figure 7-1: Wind Map of Pakistan by NREL	42
Figure 7-2: MGEL Site Location	44
Figure 10-1: Tectonic Map of Pakistan	54
Figure 10-2: Geological and Sub Surface details of Jamshoro	55
Figure 10-3: Seismic Map of Pakistan	57

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 8

LIST OF TABLES

Table 1-1: Project Planned Milestones	20
Table 1-2: Project Construction Scheduling.....	21
Table 7-1: Climate Conditions of Karachi	48
Table 10-1: Earthquake Records around Karachi	56
Table 10-2: Seismic Parameters of Karachi	56
Table 10-3: Location of Boreholes during Geo Technical Investigations (UTM zone 42R).....	60
Table 13-1: Project Construction Scheduling.....	66

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 9

LIST OF ABBREVIATIONS

AC	Alternate Current
AEDB	Alternative Energy Development Board
ASL	Associated Surveyors (Pvt.) Ltd
C.R	Core Recovery
CDM	Clean Development Mechanism
CFCs	Chlorofluoro Carbons
CH4	Methane
Cm	Centimeter
CMA	Certified Management Accountant
CNG	Compressed Natural Gas
CNOOC	China National Offshore Oil Corporation
CO2	Carbon dioxide
CoP	Conference of the Parties
CPPA	Central Power Purchasing Agency
DC	Direct Current
DGPS	Dual Global Positioning System
DISCOs	Distribution Companies
EE	Energy Efficiency
EMC	Electromagnetic Compatibility

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 10

EMP	Environment Management Plan
EPA	Energy Purchase Agreement
EPC	Engineering Procurement Construction
EU	European Union
GDP	Gross Domestic Product
GENCOs	Generation Companies
GHG	Green House Gas
GIS	Geographic Information System
GoP	Government of Pakistan
GPS	Global Positioning System
GW	Gold Wind
HAWT	Horizontal Axis Wind Turbine
HESCO	Hyderabad Electric Supply Corporation
DAE-EDGoS	Directorate of Alternative Energy, Energy Department, Govt. of Sindh
Hz	Hertz
IEE	Initial Environmental Examination
IPPs	Independent Power Producers
JI	Joint Implementation
KESC	Karachi Electric Supply Company
km	Kilometer

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 11

kV	Kilovolt
KW	Kilowatt
LNG	Liquefied Natural Gas
LOI	Letter of Intent
LOS	Letter of Support
m ²	Meter square
m ³ /h	Meter cube per hour
MTDF	Medium Term Development Framework
MVA	Million Volt-Ampere
MW	Megawatt
N ₂ O	Nitrous Oxide
NCS	National Conservation Strategy
NEPRA	National Electricity Power Regulatory Authority
NEQS	National Environmental Quality Standards
NOCs	No Objection Certificates
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Dispatch Company
O & M	Operation & Management
OHL	Overhead Lines
PAEC	Pakistan Atomic Energy Commission
PEPA	Pakistan Environment Protection Act

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 12

PLC	Programmable Logic Control
PMD	Pakistan Meteorological Department
PPIB	Private Power Infrastructure Board
PVC	Poly Vinyl Carbonate
QC	Quality Control
R & D	Research and Development
RE	Renewable Energy
RE2	Renewable Resources (Pvt.) Ltd
RQD	Rock Quality Designation
SEC/SCECO	Saudi Electricity Company
SF6	Sulfur Hexafluoride
SHYDO	Sarhad Hydro Development Organization
SPT	Standard Penetration Test
UPS	Uninterruptible Power Supply
USA	United States of America
VAWT	Vertical Axis Wind Turbine
VRLA	Valve Regulated Lead Acid
WAPDA	Water And Power Development Authority
WASP	Wind Atlas and Application Programme
WMO	World Metrological Organization
WTG	Wind Turbine Generator

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 13

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The management of Master Green Energy Ltd is thankful to Ministry of Water and Power and the dedicated team of Directorate of Alternate Energy (DAE) Sindh for generous support at all stages of project development and looks forward for their continued support.

The management of Master Green Energy Ltd also recognizes the kind cooperation of concerned Government departments (NEPRA, NTDC, HESCO).

DISCLAIMERS

This report is prepared for the benefit of Master Green Energy Ltd (MGEL) (the "Client"), and may not be relied upon or disclosed to any other person for any purpose, other than as stated below, without the Client's prior written consent in each specific case. The information contained in this report is intended to be used by the Client for such other purpose as may be necessary for the development and implementation of the Project.

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Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 14

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Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 15

DOCUMENT INFORMATION

Purpose and Scope:

The purpose of this report is to provide information required for the relevant agencies to make informed decision regarding the implementation and execution of this project.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 16

1 EXECUTIVE SUMMARY

Located on the western stretch of the South Asian Continent, the Islamic Republic of Pakistan is largely under the influence of tropical desert climate. The thermal depression of South Asia and the monsoon winds shape up Pakistan's southern coastal areas and northern mountain areas into a land rich in wind energy resources. The coastal wind-energy-rich areas normally refer to Southern Sindh and the vast plateau to the east and the northeast of Karachi city. The relative shortage of conventional energy resources in Pakistan and the hiking of fuel prices worldwide spurred the Pakistan Government to find alternative sources, including wind power.

Government of Sindh has formulated a policy to encourage the participation of private sector in the development and application of renewable energies. A Government organization called Department of Alternate Energy, Sindh (DAE, Sindh) has been established to facilitate the implementation of renewable energy projects.

At present, six (06) wind power projects of capacity approx. 50 MW each are in operation. A total of eight projects (six of 50 MW each, one of 99 MW and one of 30 MW) have achieved financial close and entered construction.

Master Green Energy Ltd (MGEL) is owned by Master Group, which already has another project of 50 MW in construction phase. The group now plans to install a Wind Power Project of 50 MW installed capacity and to accept the upfront tariff. In this regard, MGEL has an LOI of from Government of Sindh (GOS).

The wind farm Project of 50 MW of Master Green Energy Limited is in Goth Dehson Walhar, District Jamshoro, Sindh. Government of Sindh has identified suitable land for the project and the land lease will be executed in due course. The Karachi Hyderabad Motorway (Super Highway) is the connecting road to the MGEL project site. The total land area of the Project is 300 acres.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 17

This document is the complete feasibility study of the project including but not limited to soil investigations, topographic studies, wind resource assessment, energy yield estimates, environmental impact assessment, electrical and grid interconnection studies.

1.1 PROJECT OVERVIEW AND SITE

MGEL is the Project Company for 50 MW Wind power project located in Jamshoro, Sindh, that is towards North-East of Karachi. The Project site consists of 300 acres of land, which has been identified by GoS to the project company. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site.

The figure 1 shows site overview.

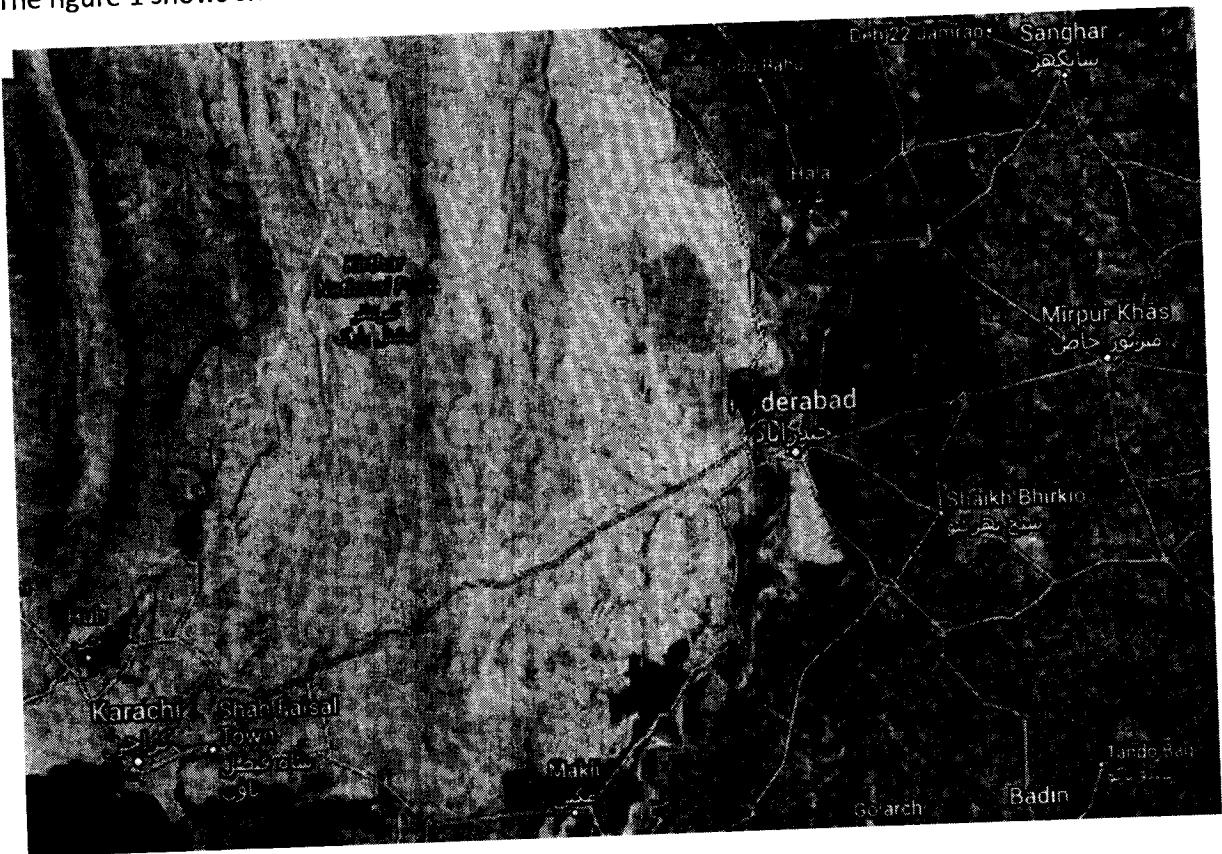


Figure 1: Geographical Location of MGEL Site

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 18

The terrain is flat at the Project Site with little vegetation; savanna is mostly observed. There are some very small and scattered pieces of agricultural lands. The area has mostly dry climate. The satellite map of Project Site is shown in Figure 2.



Figure 2: MGEL Satellite Map

Further details of Site are given in Section 07 and Site Transportation and Access Study is attached as Annex II.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 19

1.1.1 Project Size

The Project shall have an installed capacity of 50 MW spread over a land area of 300 acres.

1.1.2 Project Status and Calendar

The project calendar is given below:

Table 1-1: Project Planned Milestones

Activity / Milestone	2017				2018				2019
	1 st QTR	2 nd QTR	3 rd QTR	4 th QTR	1 st QTR	2 nd QTR	3 rd QTR	4 th QTR	1 st QTR
Time consumed in Land arrangement and Grid Data.									
Preparation of Feasibility									
Submission of Feasibility Study									
Approval of Feasibility Study									
Generation License									
Upfront Tariff									
Signing of EPA									
Signing of IA									
Financial Close									
Project Construction									
Start of Operations									

The project construction shall take 18 months from the date of planning till the COD.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 20

Table 1-2: Project Construction Scheduling

Activity / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Engineering and Mobilization																		
Construction of Temporary Establishment																		
Civil Works of WTGs and Substation																		
Construction of Substation																		
Supply of WTGs and Towers																		
Cables and Interconnection																		
Erection and Installation																		
Testing and Commissioning of EBOP																		
Testing and Commissioning of WTGs																		
EPA Tests and Reliability Run Test																		

Document Title:
Feasibility Study Report for 50MW
Wind Power Project in Jamshoro,
Sindh-Pakistan

Consultant Name:
Renewable Resources (Pvt.) Ltd

Project Sponsor:
Master Group (Pvt.) Ltd

Document No:
RE2-141-175-001

Document Issue
01

Date of Approval
March, 16

Page
21

1.1.3 Wind Resource Assessment (WRA)

A separate study has been carried out for the WRA including complete analysis of wind data and long term correlation.

1.1.4 Energy Yield Estimates

The energy yield estimates have been generated including development of wind farm layouts, determination of energy yields and uncertainty assessments.

1.1.5 Geological Conditions

The information related to geological conditions is given in Section 11. The detailed Geotechnical Investigation Report is attached as Annex V.

There were 10 bore holes with average depth of 15 meters.

The Sub-surface conditions disclosed by this investigation show a highly fissured chalky limestone with cavities in all borehole locations. The top soil is composed of alluvium material and its thickness ranges from 0.70 – 3.0m. The rocky formation displays a significant degree of fracturing which has weakened it.

The Site does not require special consideration for buried works. In general, it is a practice to provide dense, low permeability concrete to prevent degradation due to chemical attack. As such the use of Ordinary Portland Cement is recommended.

Ground water was not encountered in all boreholes up to the end of each boring.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 22

1.1.6 Design of Civil Works

Information related to the civil works is given in Section 12.

1.1.7 Design of Electrical Works

Information related to the electrical works is given in Section 13.

The Project has an installed capacity of 50 MW, using wind turbine generators (WTG), each with a capacity in the range of 1.5 – 3.3 MW. A substation consisting of step up transformer and other BOP equipment will connect the farm to the 132 kV power lines. Each WTG in the wind power station will have a capacity in the range of 1.5 – 3.3 MW, with an output voltage of 0.62 - 0.69 kV. The power from the turbine will be stepped up to Medium voltage (MV) through a generator step up transformer, which will be housed in a separate compartment in close proximity to the wind turbine tower. Power from all the WTGs in the plant will be delivered to the substation, and onwards to the grid via the step up transformers and HV switchgear, built within the boundaries of the wind power plant. The switchgear gantries will be the point of metering and connection to the 132 kV power lines.

Grid interconnection point and required reactive power compensation, if any, for the project shall be as per the findings of the grid interconnection study.

Please refer to the Grid Interconnection Study attached as Annex VI.

1.1.8 Construction Management

Construction will be undertaken by a specialist EPC Contractor, under a fixed-price, fixed schedule, lump-sum EPC contract. The process will be supervised by Renewable Resources to ensure compliance with international standards and norms.

Further information related to the construction management is given in Section 14.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 23

1.1.9 O & M Management

The EPC Contractor will undertake the O&M of the project for the initial 2 years of operations (Warranty Period) followed by a complete Field Service Agreement with an O&M operator till the end of ten years of operations. The local team shall remain part of the O&M and shall gradually take over after having On Job Trainings (OJT).

O&M management will be established with the principle of requiring "few on-duty staff". After entering the electrical equipment and machinery to their stable operation mode, the wind turbine and associated apparatus shall be managed with "no on-call staff and few on-guard staff".

The production area includes facilities such as generators, transformers, and the substation. There shall be buildings for protection and control, telecommunication, DC power supply and for administrative purposes.

1.1.10 Environmental Management

An Initial Environmental Examination for the Project has been carried out by RE2. It was concluded that the project provides significant environmental benefit as it replaces fossil fuel generation in the energy mix. With the adoption of some minor mitigation measures, the environmental footprint during the construction phase can also be minimized to a negligible level. The project is expected to meet all statutory and environmental requirements. The Initial Environment Examination (IEE) report is attached as Annex VII.

A data collection survey was also done that included geology, meteorology, hydrology, ambient air quality, water quality, soil characteristics, noise levels, shadow forecasting, flora and fauna, land use pattern, and socioeconomic conditions.

Information related to the environmental management works is given in Section 15.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 24

1.1.11 Health and Safety

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.

A safety and health supervision department will be established on the wind farm, which is to be in charge of the education, training and management of safety and health related issues after the project is put into operation. There will be safety personnel in the production section, and a part-time worker for the routine safety and health work.

The systems of patrol inspection, operation guardianship, maintenance and over-haul will be established for the daily maintenance of production equipment, instruments and apparatus. The safety and health supervision department will provide sound meter and other appropriate inspection equipment, as well as necessary public education service for production safety.

A comprehensive safety system will be established during the preparation phase, and carefully implemented during the construction process. The systems of work sheet, operation sheet, shift relief, patrol inspection, operation guardianship, maintenance and over-haul will be strictly implemented. The Safety Regulation of the wind farm will also be carefully observed to minimize accidents.

1.1.12 CDM Aspect

The Project is a power generation project with renewable resource and zero emission. When put into operation, the project can provide power supply to the southern Pakistan power grid, which currently is mainly relying on fossil fuel. Therefore, it can help to reduce the greenhouse gas emission from coal or oil-fired power generation. It can deliver good environmental and social benefits. It is also consistent with the spirit of the Kyoto Protocol and qualified for the application of CDM projects.

The Project Company intends to develop a CDM project according to the provisions of the prevailing Policy.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 25

1.2 LIST OF ANNEXURE

ANNEX – I: Pakistan Energy Profile and Global Wind Energy Stats

ANNEX – II: Transportation and Access Study Report

ANNEX – III: Wind Resource Assessment Report

ANNEX – IV: Energy Yield Estimates Report

ANNEX – V: Geo Technical Investigation Report

ANNEX – VI: Electrical Grid Interconnection Study Report

ANNEX – VII: Initial Environmental Examination (IEE) Report

ANNEX – VIII: Technology Details of WTGs.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 26

1.3 PROJECT TEAM

1.3.1 Master Green Energy Limited (MGEL)

Master Green Energy Limited (MGEL or the Project Company) is a special purpose company incorporated under the Company Ordinance 1984. The sole purpose of the company is to develop, construct, commission, operate and maintain a 50 MW wind power project.

Master Group, the main sponsor of Master Green Energy Limited, is one of the most dynamic and diverse business groups of Pakistan. The Sponsor started its operations by entering the bedding industry in 1963 as a licensee of Bayer A.G. (Germany) to manufacture foam mattresses in Pakistan and became a pioneer in the bedding industry; today, the Group is most widely known for the "Moltyfoam" mattress brand. Since its inception, the Group has grown rapidly, and has diversified into the textile, automobile, engineering and retail sectors.

1.3.2 Renewable Resources (Pvt.) Ltd - Project Consultant

www.renewableresources.com.pk

Renewable Resources (RE2) is the professional technical advisor for the Project. RE2 is a consulting company specialized in Renewable Energy (RE), Energy Efficiency (EE) and Environment (Env) Projects. The company is owned by group of professionals who have been intimately involved in the renewable energy program of Pakistan, and have a fundamental understanding of issues relating to power project development, which include but are not limited to feasibility studies, regulatory approvals, concession and security documents, and applicable policies.

RE2 is capable of conducting full feasibility package featuring power production estimates, grid interconnection and tariff model. RE2 also has the expertise to deal with all technical aspects regarding the legal documents of power projects. The professional team of RE2 is well acquainted with the policies, regulations, methodologies and standards of RE power Projects and its work output meets international standards. RE2 is presently a consultant for various power Projects in Pakistan sponsored by local and international investors, with international banks.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval: April March
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 27

1.3.3 Power Planners International– Electrical and Grid Studies (PPI)

PPI is a limited company registered in England and Wales and has a team of highly skilled and experienced professionals. Power Planners is also registered with Saudi Electricity Company (SEC), with Pakistan Engineering Council and Alternative Energy Development Board, Pakistan. It is a renowned company in power sector in the field of power system analysis and planning especially in the areas of grid interconnection studies of renewable energy resources such as wind, solar, small Hydal etc. PPI comprises of enterprising group of professionals to provide consultancy services for:

- ❖ Feasibility studies of new power plants of any nature; Hydel, Thermal, Wind-Farms and other renewable energy sources, and their interconnections with the main electrical grid.
- ❖ Feasibility Studies for cross-border or cross-country interconnections of electrical grids for power exchange.
- ❖ Analytical studies for electric utilities, Independent Power Producers (IPPs), Independent System Operators (ISOs) and industries, that are planning to add new facilities or seek solutions to problems in their existing systems to enhance power quantity and quality to their customers.
- ❖ Preparation of engineering, design and specifications for new power projects.
- ❖ Training and developing the human resource in technical skills for power planning and expansion of energy sources. PPI's engineers possess highly specialized skills, vast and profound experience, and expertise of the advanced and latest state-of-the art software prevailing in the contemporary power systems industry.

The team at PPI comprises of engineers having a work experience of 10 to 30 years with utilities and consultant companies in Pakistan and Middle East in the fields of transmission planning, power system analysis, load forecasting and generation planning for systems of wide range of operating voltages.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 28

2 COUNTRY AND INDUSTRY OVERVIEW

At this juncture, we are encountering the worst electricity crises of the history of Pakistan resulting in extended load shedding to an extent which virtually suspends economic and social life. The situation has further forced Government of Pakistan to take decisions like early market shutdown, power cutoff to industry, and two holidays per week thus affecting all business activities.

Pakistan's major electricity sources are thermal and hydro generation, meeting approximately 70% and 28% (respectively) of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil and gas. Oil import is a significant burden on the national exchequer. Import of gas could be seen as a viable option to overcome the depleting domestic reserves, but gas import has significant issues, mainly the need for substantial capital investment in infrastructure, security difficulties and physical terrain concerns. Moreover, it would still be an imported product.

Alternatives to further fuel imports for electricity generation are the use of domestic coal, or generation from hydro or other renewable sources, such as wind / solar power. These options will assist in reducing Pakistan's reliance on imported oil, and consequent vulnerability to changes in global oil prices which will in turn have a positive effect on the current trade deficit and inflating import bill.

Looking at how the country's future electricity needs might be met, wind has the potential of being a strong contributor in future because of being an indigenous resource and available in huge quantities in the country.

The detailed stats and situation of energy in Pakistan, specific information and prospects of wind and international trends in wind power sector is given in Annex I.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 29

3 REGULATORY REGIME

Power sector Pakistan has a ministry overlooking the electricity business in the country and a regulatory authority, independent of the ministry, to control the business practices in the market. There are a number of stakeholders involved in the cycle:

- ❖ Ministry of Water and Power
- ❖ National Electricity Power Regulatory Authority (NEPRA)
- ❖ National Transmission and Dispatch Company (NTDC)
- ❖ Central Power Purchase Authority Guarantee Limited (CPPAGL)
- ❖ Alternative Energy Development Board (AEDB)
- ❖ Punjab Power Development Board (PPDB)
- ❖ Directorate of Alternate Energy, Energy Department, Govt. of Sindh (DAE-GoS)

3.1 MINISTRY OF WATER AND POWER

The federal Ministry of Water and Power is the GoP's executive arm for all issues relating to electricity generation, transmission and distribution, pricing, regulation, and consumption. It exercises these functions through its various line agencies as well as relevant autonomous bodies. It also serves to coordinate and plan the nation's power sector, formulate policy and specific incentives, and liaise with provincial governments on all related issues.

3.2 ALTERNATIVE ENERGY DEVELOPMENT BOARD

Pakistan, like other developing countries of the region, is facing a serious challenge of energy deficit. Renewable Energy (RE) resources can play an important role in bridging this deficit. More importantly, RE can also play an important role in rural electrification. Realizing the importance of RE, the Government of Pakistan created the Alternative Energy Development Board (AEDB) in May 2003 to act as the central national body on the subject of Renewable Energy. The main objective of this Organization is to facilitate, promote and encourage development of Renewable Energy in Pakistan with a mission to introduce

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 30

Alternative/Renewable Energy at an accelerated rate to achieve 10 percent share of RE in the energy mix of the country.

The current initiative is directed towards creating a market-based environment that is conducive to private sector investment and participation. The AEDB provides a one-window point of operations for investors in the alternate energy sector. This is done in order to reduce the timeframe required for the completion of these projects, which are deemed essential to meet Pakistan's short term and long-term energy requirements.

3.3 NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

NEPRA has been created to introduce transparent and judicious economic regulation, based on sound commercial principles, in the electric power sector of Pakistan. NEPRA regulates the electric power sector to promote a competitive structure for the industry and to ensure the coordinated, reliable and adequate supply of electric power in the future. By law, NEPRA is mandated to ensure that the interests of the investor and the customer are protected through judicious decisions based on transparent commercial principles.

NEPRA remains the same platform for federal as well as provincial projects.

3.4 NATIONAL TRANSMISSION AND DISPATCH COMPANY (NTDC)

NTDC shall be the power purchaser. National Transmission & Dispatch Company (NTDC) Limited was incorporated on 3rd August 1998 and commenced commercial operation on 1st March 1999. It was organized to take over all the properties, rights and assets obligations and liabilities of 220kV and 500kV Grid Stations and Transmission Lines/Network owned by Pakistan Water and Power Development Authority (WAPDA). The NTDC operates and maintains nine 500kV Grid Stations, 4,160km of 500kV transmission line and 4,000km of 220kV transmission line in Pakistan.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 31

For low voltage power such as 11 kV, the autonomous distribution companies (commonly called as DISCOS) are the power purchasers. Functionally, DISCOS fall at a step lower than NTDC and are looking after low voltage assets.

3.5 Directorate of Alternate Energy, Energy Department, Government of Sindh

Directorate of Alternate Energy, Energy Department, and Government of Sindh is to solve matters relating to development, generation, supply and distribution of hydro and thermal power. It also determines of rates of supply to consumers in bulk and otherwise and may prescribe tariffs within the province except where entrusted to WAPDA. DAE, Energy Department is also responsible for perspective planning, policy formulation, processing of power projects and enactment of legislation with regard to thermal and hydro power generation and distribution.

4 CARBON CREDITS

The Kyoto Protocol to the United Nations Framework Convention on Climate Change will strengthen the international response to climate change. Adopted by consensus at the third session of the Conference of the Parties (COP) in December 1997, it contains legally binding emissions targets for industrialized countries. By arresting and reversing the upward trend in greenhouse gas emissions that started in these countries 150 years ago, the Protocol promises to move the international community one step closer to achieving the Convention's ultimate objective of preventing dangerous anthropogenic [man-made] interference with the climate system.

The developed countries are to reduce their collective emissions of six key greenhouse gases by at least 5%. This group target will be achieved through cuts of 8% by Switzerland, most Central and East European states, and the European Union (the EU will meet its group target by distributing different rates among its member states); 7% by the US; and 6% by Canada, Hungary, Japan, and Poland. Russia, New Zealand, and Ukraine are to stabilize their emissions, while Norway may increase emissions by up to 1%, Australia by up to 8%, and Iceland 10%. The six gases are to be combined in a "basket", with reductions in individual gases translated into "CO2 equivalents" that are then added up to produce a single figure.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 32

Each country's emissions target must be achieved by the period 2008 - 2012. It will be calculated as an average over the five years. "Demonstrable progress" must be made by 2005. Cuts in the three most important gases carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) will be measured against a base year of 1990 (with exceptions for some countries with economies in transition). Cuts in three long-lived industrial gases – hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulfur hexafluoride (SF₆) - can be measured against either a 1990 or 1995 baseline. A major group of industrial gases, chlorofluorocarbons, or CFCs, are dealt with under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer.

Actual emission reductions will be much larger than 5%. Compared to emissions levels projected for the year 2000, the richest industrialized countries (OECD members) will need to reduce their collective output by about 10%. This is because many of these countries will not succeed in meeting their earlier non-binding aim of returning emissions to 1990 levels by the year 2000, and their emissions have in fact risen since 1990. While the countries with economies in transition have experienced falling emissions since 1990, this trend is now reversing. Therefore, for the developed countries the 5% Protocol target represents an actual cut of around 20% when compared to the emissions levels that are projected for 2010 if no emissions-control measures are adopted.

The Kyoto Protocol provides that nations can redeem a part of their climate protection commitments by implementing projects aimed at reducing emissions in other countries. These projects are primarily to be carried out by the private sector.

These investment projects can financially benefit from generating additional emissions reductions as compared to a business as usual case.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 33

4.1 EMISSION REDUCTION MECHANISMS

There are three methods in Kyoto Protocol which permits the acquisition of emissions credits by means of project-based investment abroad:

4.1.1 Emissions Trading

Emissions or Carbon Trading, involves trading carbon emission credits within nations. Allowances are created, thereby making emissions a commodity that can be traded between industries etc. The Kyoto Protocol says that it is ok to trade in emissions, but that it should not be the major means to achieve one's commitments. Some European countries and corporations have started implementing such programs to get a head start and to see how well it will work.

4.1.2 Clean Development Mechanism (CDM)

Clean Development Mechanism (CDM) allows richer countries to offset their CO₂ emission against the emissions prevented when technology that cuts down on greenhouse gas emissions is deployed in poor countries.

4.1.3 Joint Implementation (JI)

Joint Implementation (also known as Activities Implemented Jointly) is where developed countries invest in emission-reducing activities in other industrialized countries, and gaining reduction units as a result.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 34

4.2 ROLE OF CDM IN MGEL PROJECT

The Project is a power generation project with renewable resource and zero emission. When put into operation, the project can provide power supply to the southern Pakistan power grid, which currently is mainly relying on fossil fuel. Therefore, it can help to reduce the greenhouse gas emission from coal or oil-fired power generation. It can deliver good environmental and social benefits. It is also consistent with the spirit of the Kyoto Protocol and qualified for the application of CDM projects. If the project is approved and registered as a CDM project, CERs can provide extra financial resource for the project. It will provide favorable conditions for the project financing, improve competitiveness of the project, and reduce investment risk during the project implementation process. The CDM benefits in the Project (if incurred) shall be availed according to the provision in the Policy.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 35

5 WIND INDUSTRY IN PAKISTAN

5.1 CURRENT STATUS OF WIND IPPs IN PAKISTAN

The wind energy sector of Pakistan has matured in the last few years. The major impediments delaying the development of wind power projects have been removed. Wind data of almost 10 years is available for two locations, i.e. Gharo and Jhimpir. All the stakeholders are now at the same frequency and are fully motivated to facilitate the development of wind power in the country.

Initially very few suppliers wanted to come to new market like Pakistan, but as the market has matured, many of the suppliers have invested in Pakistan and set up Pakistan offices. Today, GE, Nordex, Vestas and Goldwind are all active in the market.

5.1.1 Letter of Intent (LOI)

The total number of LOIs issued by AEDB and DAE Sindh for various projects till date is in the range of 50.

5.1.2 Land Allocation by AEDB / GOS

AEDB leased approximately 31,000 acres of land from GOS and further allocated land to twenty six (26) wind IPPs.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 36

5.1.3 Projects at Advanced Stages

Total of six (06) different projects with capacity of more than 300 MW have achieved their CODs. Following projects have started their commercial operations:

No.	Company	Capacity (MW)	COD
	FFC Energy Ltd	49.5	1st Quarter 2013
	Zorlu Energy	56.4	2nd Quarter 2013
	Foundation Wind Energy I	49.5	1st Quarter 2015
	Foundation Wind Energy II	50.0	4th Quarter 2014
	Three Gorges First Wind Farm Pakistan (Pvt) Ltd	50.0	4th Quarter 2014
	Sapphire Wind Energy Ltd	52.8	4th Quarter 2015.

Following projects have achieved financial close during 2014-15 and are currently under construction:

No.	Company	Capacity (MW)
	Yunus Energy Ltd	50.0
	Metro Power Company Ltd	50.0
	Gul Ahmed Wind Energy Ltd	50.0
	UEP Wind (Pvt) Ltd	99.0
	Master Wind Energy Ltd	52.8
	Tapal Wind (Pvt) Ltd	30.0
	HydroChina Dawood	49.5
	Tenega Genarsi	49.5

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 37

5.1.4 Projects at Advanced Development Stages

Following projects have reached the Generation License / Tariff stage so far:

No.	Company	Capacity (MW)
	HAWA Energy (Pvt) Ltd	49.3
	Jhimpir Power Ltd	49.3
	Hartford Energy (Pvt) Ltd	49.3
	Tricon Boston 1	49.3
	Tricon Boston 2	49.3
	Tricon Boston 3	49.3
	Three Gorges Second Wind Farm Ltd	49.5
	Three Gorges Third Wind Farm Ltd	49.5
	Western Energy Ltd	49.5

5.1.5 Projects at Initial Development Stages

During 2015, various projects have been issued LOIs by GOS. The approvals of land have arrived in most cases and final allotment letters are awaiting consent of Chief Minister, Sindh. All these projects are currently at different stages of feasibility study and EPC bidding. These include:

No.	Company	Capacity (MW)
	Master Green Energy Ltd	50.0
	Metro Wind Power Ltd	60.0
	Gul Ahmed Electric Ltd	50.0
	ACT2 Wind (Pvt) Ltd	50.0
	Artistic Wind Power (Pvt) Ltd	50.0
	Uni Energy Ltd	50.0
	Din Group	50.0
	Liberty Group	50.0
	Naveena Group	50.0

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 38

5.2 TARIFF REGIME IN PAKISTAN

5.2.1 Negotiated Tariff for Wind IPPs

The initial regime was of a negotiated tariff, which is still applicable. The Project Company justifies all its expenses and financial position to NEPRA through a petition. The NEPRA in return determines the project tariff on a "cost plus" basis. The Project Company is allowed 17% IRR on the equity. There are four projects so far at cost plus tariff and all are currently in operation phase.

5.2.2 Upfront Tariff for Wind IPPs

NEPRA announced a few upfront tariffs from time to time during past. The wind risk lies with the project company for upfront tariff. In lieu of it, the project companies can create cost efficiencies and draw maximum benefits from this "take and pay" basis. The indexations such as LIBOR / KIBOR, US\$ and inflation are available.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 39

6 PROJECT IN TERMS OF POLICY FRAMEWORK

6.1 LETTER OF INTENT (LOI)

First step was to obtain Letter of Intent from DAE GoS which was issued in October 15. This letter entitled the Project Company to start working on wind power project at official level and get support from DAE GoS and other government departments in the preparation of feasibility study and acquisition of land for the project. The feasibility is being submitted before expiration of LOI but after the dead line given in the LOI for the feasibility.

6.2 ACQUISITION OF LAND

The land is in process of acquisition from Government of Sindh in terms of legal formalities. However, the land has been identified by GOS for feasibility study.

6.3 FEASIBILITY STUDY

The feasibility study of the Project is being finalized in this document.

6.4 GENERATION LICENSE

Rights to produce and sell electricity in Pakistan are granted by NEPRA through "Generation License". Project Company will file an application to NEPRA for Generation License which authorizes a company to produce and sell electricity in the country.

6.5 TARIFF DETERMINATION

A separate application shall be prepared for approval of upfront tariff.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 40

6.6 LETTER OF SUPPORT (LOS)

Once the tariff is approved, the Project Company is required to move for arrangement of financing. DAE, EDGoS will issue a tripartite Letter of Support for the Project Company giving government guarantees until EPA and IA are fully effective to ensure sponsors and lender of the full government support. A bank guarantee of US\$ 2,500/MW shall be required to be submitted by the Project Company before issuance of LOS.

6.7 ENERGY PURCHASE AGREEMENT (EPA)

Agreement between the Power Purchaser and the Project Company is called Energy Purchase Agreement (EPA). This agreement lists terms and conditions for the sale and purchase of electricity between the two companies. As soon as the feasibility study is submitted and upfront tariff is filed, the Project Company shall enter into the discussions of EPA. This is going to be a significant step in the project development because no other project has negotiated an EPA with upfront tariff.

6.8 IMPLEMENTATION AGREEMENT (IA)

The Implementation Agreement (IA) provides security to the sponsors and lenders against the performance of the power purchases through guarantees from Government of Pakistan. Its discussions shall start alongside the EPA.

6.9 FINANCIAL CLOSE

Upon approval of feasibility study, grant of generation license, determination of tariff and the signing of project documents (EPA and IA); the Project Company shall move forward to complete the financial close. Discussions with lenders to arrange the financing have already been initiated.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 41

7 PROJECT SITE

7.1 WIND CORRIDOR OF PAKISTAN

Pakistan has 1046 km long coastal line with very encouraging wind regime. According to a study carried out by NREL and the wind masts installed in the Gharo and Keti Bandar wind corridor, the average wind speed in the region is 7.4 m/s making a regional potential of more than 50,000 MW. Wind Map of Pakistan by NREL is shown in figure below:

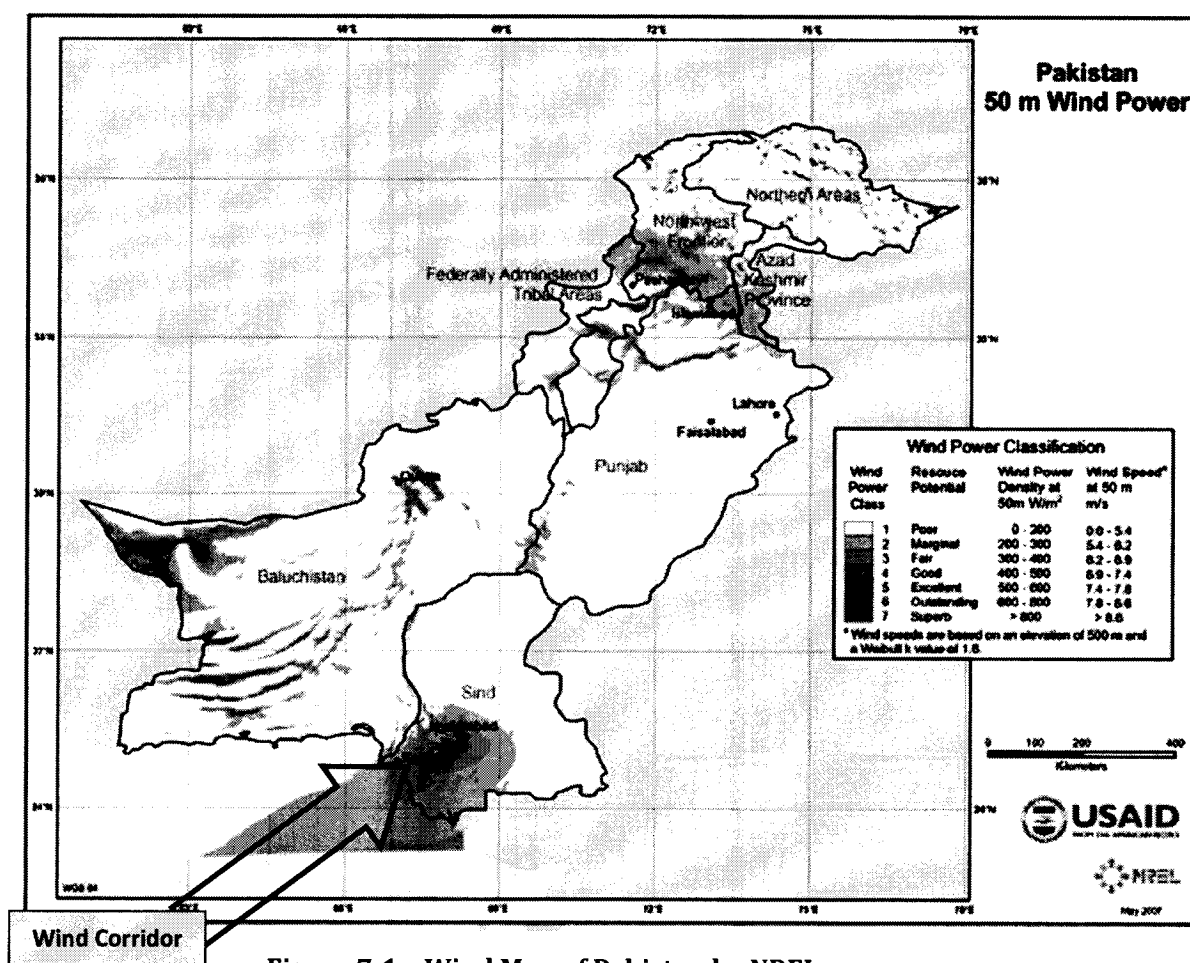
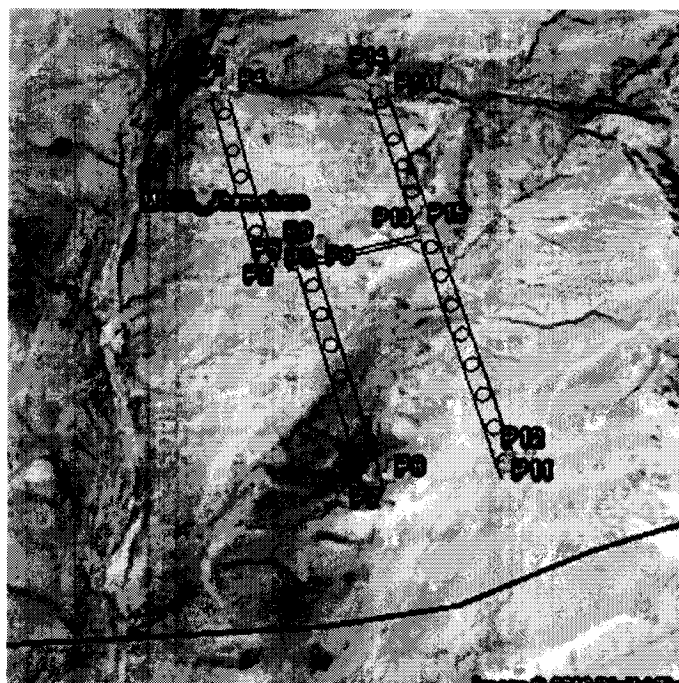


Figure 7-1: Wind Map of Pakistan by NREL

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 42

Based on the wind potential, Government of Pakistan initiated the wind power projects and facilitated land to the potential investors. The lands were allocated in Gharo, Bhambore and Jhimpir, where different wind power developers have taken the land. Later, GOS started facilitating the developers with land as well. MGEL is acquiring land in the Jamshoro block directly from GOS.

An overview of project site allocated in Jamshoro region is given below:



7.2 SITE DETAILS

The site is located near Jamshoro Sindh which is towards the North East of Karachi as shown in Figure below.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 43



Figure 7-2: MGEL Site Location

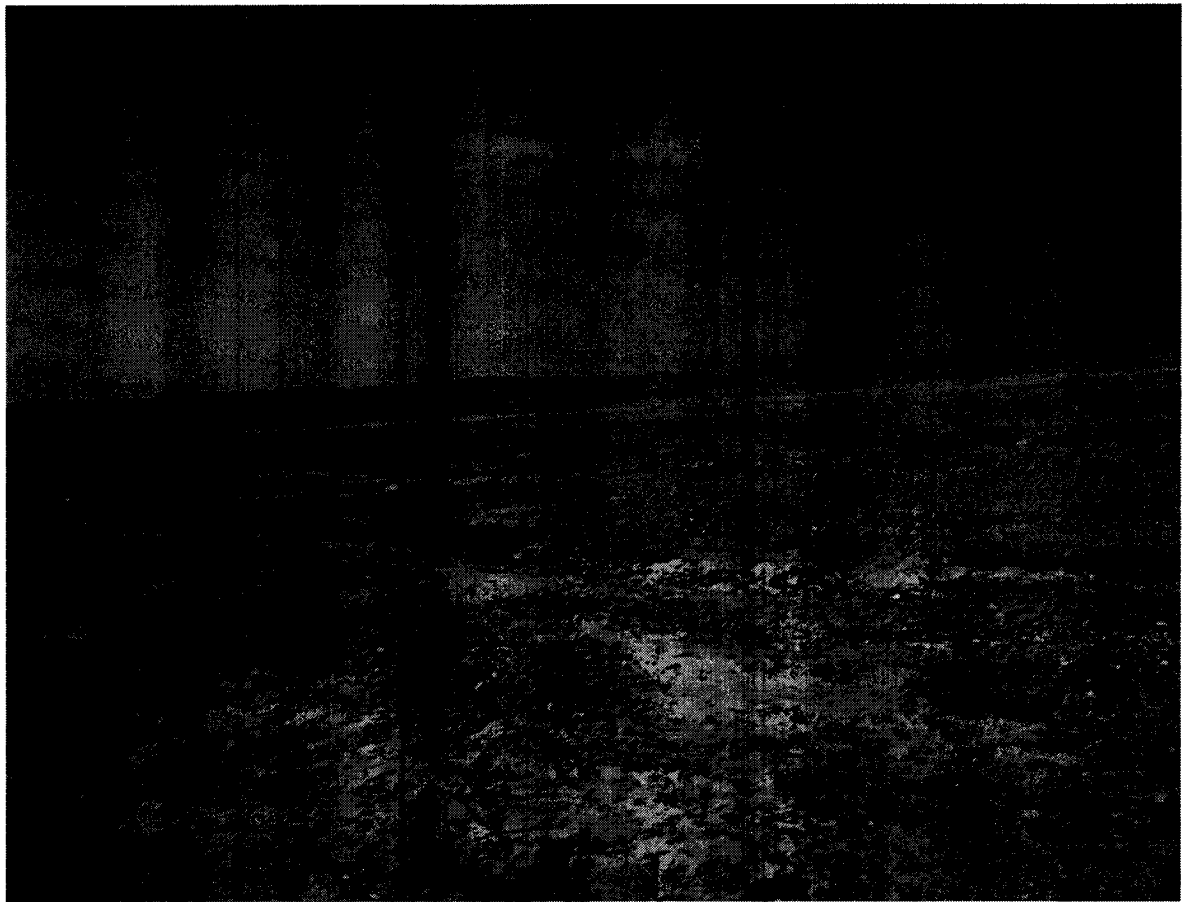
The electrical network within the vicinity of the site of the plant comprises of LV (11 kV) and HV (132 kV and 220 kV) lines.

Hyderabad Electrical Supply Company 132/11 kV grid station is DISCO in Jamshoro. Nearest Grid is Khanote Grid. The distance of the grid station from the Project site is approximately fifteen (15) kilometers.

A separate electrical and grid interconnection study is currently underway for the project including Power Quality, Load Flow, Short Circuit and Power Evacuation.

Southern end of the site is nearly flat along with surrounding having same characteristics.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 44



View of Project Site

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 45

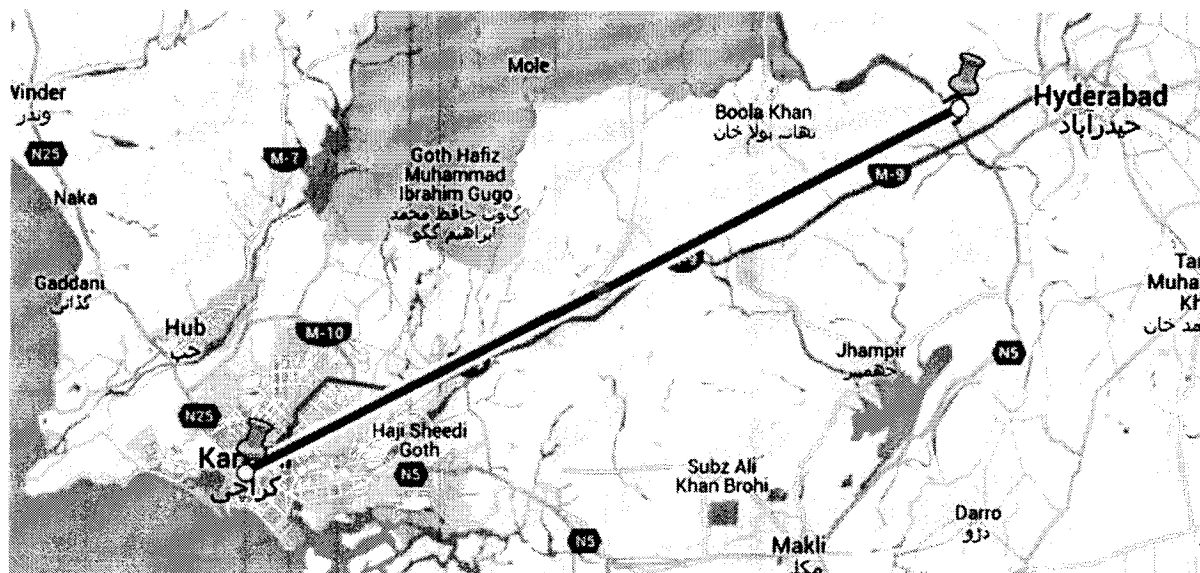
7.3 TRANSPORTATION AND ACCESS NETWORK

A Transportation and Access Study has been carried out and is attached as Annex II.

The Project site is easily accessible throughout the year.

The major track from Karachi to Jamshoro is via the Karachi-Hyderabad Motorway, and another access to the Project site is through M-9 road. When travelling via the Karachi-Hyderabad Motorway, the access from Karachi to the site is a double track with carpeted road, which turns toward the site. The terrain is flat and long and heavy vehicles can easily navigate through this road.

The satellite overview of the track from Karachi to the Project site through Karachi-Hyderabad Motorway is shown in Figure

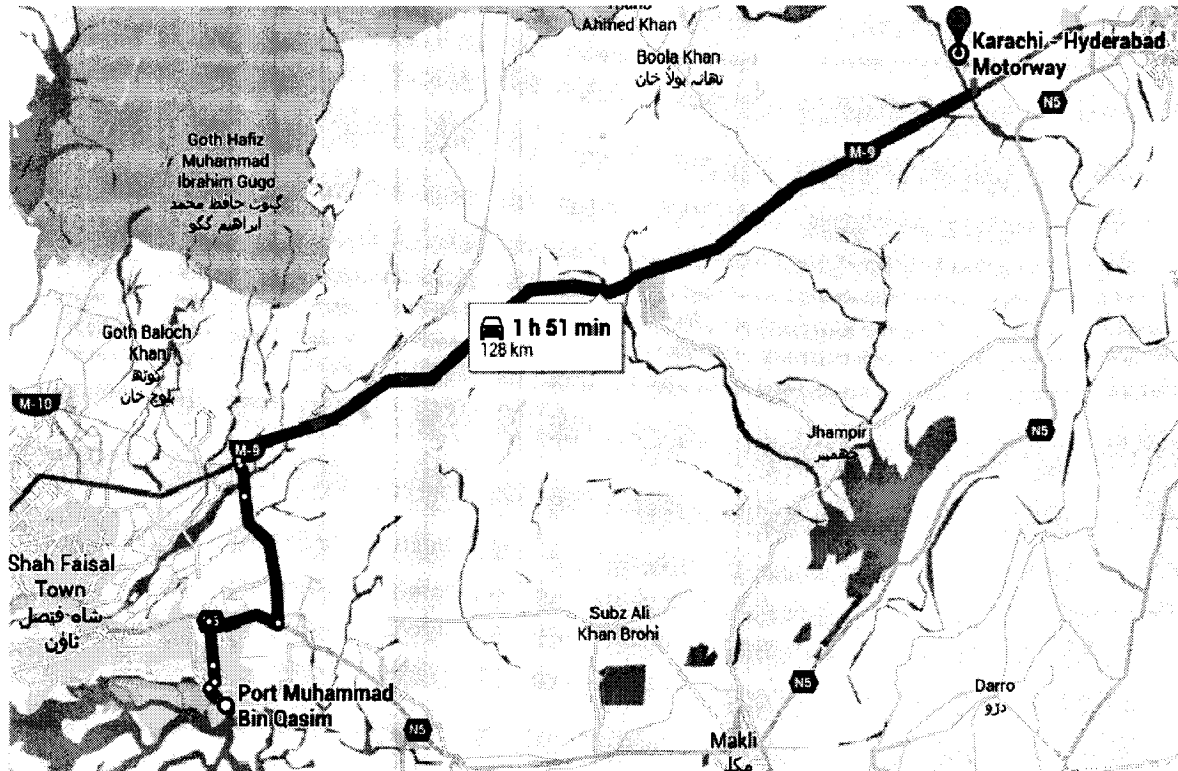


Ariel View of Complete Track (Through Karachi-Hyderabad Motorway)

The Port Qasim is the one of the major port of Pakistan and is the point of delivery of equipment for the proposed wind power project. It is located towards South of the site as shown in Figure.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 46

Aerial distance of the port from the site is 103 km. Total track length between Port Qasim Karachi and site is approximately 128 km. The track from Port to the Site is good but Karachi Hyderabad Motorway that turns to the Site needs minor development.



MGEL Site from Port Qasim

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 47

7.4 CLIMATIC CONDITIONS

The climate of southern parts of the Sindh province is characterized by fluctuating temperatures and sparse rainfall. The summers are hot and humid with average temperature ranging between 33 °C to 40°C. The temperature in summers may reach up to 50°C. The winters are pleasant with average temperature in the range of 15 °C to 25 °C. The months of July and August generally observe the annual monsoon rainfalls. The climate information of Karachi, which lies near to the site, is shown in table below:

Table 7-1: Climate Conditions of Karachi

Month	Average Temperature (°C)		Relative Humidity (%)		Total Rainfall (mm)
	Min	Max	am	pm	Mean
Jan	13	25	63	45	3.6
Feb	14	26	72	49	6.4
Mar	19	29	79	57	8.3
Apr	23	32	87	62	4.9
May	26	34	88	68	0
Jun	28	34	86	69	3.9
Jul	27	33	28	73	64.4
Aug	26	31	90	74	44.8
Sep	25	31	89	71	22.8
Oct	22	33	83	57	0.3
Nov	18	31	68	49	1.7
Dec	14	27	64	45	4.5

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 48

7.5 TELECOMMUNICATION

The wire based land line telecommunication is available in the nearby towns. All major mobile phone suppliers including Mobilink, Telenor, Warid, Ufone and Zong have coverage on the site area.

7.6 EARTHQUAKES

According to the seismic zoning map of Pakistan, the Jamshoro region falls in ZONE II-B with moderate to severe damage area probability. This has been separately covered in the Geo Technical Study and the Initial Environment Examination Report.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 49

8 WIND RESOURCE ASSESSMENT AND ENERGY YIELD ESTIMATES

The detailed wind resource assessment report and energy yield estimates have been prepared as Annex III and Annex IV of this document respectively. At present, those studies are not being submitted with this feasibility study to DAE, EDGOS because the Project plans to opt for the upcoming upfront tariff subjected to determination by NEPRA.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 50

9 SELECTION OF WTG AND EPC CONTRACTOR

MGEL is currently working on the selection of following WTG suppliers and EPC Contractors. The details of EPC Contractors and WTGs offered by them are as follows:

EPC CONTRACTOR		WTG OFFERED
DESCON	- General Electric GE 1.7-103 - Gold Wind GW 121-2.5	1.7 MW 2.5 MW
Power China	- General Electric GE 1.7-103 - General Electric GE 2.75 - Gold Wind GW 121-2.5 - Gamesa G114-2.0 - Gamesa G114-2.5	1.7 MW 2.75 MW 2.5 MW 2.0 MW 2.5 MW
Nordex	Nordex N131-3000	3.0 MW
Vestas	Vestas V126-3.3	3.3 MW

In September 2015, project details and required commercial terms were sent to potential EPC contractors, and interested parties were invited to submit their proposals. In November, MGEL received commercial and technical proposals from Descon, Power China, Nordex and Vestas, with the WTGs summarized above. After conducting extensive evaluations, Power China has been selected as the front runner, and discussions on the EPC contract have been initiated.

The main aspects considered in the selection of the WTG and EPC Contractor are as follows:

- The quality of WTG and Type Certification according to site suitability
- The quality and certifications of EBOP equipment
- The ultimate energy yield potential at P90 for the Project
- The total EPC cost and resultant tariff / IRR
- Technical guarantees, warranties and obligations
- Time for Completion
- The commercial and legal terms of the EPC package

At the moment, the entire feasibility is based on all WTGs mentioned in this section. The Project plans to make a final selection of the WTG and EPC Contractor by the time the stage for Generation License and Tariff of the Project will reach.

The specifications of WTGs under consideration are attached as Annex VIII.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 51

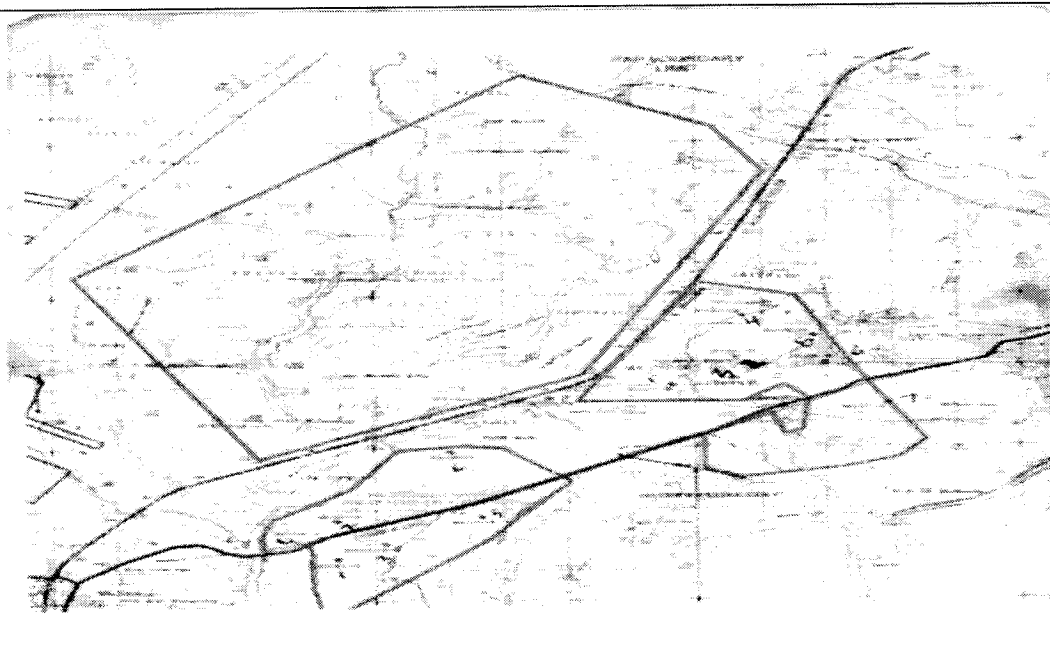
10 GEOLOGICAL CONDITIONS

In order to collect detailed regional geological information, MGEL hired professional services of PAES (Pakistan Alternative Engineering Services (PVT) Ltd: a Pakistani local prospecting agency to conduct field exploration drilling of ten (10) bore holes on the Site during December, 2015. The average drilling depth is 15 m. The complete Geotechnical Investigation Report is report is attached as **Annex-IV**.

10.1 OBJECTIVES OF GEOTECHNICAL STUDIES

- ❖ To execute 10 boreholes, at the site of each proposed turbine location, 15m (avg.) in depth.
- ❖ To execute field and laboratory geotechnical testing.
- ❖ To investigate the surface and sub-surface soil condition, to evaluate foundation design parameters.
- ❖ To provide shallow and deep foundation recommendations.

10.2 GEOLOGY OF KARACHI REGION AND SURROUNDINGS



Geological Structure Map

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 52

Geologically Karachi trough is located on the southern extension of the Kirther folded structures. It carries marine terrigenous and calcareous terrigenous Oligocene and Neogene sediments. Geological structure map of Karachi is shown in figure above.

The folds in the Palaeogene and Mesozoic sediments are overlain by the Oligocene-Neogene sediments of Karachi embayment.

The Karachi trough is delineated by the north-trending severely deformed mountain ranges namely Mor Range, Pab Range and Belaophiolite/melange zone to the west. It is surrounded by Kirther Range to the north and to the east, and by the Indus delta and the Arabian Sea Creeks to the south-east and south. In the south, the Karachi structural embayment opens to the Arabian Sea. The trough is somewhat an asymmetrical Synclinorium.

The eastern limb of this trough is wider and comparatively greater than the western limb. The prominent strikes of the folds of the trough are sub-meridional north-south changing into southwestern direction in the south. The trough may be sub-divided into three principal regions named below:

- ❖ Northern Relatively Uplifted Region
- ❖ Southern Sub Merged Region
- ❖ Western Monocline

The tectonic map of Pakistan, Geological and Sub Surface Details of Jamshoro are shown in figures below:

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 53

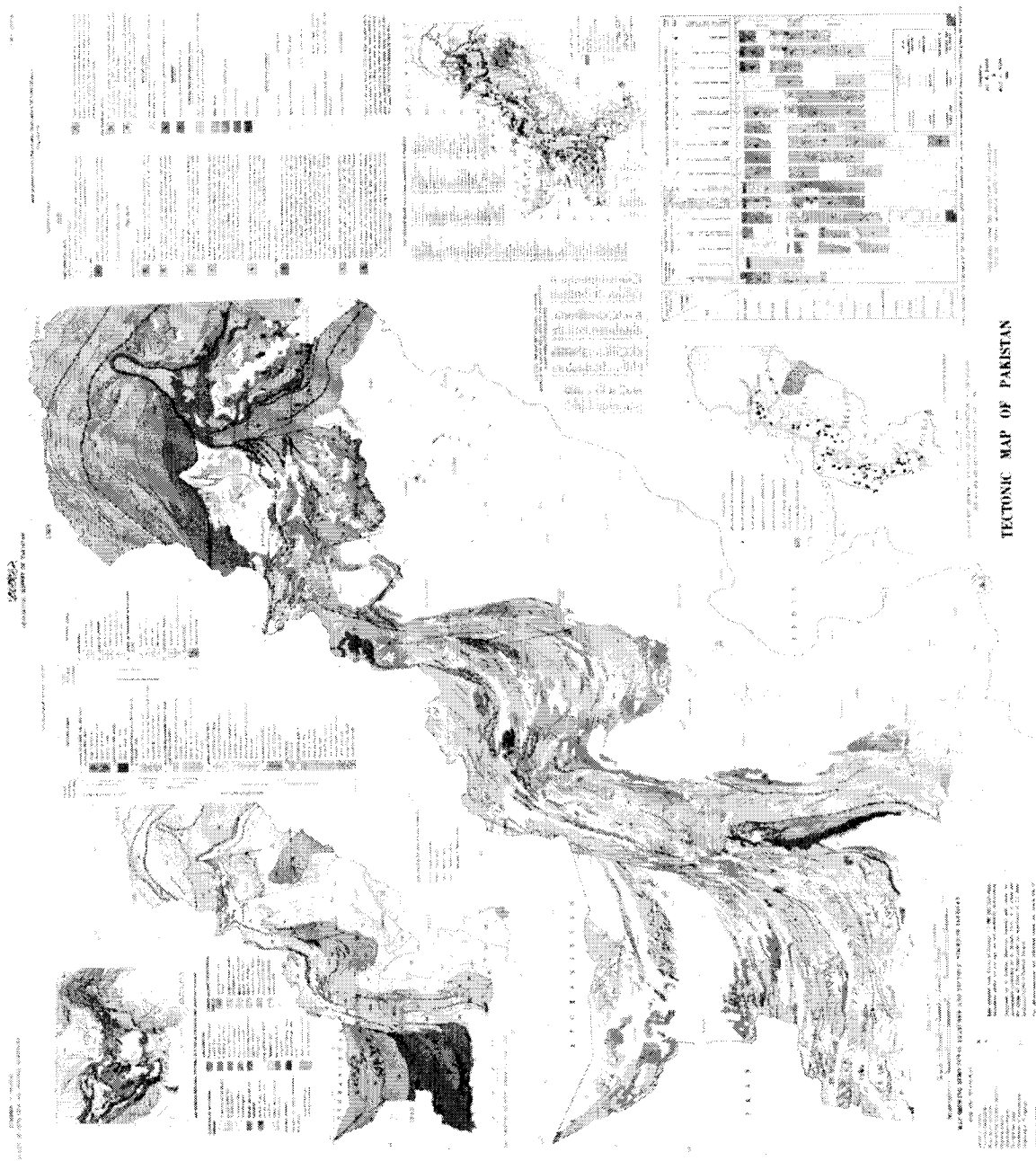


Figure 10-1: Tectonic Map of Pakistan

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 54

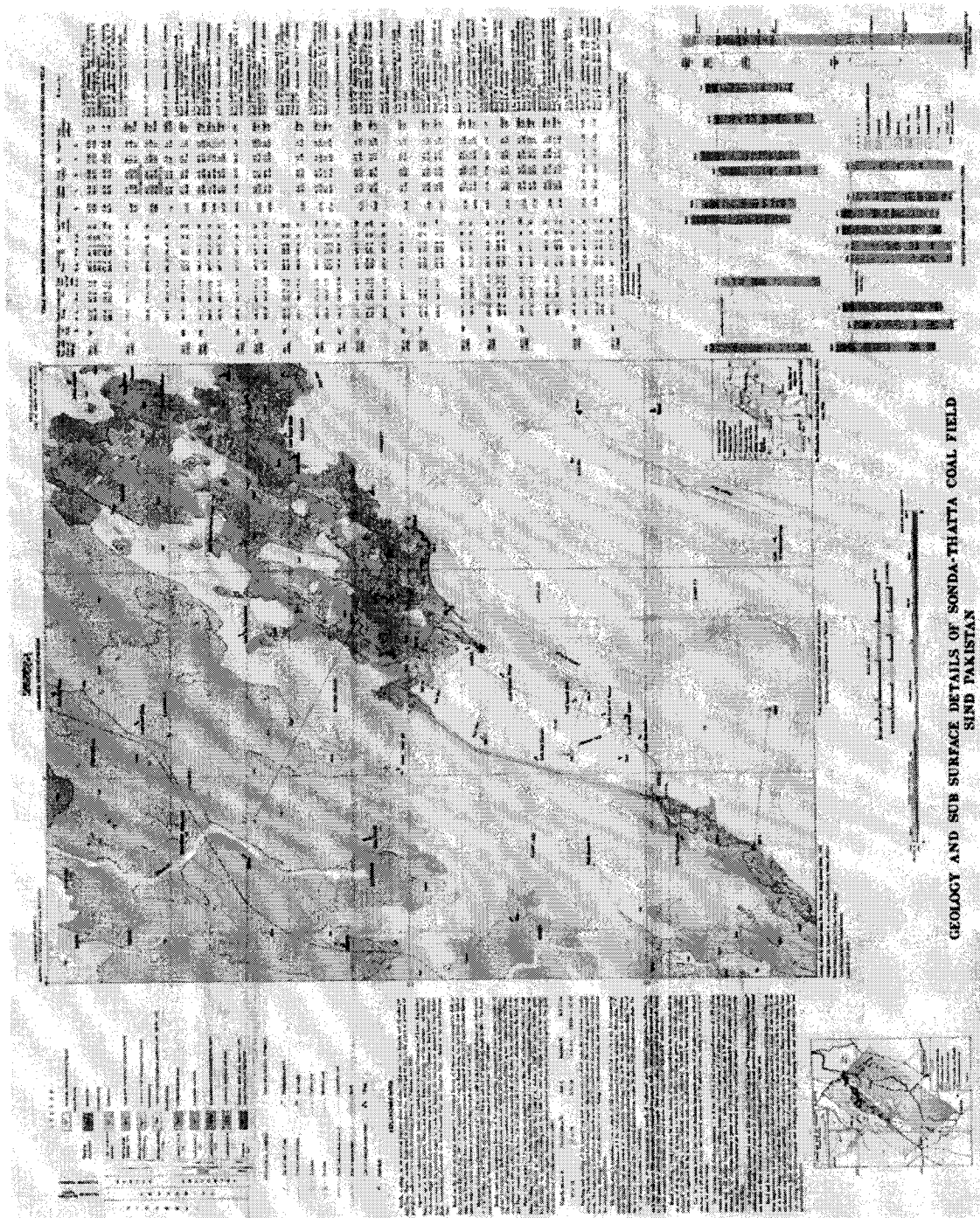


Figure 10-2: Geological and Sub Surface details of Jamshoro

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 55

10.3 SEISMOLOGY OF KARACHI REGION

The region is surrounded by some active fault lines; namely Pab Fault, OrnachNal Fault and Runn of Kuch Fault. The history of earthquakes in Karachi is given in table below:

Table 10-1: Earthquake Records around Karachi

Year	Longitude	Latitude	Depth	Scale	Intensity	Location
1962	24.70	66.00	0	4.50	—	Karachi
1965	25.03	66.76	40	4.50	—	Karachi
1966	25.00	68.00	—	5.00	VI–VII	Jhampir
1968	24.61	66.42	19	4.10	—	Karachi
1970	25.28	66.65	33	4.90	V	Karachi
1971	25.00	68.00	—	4.50	V	Jhampir
1972	25.35	66.71	33	4.50	V	Karachi
1973	25.00	68.00	—	5.00	VI	Jhampir
1973	25.48	66.33	57	4.90	V	Karachi
1975	25.50	66.80	—	4.50	V	Gadani
1975	25.22	66.59	33	4.70	V	Karachi
1976	24.96	70.38	14	4.70	V	Karachi
1984	25.86	66.41	33	5.00	VI	Karachi
1985	24.90	67.39	33	5.00	VI	Karachi
1986	25.34	66.60	33	4.60	V	Karachi
1992	25.25	67.76	33	3.60	IV	Karachi
1996	25.06	66.76	33	—	—	Karachi
1998	25.69	66.46	33	4.40	V	Karachi
1998	24.85	66.35	33	4.50	V	Karachi

The seismic parameters of Karachi region are in table below:

Table 10-2: Seismic Parameters of Karachi

Seismic Parameters	Value
UBC Zone	2B
Max Peak Ground Acceleration	16% - 20% of 'g' ($g = 9.8 \text{ m/s}^2$)
Seismic Hazard	Upper Moderate
Magnitude (Richter Scale)	5.5 to 6.5
Intensity (MM Scale)	VI – VII

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 56

10.4 FIELD WORK

10.4.1 Borehole Drilling

The drilling and sampling work has been performed using the standards, procedures and equipment's recommended for engineering site investigation. All borings were advanced through soil between sampling intervals by rotary wash methods, using rotary drilling machines of hydraulic feed. These machines are most suitable to the site conditions with all accessories for extending the bore to required depths, taking samples and performing the necessary onsite tests. Minimum drilling fluid consisting of water bentonite slurry was used for flushing out the cutting to provide a positive head and to maintain stability of the drilled hole. The boreholes were also stabilized using casing with a nominal diameter of 130mm. A drag bit was used to advance the boring. Observations during drilling such as change of strata, texture, color and drilling difficulties were noted.

The soil layers encountered in the borehole were visually classified and were later upgraded as per laboratory test results. Few samples were obtained from split spoon sampler after performing standard penetration test (SPT). A number of core samples were preserved. The samples were cleaned, labeled and put in especially made core-boxes for onward transmission to the laboratory for testing. Special care was taken during handling and transportation of samples.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 58

10.4.2 Rock Core Drilling

Rock core drilling relates to the procedure in which underlying rock is investigated by coring so as to obtain samples for classification, to determine the quality of rock, and to check for possible detrimental properties such as cracks, fissures and weathering or other deterioration that could affect the strength of the formation. To obtain rock core samples, NX diameter core barrels with special bits were used. Under rotary action, the core bit advances into the rock. A circulating supply of water was provided in the cutting edge to help flush rock cuttings and dissipate heat. "Core Runs" were made to drill the hole in segments. At the completion of a core run, the barrel and rock sample were brought to the surface, the depth of recovery was properly recorded for further evaluation in the laboratory. Based on the length of the rock core recovered from each run, core recovery (C.R.) and rock quality designation (RQD) were calculated for a general evaluation of rock quality encountered. Suitable core samples were preserved for shear strength characteristics.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 59

10.4.3 Location of Boreholes

Location of bore holes are given in below table:

Table 10-3: Location of Boreholes during Geo Technical Investigations (UTM zone 42R)

B1	25°22'2.62"	68° 8'21.42"
B2	25°23'35.90"	68° 7'44.34"
B3	25°23'22.02"	68° 9'2.77"
B4	25°22'45.86"	68° 9'3.92"
B5	25°21'59.78"	68° 8'47.97"
B6	25°22'54.72"	68° 7'52.11"
B7	25°23'3.44"	68° 8'27.30"
B8	25°23'49.80"	68° 8'40.02"
B9	25°22'42.39"	68° 9'38.19"
B10	25°22'12.66"	68° 8'54.08"

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 60

10.4.4 List of Field and Lab Tests

Geotechnical laboratory testing was carried out on retrieved disturbed soil samples. The following are the relevant tests carried out on selected samples as required for determining the subsurface conditions and correlating with the information obtained from field testing and sampling:

- ❖ Grain Size Analysis
- ❖ Liquid and Plastic limits
- ❖ Natural Moisture Contents
- ❖ Density
- ❖ Specific Gravity
- ❖ Direct Shear Test
- ❖ Unconfined Compressive Strength of Rocks
- ❖ Chemical Test

10.5 CONCLUSIONS OF GEOTECHNICAL STUDIES

Laboratory testing of soil and groundwater samples was carried out in PAES labs and includes determination of index properties through grain-size analysis, atterberg's limits, natural moisture content, specific gravity, density, unconfined compressive strength etc. Chemical characteristics of soil and ground water samples have also been assessed through determination of total dissolved solids, sulfate content, chloride content and pH.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 61

11 CIVIL ENGINEERING DESIGN

The civil engineering design mainly includes following structures:

- ❖ Foundation of WTG Towers
- ❖ Foundation of substation and grid interconnection apparatus, i.e. transformer, switchgear.
- ❖ Construction of permanent buildings (residence and offices) of O&M staff.

The design activity of the civil works shall be carried out as part of the EPC contract during early phase of construction. However, the geo technical risk shall lie under contractor's responsibility as per the terms of the EPC Contract.

Document Title: Feasibility Study Report for SOMW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 62

12 ELECTRICAL ENGINEERING DESIGN

The basic electrical design of the wind farm is discussed in this chapter. The overall electrical system has been designed considering the data from HESCO/NTDC and requirements of the grid code addendum for wind energy approved by NEPRA. As part of the grid interconnection study (**attached as Annex V**), complete modeling of the wind farm has been performed. Load Flow Studies, Short Circuit Analysis, and Transient Stability Analysis along with the Power Quality Analysis have also been performed on the existing and future planned HESCO/NTDC network as part of the report.

The dispatch voltage of shall be 132 kV. There will be two-stage step voltage, one step up to MV level at the each WTG level through individual GSUs, and the other at the substation. The MV level shall be 22 kV.

The Wind Farm shall have two 132 kV outgoing lines to keep the N-1 grid connectivity criteria. The termination point of the lines on two remote ends have been identified, which will be firmed up during the construction phase by NTDC considering the network scenario at that time. The protection and telecommunication scheme will be accordingly finalized at that time.

The Wind Farm shall be divided into collector groups. Every WTG shall be equipped with its own step-up transformer and shall be connected with the succeeding WTG by means of Ring Main Units (RMU) and vacuum breaker in configuration in/out. The connection of the RMUs to the main MV Switchgear shall be achieved by under-ground XLPE insulated single core aluminum conductor.

The MV Switchgear shall have two bus sections with bus-coupler device, each feeding half of the WTG groups. It will also feed auxiliary transformer and capacitor bank to meet the power factor requirements of the national grid code (0.95 lagging).

The 132 kV substation shall consist of two bus sections of a single bus bar with a sectionalizer and two breaker bays to connect main transformers with the 132 kV double circuit overhead lines (OHL). The Main Transformers shall meet the N-1 grid code criteria and thus may be three (03) in number (31.5/40/50 MVA each). The instrumentation transformers (CTs, VTs, CVTs) for all purposes shall be sized according to requirement.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 63

The 132 kV OHLs from the Wind farm substation to the 132 kV to far end connection points (whether adjacent grid stations or neighboring project substations) are out of the scope of the contractor and shall be installed and connected by NTDC.

The manufacturers of the HV/MV switchgear, main power transformer and other protection equipment shall be of reputable manufacturers conforming to the requirements spelled in detail in the EPC Contract and in the EPA. Further, the detailed electrical design will be subject to approval of both MGEL and NTDC as per the requirements of EPC Contract and EPA.

In this regard, the concept mentioned in this section serves as guidelines and firm design will be prepared during construction phase, which may be somewhat different from predicted here.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 64

13 CONSTRUCTION MANAGEMENT

Like all wind power projects in Pakistan, the structure of EPC contract is on a “turnkey” basis. Everything shall be managed from one platform (one window) of the EPC contractor. The partners of EPC contractor shall be underneath that platform through “subcontracting” or “joint and several arrangements”. In this way, the role of MGEL shall be to supervise and monitor everything.

MGEL personnel will supervise construction activities right from the beginning. The team of MGEL will monitor construction schedule, owner’s engineers and the EPC contractor to complete the project within given time frame and in-line with HSE guidelines.

MGEL requires careful management of construction. To achieve this, MGEL will prepare a Construction Management Master Plan taking into account all relevant aspects. The master plan shall be regularly reviewed, updated and shared with all project stakeholders.

Construction Management Plan depends on the nature of work, likelihood of disruptions, impact on local amenity, dangers or risks involved and any other relevant issue required to be addressed under the planning permit.

In order to manage all the above operations correctly, MGEL shall have a consultant as a “Construction Supervisor” who shall supervise the quality and progress of all contractors and give approvals of milestones.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 65

The project construction shall take 18 months from the date of planning till the COD. The activity structure and timelines are given in table below:

Table 13-1: Project Construction Scheduling

Activity / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Engineering and Mobilization																		
Construction of Temporary Establishment																		
Civil Works of WTGs and Substation																		
Construction of Substation																		
Supply of WTGs and Towers																		
Cables and Interconnection																		
Erection and Installation																		
Testing and Commissioning of EBOP																		
Testing and Commissioning of WTGs																		
EPA Tests and Reliability Run Test																		

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 66

14 Initial Environment Examination (IEE)

The Initial Environment Examination (IEE) has been carried out as per Pakistan Environmental Protection Act, 1997 per the requirements of Environmental Protection Agency, Government of Sindh and is already submitted. **The report is attached as Annex VII.**

A data collection survey that included geology, meteorology, hydrology, ambient air quality, water quality, soil characteristics, noise levels, shadow forecasting, flora and fauna, land use pattern, and socioeconomic conditions was undertaken, based on available secondary information or data collected in the field. Primary data was collected to establish baseline conditions for the soil, water (surface and ground) quality, flora and fauna, and noise. Secondary data was collected for land, ecology, climate, and socioeconomic factors.

According to the study conducted, prime benefit of the Project will be the replacement of conventional power generation with renewable energy. Wind energy will replace fossil fuel powered generation, and therefore reduce suspended particulate matter and greenhouse gas emissions into the atmosphere.

Environmental impacts likely to result from the project are easily manageable and can be managed cost effectively. 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 covered with shrubs, thus there is no need for removal of any significant vegetation for the construction of the wind power Project.

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

- ❖ Significant improvement in the economic activities in the surrounding areas due to generation of direct and indirect employment opportunities.
- ❖ There is negligible removal of trees for the Project, which is the main positive impact to the proposed Project area.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 67

- ❖ Environment 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 due to proposed Project with mitigations being properly taken care.

Proper GRM will have to be implemented by MGEL 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.

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 MGEL, 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.

The environment and social impact associated with the 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.

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 an options 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 movement of soils.

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

Stakeholders from Government sector and Non-Government sector have also raised concerns related to social and environment area which shall be addressed through effective planning and management.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 68

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with the associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The potential cumulative and residual impacts of the Project as a whole indicate the Project classifies as a category "B", in accordance with ADB's Safeguards Policy Statement 2009. 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 impact which can be mitigated following the EMP & shall be pollution free Renewable source of Power generation with low Environmental foot prints.

In the view of all above, it is concluded that development of 50 MW wind power project of Master Green Energy Ltd will have no adverse environmental impact and the project can be regarded as Environmental Friendly Green Project.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 69

15 CONCLUSIONS OF FEASIBILITY STUDY

The detailed feasibility of the Project has been conducted which covers all aspects required for developing the Project.

The wind climate observed on the Site indicates good annual average wind speed. Thus the annual energy estimates are also good and it is feasible to develop the Project based on General Electric GE 1.7-103 (1.7 MW), Gold Wind 121-2.5 (2.5 MW), General Electric GE 2.75 (2.75 MW), Gamesa G114-2.0 (2.0 MW), Gamesa G114-2.5 (2.5 MW), Nordex N131-3000 (3.0 MW) or Vestas V126-3.3 (3.3 MW) turbines. The Project IRR as currently being assessed is suitable.

The Project Site is feasible for the wind farm with easy access for the transportation of equipment. The climatic conditions at the Project Site are moderate and there is no significant impact of seismic hazards foreseen in the area. The telecommunication and transportation facilities are adequate.

The Project shall not have negative environmental impact during life cycle. Instead, the Project will bring positive development and improve the socio-economic conditions of the area through generation of employment opportunities and contribute in environmental sustainability of the area.

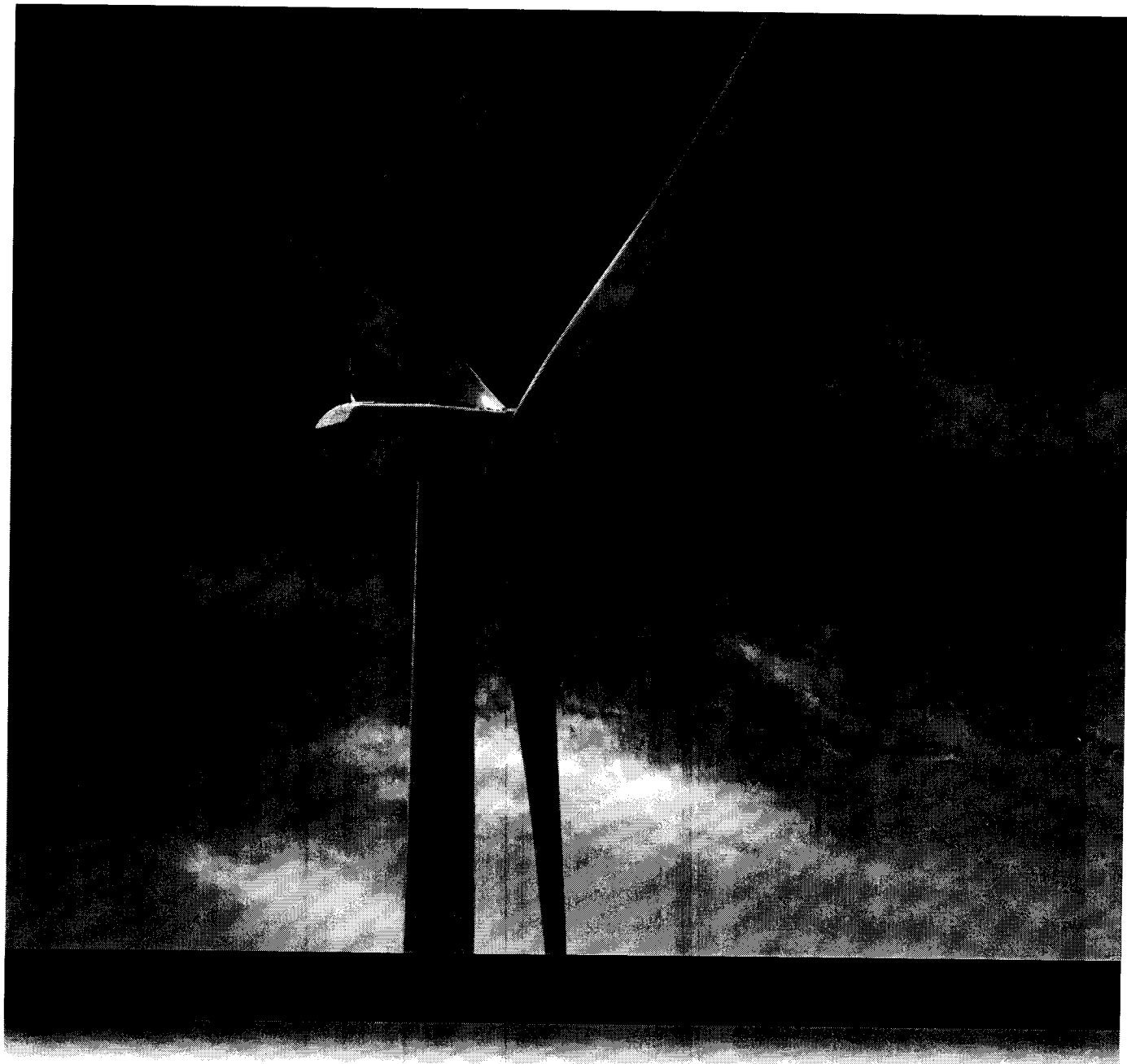
The Project Site is conveniently located close to the Grid of HESCO and NTDC. However, the currently underway Grid Interconnection study will tell which Grid to be selected for the connection.

From here onwards, the Project may enter into getting licenses and permits and into negotiation of security documents. The next steps after approval of feasibility study would be to apply for Generation License and Tariff, and to begin negotiations for EPA and IA. The Project may also enter into discussions with lenders at some stage.

It is expected that the Project will achieve financial close by 1st quarter of year 2017 and construction will be completed by 1st quarter of year 2018. It is anticipated that the Project of MGEL would be a valuable addition to the National Grid for generating electricity and contribute to overcome the current energy crises of the Pakistan.

Document Title: Feasibility Study Report for 50MW Wind Power Project in Jamshoro, Sindh-Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No: RE2-141-175-001	Date of Approval March, 16
	Project Sponsor: Master Group (Pvt.) Ltd	Document Issue 01	Page 70

3.12 Prospectus



MASTER GREEN ENERGY LIMITED

50 MW Wind Power Project – Jamshoro, Pakistan

Executive Summary

Project Name	Master Green Energy Limited
Industry	Power Sector – Wind Farm
Main Sponsors	Master Group
Project Capacity	50MW
Project Location	District Jamshoro, Sindh, Pakistan
Land Area	300 acres
Concession Period	20/25 years from Commercial Operations Date (COD)
Construction Period	18 months from date of Financial Close
Financial Close	June 2018
Power Purchaser	Central Power Purchasing Agency (Guarantee) Limited (CPPA-G)
Wind Turbines	25 x Gamesa G114 – 2.0 MW
Project Contractors	Turn-key, fixed price EPC contract initialized with Powerchina Huadong Engineering Corporation Limited (HDEC)
O&M Contractor	10 year O&M Contract to be executed with turbine supplier
Funding Plan	Debt: Equity – 75:25
Total Project Cost	US\$ 92.30 million
Equity	US\$ 69.22 million
Debt	US\$ 23.08 million

Strictly Confidential

Pakistan Energy Sector

The existing power set up in Pakistan is a mix of thermal, hydro-electric and nuclear power plants. As of June 2015, the total installed capacity of the country was 22,928 MW; which is dominated by thermal power plants (64%), followed by hydropower (31%). The remaining 5% is contributed by nuclear, wind and solar.

In the last few years, Pakistan has been gripped by a severe energy crisis; which has hindered growth rates and increased the hardships faced by common Pakistanis. In the fiscal year 2014-2015, only 97,284 GWh of electricity was generated which is far short of the demand.

Major reasons for the energy crises are (i) lack of investment in power sector, (ii) depleting gas reserves, (iii) increasing reliance on foreign fuel based power generation sources, and (iv) non-development of renewable energy sector i.e. hydel, wind, solar etc.

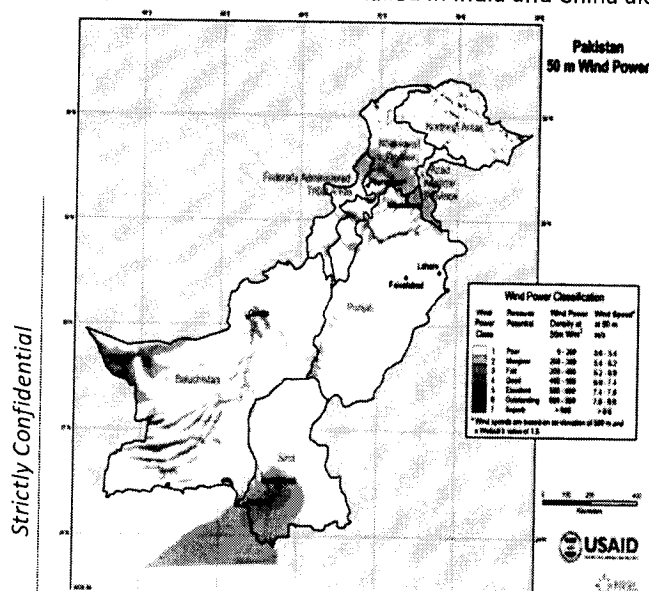
Increasing generation capacity and reducing the dependence on fossil fuels has been a key priority of the Government of Pakistan (GOP). In 2013, shortly after taking office; Nawaz Sharif's government announced its power policy, which aims to eliminate the demand-supply gap and reduce the overall cost of electricity incurred by consumers. The GOP aims to increase the total installed capacity to around 40,000 MW by the end of 2018.

Wind Power

The GOP has identified wind as one of the most feasible renewable energy resources for power generation in the short term. The technology has a globally proven track record, recognized commercial viability and an installed base of over 432,000 MW (as of 2015) around the globe (over 17,000 MW of which is installed in India and China alone), making the case for development of wind

energy in Pakistan very strong.

The Alternate Energy Development Board (AEDB) has identified the Gharao – Keti Bander – Hyderabad wind corridor (**Wind Corridor**) as being economically feasible for development of wind power projects. Based on an average wind speed of 7.5 m/s prevalent in the Wind Corridor the power generation potential for the area has been estimated to equal 50,000MW. India, on its side of the Wind Corridor, has already installed over 2,866 MW of wind power projects.



Master Green Energy Limited

Project Profile

With fluctuating prices and supply of oil and gas across the globe, relying only on conventional thermal sources for generating electricity is becoming very expensive and almost beyond the reach of developing nations like Pakistan.

Master Group (the **Sponsor** or the **Group**) is committed to helping Pakistan overcome the current energy shortage affecting the country. The Group entered the energy sector with its first 52.8 MW wind power project, Master Wind Energy Limited (**MWEL**) located in Jhimpir, Sindh. MWEL successfully achieved financial close in March 2015, and commenced commercial operations in October 2016.

In line with its commitment, the Group is currently pursuing development of a second 50 MW wind. To this effect, the Group was issued a Letter of Intent (**LOI**) from Department of Energy, Government of Sindh (**DAE GoS**) through a special purpose vehicle, namely Master Green Energy Ltd. (**MGEL**), incorporated for the sole purpose of development of a 50 MW wind power project (the **Project**) to be located at District Jamshoro, Sindh, Pakistan (**Project Site**).

Upon issuance of the LOI by DAE GoS, MGEL was allocated land in January 2016 and the Project Site was handed over to MWEL for carrying out various studies, including gathering site-specific wind data, wind resource assessments, geo-tech studies, etc. These studies have been finalized by the Project technical consultants (the **TC**) and form the basis of the feasibility study developed by the TC. In order to fulfill the requirements of the LOI, MGEL submitted the feasibility study to DAE GoS and AEDB for their review and approval.

The Project will sell power to the Central Power Purchasing Agency Guarantee Limited (**CPPA**) within the framework of the project documents specified under the *Policy for Development of Renewable Energy for Power Generation, 2006* (the **RE Policy**). The term of the off-take agreement, to be executed between MGEL and CPPA, is 20/25 years (as per prevailing policy and tariff regime).

Wind power projects in Pakistan were originally developed under a Cost Plus Tariff regime, however, since 2011, the government has regularly announced Upfront Tariffs (**Upfront Tariff**) for wind projects. The Upfront Tariff regime has been developed keeping in view international best practices for development of wind power projects and in a manner so as to ensure bankability of the projects. The Upfront Tariff (along with permitted indexations and escalations) will be applicable throughout the concession period from achievement of commercial operations. The concession shall be backed by sovereign guarantees that are given by the GOP under the Concession Agreements namely the Energy Purchase Agreement and the Implementation Agreement.

The Project was initially proposed under the 2015 Upfront Tariff announced by the Government. However, this tariff stands expired as of June 2016. NEPRA has recently announced a new Benchmark tariff regime for wind power projects, development of a competitive bidding mechanism for award of tariff to projects is currently underway. MGEL is awaiting currently awaiting issuance of details of such mechanism by the Alternative Energy Development Board.

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	2011		2013		2015	
	Foreign Debt	Local Debt	Foreign Debt	Local Debt	Foreign Debt	Local Debt
RS/KWH	12.6100	17.2755	13.1998	16.2926	10.6048	12.7064
C/KWH	14.6628	20.0878	13.5244	16.6933	10.4481	12.8970

Negotiations on concession agreements will be carried out after the award of tariff (expected in December, 2017).

MGEL has already conducted an extensive bidding and evaluation process to select an EPC contractor and wind turbine supplier for the Project. Financial close is expected in June 2018, once all development activities have been concluded.

Project Status

MGEL's current progress and development milestones are summarized below

Letter of Intent		✓
Land Allocation		✓
Soil and Topographical Survey		✓
Energy Yield Assessment		✓
Grid Interconnection Study		✓
Arrangement of Financing		Jun 2017
EPC and O&M Contract		Aug 2017
Tariff and Generation License		Dec 2017
Letter of Support		Jan 2018
EPA & IA		Jun 2018
Financing Agreements		Jun 2018

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Shareholder Profile



MGEL is sponsored by Master Group. Brief profile of the Sponsor is given below.

Master Group

Master Group, the main sponsor of MGEL, is one of the most dynamic and diverse business groups of Pakistan. The Sponsor started its operations by entering into the bedding industry in 1963 as a licensee of Bayer A.G. (Germany) to manufacture foam mattresses in Pakistan and became a pioneer in the bedding industry.

In the year 1988, the Sponsor entered into the manufacturing and supply of automobile interiors including seats with reclining mechanism and assembly, roof headlining and door trims to renowned OEMs such as Honda, Toyota, Suzuki, Nissan, Daihatsu, Hino and Volvo and today fulfils 70% of the requirements of the OEMs in Pakistan. In 1993, the Sponsor installed its first state of the art weaving unit marking its entry into the textile business.

Today, Master Group has a strong fixed/current asset base of over Rs. 20 billion and an annually increasing group turnover of more than Rs. 25 billion. The Sponsor is not only the leading player in the bedding market, but has also diversified over the period into the textile, auto and engineering sectors.

The Sponsor is committed to play its part in the development of Pakistan's various sectors. Realizing the role of clean energy in development of the nation, the Sponsor ventured into the power generation sector by developing a 50 MW wind power project in Jhimpir, Sindh. Master Wind Energy Limited is currently in the construction phase and is expected to become operational in September 2016. Master Green Energy Limited is the Sponsor's second project in the wind power sector, which is expected to achieve financial close by December, 2017.

Project Cost & Funding Plan

Types of Funds	Millions US\$		Millions US\$
EPC Cost	82.00	Long Term Debt – 75%	
Interest During Construction	3.00	Foreign	25.00
Project Development Cost	4.00	Local	44.23
Insurance	0.80	Equity – 25%	
Financial Charges	2.50	Master Group	23.08
Total	92.30	Total	92.30

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Master Group will fund 100% of the equity requirements of the Project. On the debt financing front, MBL and NBP have been appointed as Mandated Lead Arrangers (MLAs) for MGEL. The MLAs have received in-principal commitments for the entire debt amount from the

local debt market. Foreign financiers have also shown interest in the project, and it is expected that a foreign component of \$25 million will be included in the final mix. The debt will be for a tenor of twelve (12) years, with a two (02) year grace period.

Project Implementation

Selection of EPC and O&M Contractor

The Project will be developed under a fixed-price, turnkey EPC Contract, as is customary in project finance transactions. With an objective of setting up its Project in compliance with the highest standards and, *inter alia*, to select the most efficient and reliable wind turbine generator (the **WTG**) supplier and engineering, procurement & construction (**EPC**) contractor for its Project, the Project Company conducted thorough research of various WTG suppliers and EPC contractors in the global wind industry.

In October 2015, MGEL issued a Request for Proposal to renowned EPC Contractors for award of EPC Contract of the Project. Proposals were received in November 2015, and after an extensive evaluation process, Powerchina Huadong Engineering Corporation Limited (**HDEC**) was shortlisted as the preferred bidder. Negotiation for the EPC contract were held in January 2016, and the contract has been finalised and initialled.

MGEL and its technical advisors also shortlisted various technologies and WTG vendors for its wind farm. A number of WTG options were considered including:

1. GE 1.7 MW
2. GW 2.5 MW
3. Gamesa 2.0 MW
4. Nordex 3.0 MW
5. Vestas 3.3 MW

After a complete, site-specific Energy Yield Assessment the Gamesa G114 2.0 MW turbine has been selected as the WTG of choice. A turn-key O&M contract for provision of O&M services for the first ten years of operations will also be signed with the WTG supplier.

I. Powerchina Huadong Engineering Corporation Limited – Profile

Huadong Engineering Corporation Limited was founded in 1954. It is a multi-specialized, interdisciplinary and comprehensive international engineering corporation. Headquartered in Hangzhou, HDEC has its branches in Sichuan, Chongqing, Fujian, Guangdong, Jiangxi and Yunnan, as well as its overseas branches and subsidiaries, such as in Vietnam, Thailand, Indonesia, Pakistan, Turkey, Ethiopia, Kenya, Nigeria and Costa Rica etc. The Large Dam Safety Supervision Center under National Energy Administration is set up by HDEC.

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HDEC operates in both domestic and international target markets, devoting itself to three main engineering fields (hydropower & renewable energy, urban construction & environmental engineering, dams & infrastructure safety), and three main business (design & consultancy, EPC contracting and investment). HDEC possesses the capability of providing systematic solutions at every stage of the development process; throughout the resource identification, planning and design, investment and financing, procurement management, construction management, and operations management, etc, and has the modern management structure compatible to its undertakings.

II. Gamesa Corporación Tecnológica – Profile

Gamesa Corporación Tecnológica, formerly Grupo Auxiliar Metalúrgico, is a Spanish manufacturing company principally involved in the fabrication of wind turbines and the construction of wind farms

With 22 years' experience in the wind industry and more than 35,200 MW installed, Gamesa is a global technological leader in the wind industry, with a footprint in 55 countries. Its comprehensive response includes also the wind turbine's operation and maintenance services, that manages for more than 22 GW. The company has production centres in the main wind markets: Spain and China, as the global production and supply hubs, while maintaining its local production capacity in India and Brazil.

Project Consultants

- I. **Technical Consultant** – Renewable Resources (RE2) is the professional technical advisor for the Project. RE2 is a consulting company specialized in Renewable Energy (RE), Energy Efficiency (EE) and Environment (Env) Projects. The company is owned by group of professionals who have been intimately involved in the renewable energy program of Pakistan, and have a fundamental understanding of issues relating to power project development, which include but are not limited to feasibility studies, regulatory approvals, concession and security documents, and applicable policies.

RE2 is capable of conducting full feasibility package featuring power production estimates, grid interconnection and tariff model. RE2 also has the expertise to deal with all technical aspects regarding the legal documents of power projects. The professional team of RE2 is well acquainted with the policies, regulations, methodologies and standards of RE power Projects and its work output meets international standards. RE2 is presently a consultant for various power Projects in Pakistan sponsored by local and international investors, with international banks.

- II. **Legal Consultant** – Pinsent Masons is an international, full service commercial law firm headquartered in London, with 18 offices across the globe including UK, Europe, the Gulf and Asia. The organization consists of more than 380 partners, 1,500 lawyers and over 2,500 staff world-wide.

The firm provides a full range of legal services across a wide range of sectors globally, one of which is Energy and Natural Resources. Pinsent Masons is one of the leading practices in this sector, with a dedicated and experienced team specifically for this sector. They are also experts

on Islamic Finance Agreements and where required ensure transactions are structured according to Islamic principles.

- III. **Soil and Geotechnical Expert** – PAES is a service company in the wind sector. It has the expertise in the installation and supervision of 60m, 80m, 85m, 90m & 100m wind measuring masts, Topographical Survey, Soil Investigation Services and Land Facilitation Services. The company is committed toward the development and promotion of wind energy sector in Pakistan. The company offers comprehensive professional services of specialized staff in survey services, civil and structural engineering, topographic surveys, soil investigation, land facilitation and has strong expertise for proper implementation of standard civil engineering codes on site while installations of wind mast to achieve zero complaint status from clients.
- IV. **Grid Study Consultant** – PPI is a limited company registered in England and Wales and has a team of highly skilled and experienced professionals. Power Planners is also registered with Saudi Electricity Company (SEC), with Pakistan Engineering Council and Alternative Energy Development Board, Pakistan. It is a renowned company in power sector in the field of power system analysis and planning especially in the areas of grid interconnection studies of renewable energy resources such as wind, solar, small Hydal etc.

The team at PPI comprises of engineers having a work experience of 10 to 30 years with utilities and consultant companies in Pakistan and Middle East in the fields of transmission planning, power system analysis, load forecasting and generation planning for systems of wide range of operating voltages.

Environmental Impact of the Project

A comprehensive and detailed Initial Environmental Examination (IEE) was carried out at the sight, in line with federal and preovincial policy guidelines. The proposed facility is a wind power generation plant and does not release emissions or harmful pollutants into the atmosphere. On the whole, wind power projects benefit the environment as they reduce the requirement for fossil fuel based thermal power stations.

The site for the Project is a barren region with little or no vegetation and few inhabitants. The IEE concludes that the proposed Project has a number of positive impacts and negligible negative impacts. The negative impacts can easily be mitigated through a comprehensive environmental monitoring plan throughout the construction and operations period.

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Structured Legal Framework

Local power sector regulatory framework has evolved gradually over a period of time and is now structured to be investor friendly; it hedges the risks and amplifies the returns of the investors and lenders. Key risks covered include:

- Protection against political risks and risk of change in law
- Availability of foreign currency to cover all sorts of payments
- Indexation of fixed and variable costs to cover against inflation risk
- Guaranteed Project Offtake under the Energy Purchase Agreement (EPA)

Financially Strong & Experienced Sponsors

Master Group is one of the most dynamic and leading business groups of Pakistan. Having an annually increasing group turnover of more than Rs. 30 billion, the Sponsor is committed to play its part in the development of Pakistan's various sectors.

The Group has extensive experience in development and operations of complex manufacturing facilities and plants. All manufacturing facilities currently in operation in Master Group were developed on a non-turn key basis under the direct supervision of the Sponsors. Each of these facilities was completed without any cost overrun and within the time frames envisaged for development of the same.

However, keeping in view the structure adopted for development of IPPs in Pakistan, the Sponsors have opted for development of their first wind power project namely Master Wind Energy Limited on a turn key EPC basis. This has allowed the Sponsors to gain first hand experience in developing projects based on an EPC structure.

Turnkey EPC Contract & Long Term O&M

The Sponsors have initialized a fixed-price, turn-key, non-escalable EPC Contract with HDEC (with Gamesa 2.0 wind turbines) for development of the MGEL project, with ample guarantees and warranties built in for protection of the lenders.

In addition to the EPC Contract, MGEL will enter into a long term O&M contract with Gamesa, the wind turbine supplier, to ensure smooth and uninterrupted operations and protection for the entire repayment term (10 years) of the loan.

Advanced Technology

The 2.0 MW Gamesa platform, with over 20 installed GW accumulated in 34 countries, bases its technology on speed control and variable pitch, incorporating the latest technologies in order to obtain maximum wind energy capture with the greatest efficiency.

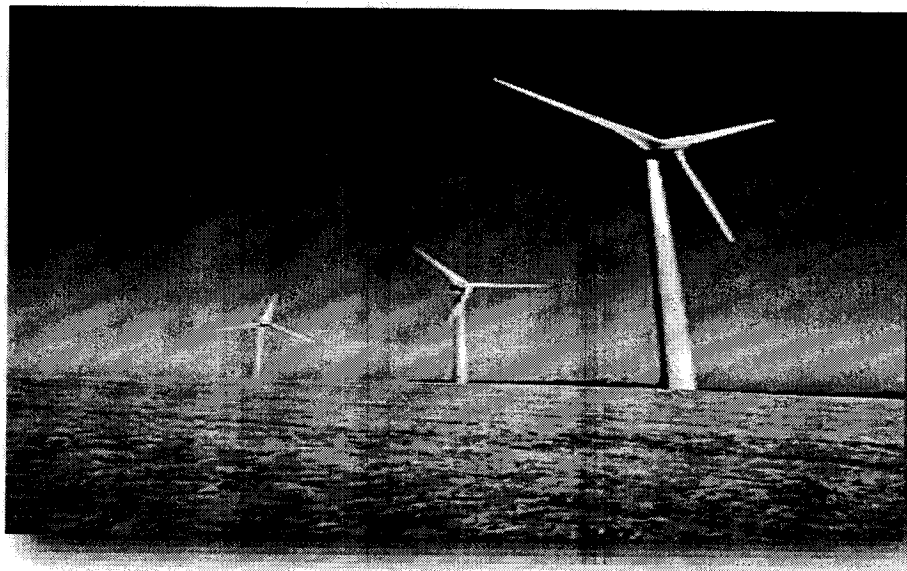
Advanced Project Development Stage

The Project Company has completed the requisite technical and financial feasibility studies, is in final negotiations with the contractors for EPC and O&M. More so, the financing of the project has also been committed and the key terms have been agreed with the lenders. The project will proceed at a rapid pace once new tariff is announced.



ELECTRICAL GRID STUDIES

For
**50 MW Wind Power Plant by Master
Green Energy Limited**



**Final Report
(March 2017)**

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Executive Summary

- The study objective, approach and methodology have been described and the plant's data received from the client Master Green Energy Limited has been validated.
- The wind project by Master Green Energy Limited, referred to as Master Green 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-380/2728-30 dated 24-06-2016.
- Recently a study of 10 WPPs was carried out by NTDC 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 Master Green 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, Master Green WPP which is the plant under study has been located in Jamshoro district. Master Green Wind Power Plant would be connected by loop in-loop out configuration of the newly proposed Nooriabad - Jamshoro old 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 Master Green 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 Master Green WPP includes 132 kV D/C transmission line approx. 7 km long, on Greeley conductor for looping in/out on the 132kV single circuit from Nooriabad to Jamshoro-old grid station.
- The existing grid system of HESCO and NTDC in the vicinity of Master Green WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Master Green WPP and no bottlenecks or constraints have been found in the grid system.
 - Wind Farm of Master Green has been modeled considering Type-3 WTGs. They are Doubly Fed Induction Generators which are designated as Type-3 WTG. The terminal voltage is 0.69 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 Master Green 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 Master Green WPP and a future scenario of 2022, for the dispersal of power from Master Green 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 Master Green 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
 - Series Compensation of 500kV lines from Jamshoro to upcountry
- 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 Master Green 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 Master Green 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 Master Green 132 kV are 8.60 kA and 9.47 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Master Green Farm Substation as per NTDC requirements for 132 kV. The fault levels for Master Green 22 kV are 18.98 kA and 21.60 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 Master Green WPP power to the grid.

The switchgear ratings for Master Green 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 Master Green 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 Master Green WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Master Green 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 Master Green 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

Executive Summary

1. Introduction

- 1.1. Background
- 1.2. Objectives
- 1.3. Planning Criteria
- 1.4. Operating Criteria
- 1.5. Input Data

2. Description of Problem & Study Approach

- 2.1 Description of the Problem
- 2.2 Approach to the Problem

3. Analysis of Network Prior to Master Green WPP Interconnection

- 3.1 Description of the Network
- 3.2 Load Flow Analysis

4. Development of Interconnection Scheme

- 4.1 Interconnection of Master Green 50 MW WPP
- 4.2 Proposed Interconnection Scheme

5. Modeling of Master Green Side Wind Farm

- 5.1. Electrical Layout of Wind Farm
- 5.2. Wind Farm Substation 132/22 kV

6. Load Flow Analysis

- 6.1. Modeling of Wind Farm in Load Flow
- 6.2. Reactive Power Requirements
- 6.3. Load Flow Analysis for Peak Load Scenario of August/September 2019
- 6.4. Load Flow Analysis for Off-Peak Load Scenario of August/September 2019
- 6.5. Load Flow Analysis for future scenario of 2022
- 6.6. Conclusion of Load Flow Results

References

7. Short Circuit Analysis

- 7.1. Methodology and Assumptions



- 7.2. Fault Currents Calculations
- 7.3. Conclusions of Short Circuit Analysis
- 8. Transient Stability Analysis**
 - 8.1. Assumptions and Methodology
 - 8.2. Dynamic impact of system disturbances
 - 8.3. Dynamic impact of Wind Farm Disturbances
 - 8.4. Dynamic impact of Fault on 220 kV Primary System
 - 8.5. Conclusion of Stability Study
- 9. Power Quality Issues**
 - 9.1. Flicker
 - 9.2. Voltage Unbalance
- 10. Conclusions & Recommendations**

Appendices

Appendix –1: Maps

Appendix –2: Data

- 2.1: Generation Plan
- 2.2: Transmission Expansion Plan
- 2.3: Load Forecast
- 2.4: Technical Data Provided By Client

Appendix –3: Plotted Results of Chapter 3

Appendix –4: Sketch for Chapter 4

Appendix –5: Sketches for Chapter 5

Appendix –6: Plotted Results of Chapter 6

Appendix –7: Plotted Results of Chapter 7

Appendix –8: Plotted Results of Chapter 8

Appendix –9: Dynamic Data For Stability Analysis



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 NTDC 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. Master Green 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 Master Green Wind Power Plant on the System
2. Impact of the System on Master Green 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 Master Green 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 Master Green 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 Master Green Wind Farm and the NTDC/HESCO substations of 132 kV connecting with the Master Green 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 Master Green WPP in response to Grid disturbances and vice versa the dynamic impact of disturbances in Master Green WPP on the Grid.
9. To check the ability of the wind turbine generators of Master Green 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	$\pm 5 \%$, Normal Operating Condition
	$\pm 10 \%$, Contingency Conditions
Frequency	50 Hz, Continuous, $\pm 1\%$ 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 IEC61400-21 standards

1.4 Operating Criteria

The operating requirements to be fulfilled by the proposed Master Green 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 Master Green 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 Master Green 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. Master Green 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 Master Green WPP as provided by the Client Master Green Energy 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 Master Green Wind PP.



3. Analysis of Network Prior to Master Green WPP Interconnection

3.1 Description of the Network

The electrical grid, which is relevant for interconnection of Master Green 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” Master Green 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 Master Green 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 NTDC 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 Ghara clusters but without including Master Green 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	Nooriabad to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 3.2	Jamshoro-Old to Jamshoro-New 132 kV Single Circuit Out
Exhibit 3.3	Gulshan Shabz to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 3.4	Kotri GTPS to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 3.5	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit 3.6	Jamshoro-New to Hala Road 132 kV Single Circuit Out
Exhibit 3.7	Jhimpir-1 to T.M.Khan Road 132 kV Single Circuit Out
Exhibit 3.8	Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit Out
Exhibit 3.9	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.10	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 3.11	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 3.12	Jamshoro 500/220 kV Single Transformer Out
Exhibit 3.13	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 3.13a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW



Exhibit 3.14 Jamshoro to Dadu 500 kV Single Circuit Out

Exhibit 3.14a 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 Master Green WPP shown plotted in Exhibits 3.1 to 3.12 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 3.13 and 3.14, 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. Results are shown in Exhibit 3.14(a) and 3.15(a). The details of the curtailment of WPPs are provided below:

Plant Name	Gross output	Curtailed Output
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
Master Green	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

With the curtailment process described above, it is established with Load flow results that the network existing before Master Green WPP in the same vicinity in



Jamshoro cluster including the Jamshoro 220/132 kV collector substation is enough to absorb their power, and has no limitations in terms of power transfer capacity under normal as well as N-1 contingency, prior to connection of Master Green WPP. We will check the adequacy of network after adding Master Green WPP in Chapter 6.



4. Development of Interconnection Scheme

4.1 Interconnection of Master Green 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 Master Green WPP, the nearest substation is the collector substation of Jamshoro 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 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 Master Green WPP includes 132 kV D/C transmission line approx. 7 km long, on Greeley conductor for looping in/out on the 132kV single circuit from Nooriabad to Jamshoro-old grid station.

The connection scheme of Master Green WPP for the scenario of August/September 2019 as shown in Appendix - 4 is by interconnecting Master Green has been located in Jamshoro district. Master Green Wind Power Plant would be connected by loop in-loop out configuration of the newly proposed Nooriabad - Jamshoro old 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 Master Green WPP with neighboring wind power plants may change, depending upon the COD of the project.



5. Modeling of Master Green Wind Farm

5.1 Electrical Layout of Wind Farm

5.1.1 Master Green WPP Energy Selection

Master Green 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 0.69 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 Master Green 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 Master Green 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 Master Green medium voltage bus named Master Green-MV 22 kV and Master Green 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

Master Green 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 0.69 kV terminal is 0.66 MVAR for each WTG. Part of this reactive power will be consumed by the 0.69/22 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 Master Green 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 Master Green 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 Master Green 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 14.40 MVAR at (22.07 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 $\pm 5\%$ 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	Master Green 132/22 kV Single Transformer Out
Exhibit 6.1.2	Master Green to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.1.3	Nooriabad to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.1.4	Nooriabad to Master Green 132 kV Single Circuit Out
Exhibit 6.1.5	Jamshoro-Old to Jamshoro-New 132 kV Single Circuit Out
Exhibit 6.1.6	Gulshan Shabz to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.1.7	Kotri GTPS to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.1.8	Jhimpir to Kotri-GTPS 132 kV Single Circuit Out
Exhibit 6.1.9	Jamshoro-New to Hala Road 132 kV Single Circuit Out
Exhibit 6.1.10	Jhimpir-1 to T.M.Khan Road 132 kV Single Circuit Out
Exhibit 6.1.11	Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit Out
Exhibit 6.1.12	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.1.13	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.1.14	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.1.15	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.1.16	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.1.16a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 6.1.17	Jamshoro to Dadu 500 kV Single Circuit Out
Exhibit 6.1.17a	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 Master Green WPP shown plotted in Exhibits 6.1.1 to 6.1.15 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 6.1.16 and 6.1.17, 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 Master Green WPP is curtailed to 7MW in case of these contingency events. Results are shown in Exhibit 6.1.16(a) and 6.1.17(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
Master Green	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	Master Green 132/22 kV Single Transformer Out
Exhibit 6.2.2	Master Green to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.2.3	Nooriabad to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.2.4	Nooriabad to Master Green 132 kV Single Circuit Out
Exhibit 6.2.5	Jamshoro-Old to Jamshoro-New 132 kV Single Circuit Out
Exhibit 6.2.6	Gulshan Shabz to Jamshoro-Old 132 kV Single Circuit Out



Exhibit 6.2.7	Kotri GTPS to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.2.8	Jhimpir to Kotri-GTPS 132 kV Single Circuit Out
Exhibit 6.2.9	Jamshoro-New to Hala Road 132 kV Single Circuit Out
Exhibit 6.2.10	Jhimpir-1 to T.M.Khan Road 132 kV Single Circuit Out
Exhibit 6.2.11	Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit Out
Exhibit 6.2.12	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.2.13	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.2.14	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.2.15	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.2.16	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.2.16a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 6.2.17	Jamshoro to Dadu 500 kV Single Circuit Out
Exhibit 6.2.17a	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 Master Green WPP shown plotted in Exhibits 6.2.1 to 6.2.15 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 6.2.16 and 6.2.17, 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 6.2.16(a) and 6.2.17(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	Master Green 132/22 kV Single Transformer Out
Exhibit 6.3.2	Master Green to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.3.3	Nooriabad to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.3.4	Nooriabad to Master Green 132 kV Single Circuit Out
Exhibit 6.3.5	Jamshoro-Old to Jamshoro-New 132 kV Single Circuit Out
Exhibit 6.3.6	Gulshan Shabz to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.3.7	Kotri GTPS to Jamshoro-Old 132 kV Single Circuit Out
Exhibit 6.3.8	Jhimpir to Kotri-GTPS 132 kV Single Circuit Out
Exhibit 6.3.9	Jamshoro-New to Hala Road 132 kV Single Circuit Out
Exhibit 6.3.10	Jhimpir-1 to T.M.Khan Road 132 kV Single Circuit Out
Exhibit 6.3.11	Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit Out
Exhibit 6.3.12	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.3.13	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.3.14	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.3.15	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.3.16	Matari to Dadu 500 kV Single Circuit Out
Exhibit 6.3.17	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
- Series Compensation of 500kV lines from Jamshoro to upcountry

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 Master Green 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 Master Green WPP under normal as well as the contingency conditions for all the scenarios studied.

Master Green Wind Power would be connected by loop in-loop out configuration of the newly proposed Nooriabad - Jamshoro old 132kV single circuit. Greeley conductor with the capacity of 184 MVA per circuit has been used for the interconnection of Master Green 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 Master Green 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 Master Green 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 Master Green 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. For Jamshoro 220kV substation whose fault level exceed 40kA, this is due to the reinforcements in the NTDC system hence NTDC should take mitigation measures to reduce these fault levels.

The fault levels of Master Green 132 kV are 8.60 kA and 9.47 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Master Green Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Master Green 22 kV are 18.98 kA and 21.60 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 Master Green WPP – 2022

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Master Green-MV 22 kV	18.98	21.60
Master Green 132 kV	8.60	9.47
Nooriabad 132kV	11.92	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	26.69
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	8.00
T.M. Khan Road 220 kV	22.56	18.46
Jamshoro 220 kV	45.00	45.78
Halla RD 220 kV	29.68	22.90
Jamshoro 500 kV	40.62	34.94
Matiari-CS 500 kV	43.09	30.36

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 Master Green WPP 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Master Green-MV 22 kV	14.50	16.80
Master Green 132 kV	6.43	7.04
Nooriabad 132kV	7.88	8.41



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	10.64
Jhimpir-1 132 kV	18.25	18.99
Jhimpir-2 132 kV	16.99	16.59
Jhimpir 132 kV	7.31	6.89
Thatta 132 kV	4.74	4.71
Halla RD 132 kV	15.59	15.20
Gharo-New 132 kV	7.44	7.53
Jhimpir-2 220 kV	19.01	15.88
Jhimpir-1 220 kV	14.88	13.42
Gharo-New 220 kV	7.42	6.31
T.M. Khan Road 220 kV	14.89	12.93
Jamshoro 220 kV	23.86	23.62
Halla RD 220 kV	18.13	14.89
Jamshoro 500 kV	13.12	11.18
Matari 500 kV	12.76	10.52

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 Master Green 132 kV are 8.60 kA and 9.47 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Master Green Farm Substation as per NTDC requirements for 132 kV.



The fault levels for Master Green 22 kV are 18.98 kA and 21.60 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 Master Green Wind Power Plant on the System
2. Dynamic impact of the System on Master Green Wind Power Plant

8.1 Assumptions & Methodology

8.1.1 Type-3 WTG Dynamic Model

Master Green 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: Master Green 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Master Green to Jamshoro-Old 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Master Green 132 kV 2. Master Green MV 22 kV 3. Nooriabad 132 kV 4. Jamshoro-Old 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	The voltages of all the bus bars recover after fault clearance	8.1.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.1.2
• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.3



• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.4
• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.6
• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.1.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.8
• MW Line Flow • MVAR Line Flow	Master Green to Nooriabad 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.1.9
• MW Output • MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.1.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 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: Master Green 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Master Green to Jamshoro-Old 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Master Green 132 kV 2. Master Green MV 22 kV 3. Nooriabad 132 kV 4. Jamshoro-Old 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	The voltages of all the bus bars recover after fault clearance	8.2.1



Frequency	Master Green 132 kV	Recovers after fault clearance	8.2.2
- Plant MW Output - Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.3
- Speed - Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.4
- Torque - Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.5
- Paero - Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.6
- Turbine Rotor Speed Deviation - Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.2.7
- Pitch control - Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.8
- MW Line Flow - MVAR Line Flow	Master Green to Nooriabad 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.2.9
- MW Output - MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.2.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 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: Master Green MV 22 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Master Green 132/22 kV Single Transformer			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Master Green 132 kV	The voltages of	8.3.1



	2. Master Green MV 22 kV 3. Nooriabad 132 kV 4. Jamshoro-Old 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	all the bus bars recover after fault clearance	
Frequency	Master Green 132 kV	Recovers after fault clearance	8.3.2
• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.3
• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.4
• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.6
• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.3.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.8
• MW Line Flow • MVAR Line Flow	Master Green 132/22 kV Single Transformer	Attains steady state value after damping of oscillations	8.3.9
• MW Output • MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 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: Master Green 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. Master Green 132 kV 2. Master Green MV 22 kV 3. Nooriabad 132 kV 4. Jamshoro-Old 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	The voltages of all the bus bars recover after fault clearance	8.4.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.4.2
• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.3
• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.4
• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.6
• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.4.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4.8
• MW Line Flow • MVAR Line Flow	Master Green 132/22 kV Single Transformer	Attains steady state value after damping of oscillations	8.4.9
• MW Output • MVAR Output	FFC 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 4. Nooriabad 132 kV 5. Atlas 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.4.11



8.2.5

Fault Type: 3-Phase			
Fault Location: Jamshoro 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jamshoro-Old to Master Green 132kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Jamshoro-Old 132 kV 2. Master Green 132 kV 3. Master Green MV 22 kV 4. Nooriabad 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	The voltages of all the bus bars recover after fault clearance	8.5.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.5.2
• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.3
• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.4
• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.6
• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.5.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.8
• MW Line Flow • MVAR Line Flow	Jamshoro-Old to Nooriabad 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.5.9
• MW Output • MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV	Damps down quickly and attain a steady state value	8.5.11



	5. Atlas 220 kV		
	6. Guddu-New (Reference)		

8.2.6

Fault Type: 1-Phase			
Fault Location: Jamshoro 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jamshoro-Old to Master Green 132kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Jamshoro-Old 132 kV 2. Master Green 132 kV 3. Master Green MV 22 kV 4. Nooriabad 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	The voltages of all the bus bars recover after fault clearance	8.6.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.6.2
- Plant MW Output - Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.3
- Speed - Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.4
- Torque - Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.5
- Paero - Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.6
- Turbine Rotor Speed Deviation - Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.6.7
- Pitch control - Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6.8
- MW Line Flow - MVAR Line Flow	Jamshoro-Old to Nooriabad 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.6.9
MW Output	FFC Collector Group-1 0.7 kV	Recovers after damping down	8.6.10



• MVAR Output		oscillations	
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 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: Nooriabad 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Nooriabad to Master Green 132kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Nooriabad 132 kV 2. Master Green 132 kV 3. Master Green MV 22 kV 4. Jamshoro-Old 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	The voltages of all the bus bars recover after fault clearance	8.7.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.7.2
• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.3
• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.4
• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.6
• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.7.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.8



• MW Line Flow • MVAR Line Flow	Master Green to Jamshoro-Old 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.7.9
• MW Output • MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.7.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 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: Nooriabad 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Nooriabad to Master Green 132kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Nooriabad 132 kV 2. Master Green 132 kV 3. Master Green MV 22 kV 4. Jamshoro-Old 132 kV 5. Jamshoro-New 132 kV 6. Jamshoro 220kV	The voltages of all the bus bars recover after fault clearance	8.8.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.8.2
• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.3
• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.4
• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.6



• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.8.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.8
• MW Line Flow • MVAR Line Flow	Master Green to Jamshoro-Old 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.8.9
• MW Output • MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 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: Jamshoro 220 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jamshoro to Hala Road 220 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Jamshoro 220 kV 2. Hala Road 220 kV 3. T.M.Khan Road 220 kV 4. Hala Road 132 kV 5. Jamshoro-New 132 kV 6. Master Green 132 kV	The voltages of all the bus bars recover after fault clearance	8.9.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.9.2
• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.3
• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.4



• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.6
• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.9.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.8
• MW Line Flow • MVAR Line Flow	Jamshoro to Hala Road 220 kV Single Circuit	Attains steady state value after damping of oscillations	8.9.9
• MW Output • MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.9.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 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: Jamshoro 220 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jamshoro to Hala Road 220 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Jamshoro 220 kV 2. Hala Road 220 kV 3. T.M.Khan Road 220 kV 4. Hala Road 132 kV 5. Jamshoro-New 132 kV 6. Master Green 132 kV	The voltages of all the bus bars recover after fault clearance	8.10.1
Frequency	Master Green 132 kV	Recovers after fault clearance	8.10.2



• Plant MW Output • Plant MVAR Output	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.3
• Speed • Pmechanical	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.4
• Torque • Pitch Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.5
• Paero • Shaft Twist Angle	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.6
• Turbine Rotor Speed Deviation • Generator Speed Deviation	Master Green Collector Group-1 0.7 kV	Recovers	8.10.7
• Pitch control • Pitch compensation	Master Green Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.8
• MW Line Flow • MVAR Line Flow	Jamshoro to Hala Road 220 kV Single Circuit	Attains steady state value after damping of oscillations	8.10.9
• MW Output • MVAR Output	FFC Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.10.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Atlas 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.10.11

8.5 Conclusion of Stability Study

The transient stability analysis performed as discussed above indicates that the NTDC system connecting to Master Green WPP through the proposed scheme of interconnection is strong enough to absorb the worst disturbances on either side i.e. on Master Green WPP side or the Grid side.



There are no constraints of connecting Master Green 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 Master Green 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 Master Green Wind farm reduced



as low as 25 % of its rated capacity. Therefore taking one collector group as one equivalent generator of $6 \times 2 = 12$ 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 = 550 MVA

The value of $c(\psi_k)$ 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.

$$c(\psi_k) = P_{st, fic} \cdot \frac{S_{k, fic}}{S_n}$$

where

S_n is the rated apparent power of the wind turbine;

$S_{k, fic}$ is the short-circuit apparent power of the fictitious grid.

The value of $c(\psi_k)$ 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

$P_{st\sum} = P_{it\sum} = 0.009887 = 0.9887 \%$

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 Master Green 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)



$$P_{st\Sigma} = \frac{18}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{10,i} \cdot (k_{f,i}(\psi_k) \cdot S_{n,i})^{3,2} \right)^{0,31}$$

$$P_{lt\Sigma} = \frac{8}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{120,i} \cdot (k_{f,i}(\psi_k) \cdot S_{n,i})^{3,2} \right)^{0,31}$$

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 $k_{f,i}(\psi_k)$ 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;

$$P_{st\Sigma} = 0.229995$$

$$P_{lt\Sigma} = 0.220842$$

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_{It} 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)

$S_{KSS} = 540$ MVA (Exhibit 7.1.2)

Substituting these values we get

$$\Delta V = 0.002826 = 0.2826 \%$$

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 = 0.00625 = 0.625 %

Which is less than the maximum permissible specified as 4 %.



10- Conclusions & Recommendations

- Interconnection Study has been carried out for 50 MW Master Green WPP which is proposed to be connected by loop in-loop out configuration of the newly proposed Nooriabad - Jamshoro old 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 Master Green WPP includes 132 kV D/C transmission line approx. 7 km long, on Greeley conductor for looping in/out on the 132kV single circuit from Nooriabad to Jamshoro-old grid station.
- The existing grid system of HESCO and NTDC in the vicinity of Master Green WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Master Green WPP and no bottlenecks or constraints have been found in the grid system.
- Wind Farm of Master Green has been modeled considering Type-3 WTGs. They are Doubly Fed Induction Generators which are designated as Type-3 WTG. The terminal voltage is 0.69 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 Master Green 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 Master Green WPP and a future scenario of 2022, for the dispersal of power from Master Green 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 Master Green 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
 - Series Compensation of 500kV lines from Jamshoro to upcountry
- 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 Master Green 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 Master Green 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 Master Green 132 kV are 8.60 kA and 9.47 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Master Green Farm Substation as per NTDC requirements for 132 kV. The fault levels for Master Green 22 kV are 18.98 kA and 21.60 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 Master Green WPP power to the grid.

The switchgear ratings for Master Green 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 Master Green 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 Master Green WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Master Green 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 Master Green 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.





ORIGINAL



INITIAL ENVIRONMENTAL EXAMINATION (IEE) OF 50 MW WIND POWER PROJECT IN JAMSHORO, SINDH PAKISTAN



December, 2015

PROJECT COMPANY

Master Green Energy Ltd

PROJECT CONSULTANTS

Renewable Resources (Pvt.) Ltd

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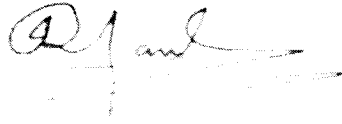
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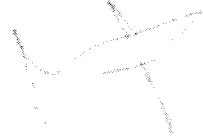
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	Project Sponsor: Master Group	Document Issue 01	Page 4

TABLE OF CONTENTS

EXECUTIVE SUMMARY	14
1 INTRODUCTION AND PURPOSE OF STUDY	21
1.1 PROJECT PROPONENT	21
1.2 THE PROFESSIONAL ADVISORS	21
1.3 PROJECT BACKGROUND & JUSTIFICATION	23
1.4 PROSPECTS OF WIND ENERGY IN PAKISTAN	25
1.5 PROJECT OVERVIEW & OBJECTIVES	26
1.6 NEED AND OBJECTIVES OF IEE STUDY	27
1.7 BASIS PROJECT CATEGORIZATION OF EIA STUDY	28
1.8 Scope of IEE Study	29
1.9 Methodology for Initial Environmental Examination Study	30
1.9.1 Scoping	31
1.9.2 Impact Assessment	32
1.9.3 Documentation	33
1.10 METHOD FOR EVALUATING IMPACT	33
2 LEGISLATIVE REQUIREMENTS	34
2.1 NATIONAL ENVIRONMENTAL LAWS	34
2.2 POLICY GUIDELINES	34
2.2.1 National Conservation strategy	34
2.2.2 The Biodiversity Action Plan	36
2.3 ENVIRONMENT INSTITUTIONS AND ADMINISTRATION	36
2.4 LAWS, REGULATIONS, AND GUIDELINES	36
2.5 PAKISTAN ENVIRONMENTAL PROTECTION ACT, 1997	37
2.6 SINDH ENVIRONMENTAL PROTECTION ACT, 2014	37
2.7 PAKISTAN ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2000	38
2.8 SINDH ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2014	39
2.9 SECTORAL GUIDELINES FOR ENVIRONMENTAL REPORTS-WIND POWER PROJECTS	40
2.10 POLICY FOR DEVELOPMENT OF POWER GENERATION PROJECTS, 2006	40
2.11 PROJECT DEVELOPMENT IN TERMS OF POLICY FRAMEWORK	40

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 5
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2.11.1	Letter Of Intent (LOI)	41
2.11.2	Acquisition of Land	41
2.11.3	Submission of Feasibility Study	41
2.11.4	Generation License	41
2.11.5	Tariff Determination	41
2.11.6	Letter of Support (LOS)	42
2.11.7	Energy Purchase Agreement (EPA)	42
2.11.8	Implementation Agreement (IA)	42
2.11.9	Financial Close	42
2.12	NATIONAL AND INTERNATIONAL ENVIRONMENTAL STANDARDS	43
2.12.1	National Environmental Quality Standards	43
2.12.2	National Environmental Policy, 2005	43
2.12.3	Land Acquisition Act, 1984	44
2.12.4	Telegraph Act, 1985	45
2.12.5	The Sindh Wildlife Protection Ordinance, 1972	45
2.12.6	The Sindh Fisheries Ordinance, 1972	45
2.12.7	The Forest Act 1927	46
2.12.8	Canal and Drainage Act, 1873	46
2.12.9	The Antiquities Act, 1975& the Sindh Cultural Heritage (Preservation) Act, 1994	46
2.12.10	Factories Act, 1934	46
2.12.11	Employment of Child Act, 1991	47
2.12.12	Civil Aviation Rules, 1994	47
2.12.13	Pakistan Penal Code, 1860	48
2.12.14	National Resettlement Policy / Ordinance	48
2.12.15	Sindh Local Government Ordinances, 2001	49
2.12.16	The IUCN Red List	49
2.12.17	Motor Vehicles Ordinance, 1965, and Rules, 1969	50
2.12.18	Cutting of Trees (Prohibition) Act, 1975	50
2.13	OPIC- ENVIRONMENTAL AND SOCIAL POLICY STATEMENT	50
2.13.1	Screening and Categorization	51
2.13.2	Applicant Role and Responsibilities	51
2.13.3	Tailored Reviews	51
2.14	ASIAN DEVELOPMENT BANK (ADB) POLICIES & STANDARDS	52
2.14.1	2009 Safeguard Policy Statement	52
2.14.2	Policy on Gender and Development	52
2.14.3	Social Protection Strategy	53
2.14.4	2005 Public Communications Policy	54
2.14.5	Core Labor Standard	54
2.15	WORLD BANK GUIDELINES ON ENVIRONMENT	55
2.16	Equator Principles	56
2.17	IFC Performance Standards on Social and Environmental Sustainability	58
2.18	IFC- Environmental, Health, and Safety Guidelines	62
2.19	INSTITUTIONAL SETUP FOR ENVIRONMENTAL MANAGEMENT	64

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 6

2.20	OBLIGATION UNDER INTERNATIONAL TREATIES	64
3	DESCRIPTION OF PROJECT	66
3.1	PROJECT LOCATION	66
3.2	ROAD ACCESS	69
3.3	PROJECT SIZE AND COMPONENTS	71
3.3.1	Preconstruction Phase	71
3.3.2	Construction Phase	71
3.3.3	Operation and Maintenance Phase	72
3.3.4	Decommissioning Phase	72
3.4	PROJECT SCHEDULE	73
3.5	LOCATION OF GRID	74
3.6	WIND TURBINE DETAILS	75
3.7	INFRASTRUCTURE DETAILS	75
3.8	NET ENERGY YIELD AND CAPACITY FACTOR	75
4	BASELINE ENVIRONMENTAL CONDITIONS	76
4.1	CLIMATIC CONDITIONS	76
4.2	SURFACE AND GROUND WATER HYDROLOGY AND DRAINAGE	78
4.3	AMBIENT AIR QUALITY	81
4.4	NOISE QUALITY	81
4.5	SEISMIC HAZARDS	81
4.6	FLOODS	84
4.7	GEOLOGICAL SETTINGS	85
4.8	SOIL CLASSIFICATION	86
4.9	LAND USE CAPABILITY	86
4.10	SOCIO ECONOMIC FEATURES	87
4.10.1	Local Settlement Pattern and Population	87
4.10.2	Health and Education Facilities	89
4.10.3	NGOs Working in the Area	90
4.10.4	Income Source	91
4.10.5	Infrastructure and Industry	91
4.11	ECOLOGY	92
4.11.1	Flora	93
4.11.2	Fauna	94
4.12	NATURAL MINERAL RESOURCES	95

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 7

5	ANALYSIS OF PROJECT ALTERNATIVES	97
5.1	WITH OR WITHOUT PROJECT	97
5.2	ALTERNATIVE FUEL	98
5.3	Location Alternative	98
6	POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES	100
6.1	LAND USE	100
6.2	AIR QUALITY	101
6.3	NOISE QUALITY	101
6.4	NOISE FROM WIND TURBINES	103
6.5	SHADOW FORECASTING	106
6.6	WATER USE AND QUALITY	107
6.7	GROUNDWATER CONTAMINATION	108
6.8	Solid Waste Generation	108
6.9	Wastewater Generation	109
6.10	BIOLOGICAL ENVIRONMENT	110
6.10.1	Wetland and Wildlife Sanctuaries	110
6.10.2	The Indus Flyway	112
6.10.3	Birds/Avian Collision	114
6.10.4	Flora and Vegetation	120
6.11	SOCIO ECONOMIC ENVIRONMENT	120
6.11.1	Archeological Sites	120
6.11.2	Re-Settlement	121
6.11.3	Visual Impact on Landscape	122
6.11.4	Aviation Hazard	123
6.11.5	Traffic Management	123
6.11.6	Labor Welfare and Safety	124
6.11.7	Seismic Hazards	125
	PUBLIC CONSULTATION	126
7	PUBLIC CONSULTATION	126
7.1	Objectives of Public Consultation	126
7.2	Consultation Process	127
7.2.1	Scope	127
7.2.2	Community Consultation	127
7.2.3	Government Agencies	129
7.2.4	Non-Governmental Organizations	131

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 8

8	ENVIRONMENT MANAGEMENT PLAN	135
8.1	PURPOSE AND OBJECTIVE OF EMP	135
8.2	COMPONENT OF EMP	136
8.3	INSTITUTIONAL ARRANGEMENT	136
8.3.1	PROJECT DEVELOPER	136
8.3.2	Supervision Consultant (RE)	138
8.3.3	Lead Contractor	138
8.4	MITIGATION & MONITORING PLAN	140
8.5	GRIEVANCE REDRESSAL MECHANISM	141
8.6	REPORTS AND DOCUMENTATION	142
8.7	ENVIRONMENTAL AND SOCIAL TRAININGS	142
8.8	PUBLIC DISCLOSURE REQUIREMENTS	143
8.9	COST ESTIMATES FOR EMP IMPLEMENTATION	143
9	INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION	144
10	FINDING AND RECOMMENDATION	146
	ANNEXURE	149

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 9

LIST OF FIGURES

Figure 1.1: Electricity Mix of Pakistan by Source	23
Figure 1.2: Wind Map of Pakistan by NREL	25
Figure 3.1: MGEL Project Site Layout.....	67
Figure 3.2: A View of Project Site	68
Figure 3.3: Ariel View of Complete Track (Through Karachi-Hyderabad Motorway)	69
Figure 3.4: MGEL Site from Port Qasim	70
Figure 3.5: Nearest HESCO grid station	74
Figure 4.1: Graph of Average Maximum and Minimum Temperature (°C)	77
Figure 4.2: Satellite View of Keenjhar/Kalri Lake near Project Site	78
Figure 4.3: View of Kinjhar/Kalri Lake near Project Site	79
Figure 4.4: Seismic Hazard Zones of Pakistan.....	82
Figure 4.5: Seismic Map of Pakistan	83
Figure 4.6: Flood Map of Pakistan.....	84
Figure 4.7: Geological and Sub Surface Details of Jhampir.....	96
Figure 6.1: Noise Generating from Wind Turbine.....	104
Figure 6.2: Noise Generating from Wind Turbine.....	105
Figure 6.3: Shadow Flicker of Wind Turbine.....	106
Figure 6.4: Wetlands of Pakistan	110
Figure 6.5: Wetland located in Sindh	111
Figure 6.6: Indus Flyway for Migratory Birds/Green Route No.04	115
Figure 6.7: Birds Flying and Staying Patterns on Keenjhar Lake with Respect to Wind Farms.....	117

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 10

LIST OF TABLES

Table 1-1: Project at a Glance	26
Table 2-1 World bank Guidelines for Noise levels.....	56
Table 3-1: Land Coordinates	68
Table 3-2: Technical Specification s of Wind Turbine	75
Table 3-3: Annual Energy Production Estimates	75
Table 4-1: Average Maximum and Minimum Temperatures in Jhimpir Region (°C)	77
Table 4-2: Average Precipitation and Rainfall Days in Jhimpir Region	78
Table 4-3: Geologocal Formations covered in the Wind Corridor of Jhimpir	85
Table 4-4: Land Use Capability Class in Jamshoro	87
Table 4-5 List of Settlements and Population details.....	88
Table 6-1: Migratory and Local Birds of Keenjhar Lake	113
Table 7-1 General Public Interviewed during Public Consultation at Jamshoro.....	129

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 11

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
CBD	Convention on Biological Diversity
CITES	Convention on Trade of Endangered Species
CLs	Core Labor Standards
Db	Decibel
DMC	Developing Member Countries
EIA	Environmental Impact Assessment
EHS	Environment Health and Safety
EMP	Environment Management Plan
ESMC	Environmental and Social Management Cell
EPA	Energy Purchase Agreement
EMMP	Environment Monitoring and Management Plan
GAD	Gender and Development
GHG	Greenhouse Gas Emissions
GRM	Grievance Redressal Mechanism
IEE	Initial Environmental Examination
IFC	International Finance Corporation
JICA	Japan International Cooperation Agency
Km	Kilometers
LAA	Land Acquisition Act
LOS	Law of Seas
MEA	Multilateral Environmental Agreements
MW	Mega Watt

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 12

MWh	Mega Watt Hour
NCS	National Conservation Strategy
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NGO	Non-Government Organization
Nox	Nitrate Oxides
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Dispatch Company
O & M	Operation and Maintenance
OPIC	Overseas Private Investment Corporation
PEPA	Pakistan Environment Protection Act
POPs	Persistent Organic Pollutants
Pak-EPA	Pakistan Environment Protection Agency
PV	Photo Voltaic
RE2	Renewable Resources (Pvt.) Ltd
SCR	Social Complaint Register
SHEE	Safety Health Environment and Energy
Sox	Sulfur Oxides
WWF	World Wildlife Foundation

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 13

EXECUTIVE SUMMARY

Introduction

This document is an Initial Environmental Examination IEE of a **50 MW Wind Power Project** (Project) being developed by Master Green Energy Limited in District Jamshoro, Sindh Pakistan.

The sponsor of the Project is Master Group. Master Group is one of the most dynamic and diverse business groups of Pakistan. The Group started its operations by entering the mattress manufacturing industry in 1963, as a licensee of Bayer A.G. (Germany), and became a pioneer in the bedding industry.

Today with a strong asset base of over Rs. 22 billion (USD 220 million), the Group is not only a leading player in the bedding market (with more than 50% market share) but has also diversified into the textile, furniture, auto and engineering sectors. The Master Group enjoys impeccable integrity both in the international and domestic markets, which is reflected in its growing balance sheet over the last three years.

The Master Group comprises of companies performing in different industrial sectors including but not limited to textiles, foam and spring mattresses, engineering and automobile sector. The major Group companies are as follows:

Master Enterprises (Private) Limited, Dura Industries (Private) Limited, Master Celeste (Private) Limited (Collectively, Master Molty Foam), Master Textile Mills Limited, Procon Engineering (Private) Limited, Master Motor Corporation (Private) Limited, Master OffiSys (Private) Limited and Master Wind Energy Limited. Now Master Group is interested to install another 50 MW Wind Power Project in Jamshoro District, Sindh-Pakistan.

Consultant

Renewable Resources is the Project consultant engaged for Project development including the Initial Environmental examination (IEE) of the Project.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 14

The contact details of consultant are given below;

Renewable Resources (Pvt.) Ltd	
Islamabad Office	No.1002, 10 th Floor, Green Tower, Jinnah Avenue, Islamabad – Pakistan Tel: 0092 51 8358591 Fax: 0092 51 8358592
Karachi Office	86/I Khayaban-e-Behria, Phase V, Karachi – Pakistan Tel: 0092 21 35347122 Fax: 0092 21 35347123
Website	www.renewableresources.com.pk
Contact Person	Irfan Afzal Mirza, CEO
Email	irfanmirza@renewableresources.com.pk

Project Sponsors

MGEL is owned by the renowned Master Group of Companies most widely known for the “Moltyfoam” mattress brand. Contact details are as follows;

Master Green Energy Ltd	
Address	82-C/1 Gulberg-III, Lahore, Pakistan Tel: 0092 (0)42 35752620-2 Fax: 0092 (0)42 35750895 - 35751905 Email: info@master.com.pk
Contact Persons	Rumman Dar Email: rumman.dar@masterwind.com.pk

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 15

Study Methodology

The study was conducted using standard methodology prescribed by national and international agencies to facilitate the review of identified environmental issues. This entailed an understanding and description of the environment within the activities which will occur or potentially have influence on the social and biological environment. The IEE study was conducted in four phases.

- Phase-I involved the definition and categorization of the Project components, collection of baseline data and information of the defined Project area through physical survey and consultation with the local inhabitants near the Project area.
- Phase-II involved the laboratory analysis of the different environmental parameters which includes (Ambient Air Monitoring, Ambient Noise, and Water quality analysis of the project area.
- Phase-III involved assessment of potential impact assessment of the pre-construction, construction, operation and Decommission phase of the Project.
- Phase-IV involved the mitigation measures, formulation and monitoring of an Environmental Management Plan (EMP) to minimize the environmental impacts of the Project during construction and operation phase.

The approach of IEE study includes the following steps:

- ❖ Describing the Project and details of Project Proponents
- ❖ Review of applicable Statutory Requirements and compliances
- ❖ Establishing environmental baseline conditions through survey and consultation with the local stakeholders
- ❖ Scoping the issues and establishing the boundaries of the assessment
- ❖ Review of Project Alternatives
- ❖ Assessing the potential environmental effects of the Project, including residual and cumulative effects
- ❖ Identifying potential mitigation measures to eliminate or minimize the potential adverse environmental impacts
- ❖ Environmental Management & Monitoring Plan and follow-up programs

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 16

Statutory Requirements

The report fulfills the following regulatory requirements:

- ❖ Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 with reference to Pakistan Environmental Protection Act, 1997,
- ❖ Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations, 2014 with reference to Sindh Environmental Protection Act, 2014
- ❖ Performance Standards of IFC and World Bank group

The details of the statutory requirements and compliances of this IEE report to the national and international regulations or guidelines are explained in **Section 2** of this report.

Project Overview

The wind farm Project of 50 MW of Master Green Energy Limited is located in Goth Dehson Walhar, District Jamshoro Sindh. The land has been leased by the Government of Sindh to the project company. The Karachi Hyderabad Motorway (Super Highway) is connecting road to the MGEL project site. The total land area of the Project is 2000 acres.

Subject to finalization of the EPC, the Project will install 29 units of G.E 1.7 turbine generators (WTGs), each with rated output of 1.7MW. However, the exact configuration will be determined upon finalisation of the EPC. The other options of wind turbine generators (WTGs) are also available like, Nordex wind turbine generators (WTGs) rated output of 3.0MW total 16 WTGs, Vestas V126 wind turbine generators (WTGs) rated output of 3.3 MW total 15 WTGs, G.E 1.7 wind turbine generators (WTGs) rated output of total 29 WTGs.

Further details about the Project and its location are given in **Section3** of this report.

Description of Environment

A data collection survey was undertaken that included geology, meteorology, hydrology, ambient air quality, water quality, soil characteristics, noise levels, shadow forecasting, flora and fauna, land use pattern, and socio-economic conditions, based on available secondary information or data collected in the field. Primary data was collected to establish baseline conditions for the soil, water (surface and ground) quality, flora and fauna, and noise. Secondary data was collected for land, climate, and socioeconomic factors.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 17

The physical survey of the site was conducted by Mr. Umair Ali Khilji of Renewable Resources (Pvt) Ltd. The environmental and social baseline conditions observed in the Project area are presented in **Section 4** of this report.

Impact Assessment and Mitigation

A detailed analysis of Project alternatives are discussed in **Section 5**. During the IEE, the Project potential social and environmental impacts were identified. Each identified environmental and social impact was then characterized with respect to its nature, reversibility, geographical extent, consequence-severity and likelihood. Based upon this characterization, the impacts were then assessed to be of high, medium or low significance. The IEE has recommended appropriate mitigation measures to address the potential environmental and socio-economic impacts. The details of impact assessment and mitigation measures are provided in **Section 6**, which is further supplemented by the Environmental Management Plan (EMP) provided in **Section-8** of this report.

Stakeholder Consultation

Stakeholder consultation was carried out as part of IEE study. The details of the consultation are documented in **Section-8** of the report.

Finding and Recommendations

- Wind Power Project is a green energy Project and, therefore, there is no major long lasting social or environment impact foreseen.
- Air quality of the area may be slightly disturbed only during construction phase of the Project.
- The Project Area does not fall under any sensitive, protected area.
- No threatened / Near-Threatened species of wildlife was recorded in the Project Area.
- There are eight settlements near the project area; only five are permanent settlements and other three were seasonal/temporary settlements. These settlements are outside from the project land area at distance of 2.6 Kilometers therefore no disturbance to the inhabitants is foreseen.
- Regarding bird mortality due to collision, it is found that birds landing area is around 40 km away from the wind farm and the migratory birds are not seen in the wind farm area and there are minimal to zero chance of bird collision from these wind turbines.
- Noise impacts will be less than 70 DB (A) which is within the range as per National Environmental Quality Standards (NEQs) of Pakistan.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 18

- The environmental disturbance normally associated with construction activities will be minimized through an Environment Management Plan (EMP), implementation of which will continue during Project operation and which includes monitoring arrangements.
- The Project will bring a positive development in the area and improve the socio-economic conditions through generation of employment opportunities and opening of avenues for the development of this area. Power project constructed and then operated in the area will cause development of good infrastructure, which will be benefited by the local population.
- At least, one year bird monitoring is recommended to compile substantive data about the impacts of wind power plants on the birds and other important wildlife of the area.
- The Project will also help promote renewable energy in Pakistan and will contribute positively by meeting the energy supply demand of the country.
- This IEE study concludes that the proposed Wind project will not lead to significant adverse environmental and social impacts of such nature or magnitude that would require a more detailed report 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.

The project has been discussed with local people, government officials and NGO (like Wildlife department, WWF, IUCN). The consultations elicited general support for the project. There were no serious environmental issues raised or matters that the Consultant had overlooked. The main concerns expressed were to ensure that local people got employment on the project and that measures were in place to avoid excessive noise or dust and bird mortality. In the view of all above, 50 MW wind power Project of Master Green Energy Ltd can be regarded as **Environmental Friendly Green Project**. The details of IEE findings and recommendations are discussed in **Section-9** of this report.

The following Annexures are attached with the report in order to support the results and findings of the report.

- Annexure-I: Environmental Management and Monitoring Plan
- Annexure-II: EMP Implementation Cost Estimates
- Annexure-III: Pakistan Environmental Protection Agency Act 1997 and (Review of IEE and EIA) Regulations, 2000
- Annexure-IV: Sindh Environmental Protection Agency Act 2014 and (Review of IEE and EIA) Regulations, 2014
- Annexure-V: Pakistan National Environmental Quality Standards
- Annexure-VI: IFC HSE Guidelines for Wind Energy Sector

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 19

Annexure-VII: Laboratory Analysis Reports

Annexure-VIII: List of Flora and Fauna Recorded in Project Area

Annexure –IX: Snapshots of Biological Environment

Annexure-X: Social Survey Forms

Annexure-XI: Snapshots of Community Consultation

Annexure-XII: Snapshots of Stakeholders Consultation

Annexure-XIII: NOC of Sindh Wildlife Department

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 20

SECTION 1

INTRODUCTION AND PURPOSE OF STUDY

1 INTRODUCTION AND PURPOSE OF STUDY

1.1 PROJECT PROPONENT

The sponsor of the Project is Master Group of Companies.

Master Green Energy Limited (MGEL or the Project Company) is a special purpose company incorporated under the Company Ordinance 1984. The sole purpose of the company is to develop, construct, commission, operate and maintain a 50 MW wind power project. MGEL is owned by the renowned Master Group of Companies most widely known for the "Moltyfoam" mattress brand.

Master Group is interested to setup another Wind Power Project of 50 MW Capacity in Jamshoro District, Sindh, Pakistan.

Renewable Resources (Pvt) Limited (RE2) is the consultant to develop the Project of Master Energy Pvt. Ltd.

Master Green Energy Limited has land available having area of approximately 2000 Acres. In order to identify the land for the wind farm within the same area, preliminary site assessment has been carried out.

1.2 THE PROFESSIONAL ADVISORS

Renewable Resources (Pvt.) Ltd is the professional technical advisor for the Project. Renewable Resources is a consulting company specialized in Renewable Energy (RE), Energy Efficiency (EE) and Environment (Env.) Projects. The company is owned by group of professionals who have been intimately involved in the renewable energy program of Pakistan, and have a fundamental understanding of issues relating to power project development, which include but are not limited to feasibility studies, regulatory approvals, concession and security documents, and applicable policies.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 21

RE2 is capable of conducting full feasibility package featuring power production estimates, grid interconnection and tariff model. RE2 also has the expertise to deal with all technical aspects regarding the legal documents of power projects. The professional team of RE2 is well acquainted with the policies, regulations, methodologies and standards of RE power Projects and its work output meets international standards. RE2 is presently a consultant for various power Projects in Pakistan sponsored by local and international investors, with international banks.

RE2 has gained significant experience in conducting Environmental and Social Impact Assessments (ESIA) and Initial Environmental Examinations (IEE) of renewable energy projects in accordance with national and international laws and standards. These studies cover all baseline environmental conditions and anticipated environmental impacts of projects and provide comprehensive Environmental Management Plans.

To date, RE2 has conducted Eighteen (18) environmental studies of renewable energy projects, which have all been approved by the relevant Environmental Protection Agencies.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 22

1.3 PROJECT BACKGROUND & JUSTIFICATION

Pakistan's major electricity sources are thermal and hydro generation, meeting approximately 70% and 28% (respectively) of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil and gas. While both are produced domestically, demand already outstrips supply by a considerable amount. Oil import is a significant burden on the national exchequer and the increasing import bill continues to exert further pressure on the foreign exchange reserves. Electricity mix of Pakistan (2013-2014) is presented in **Figure 1.1**.

ELECTRICITY GENERATION 2013-14 TOTAL: 103,670 GWH

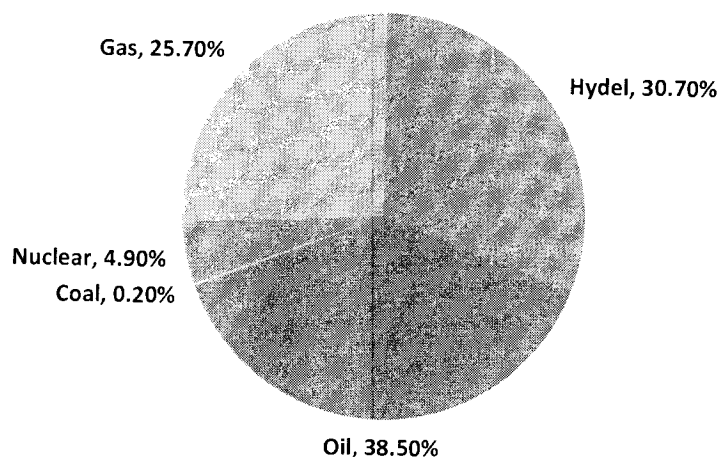


Figure 1.1: Electricity Mix of Pakistan by Source¹

¹ Energy Year Book of Pakistan 2014

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 23

Import of gas could be seen as a viable option to overcome the depleting domestic reserves. However, gas import has significant challenges, such as the need for substantial capital investment in infrastructure, security difficulties and physical terrain concerns. Moreover, it would increase Pakistan's reliance on imported fuels with associated foreign exchange burdens. This must be considered in the context of rising costs for gas and oil-based fuels as a result of uncertainty over future supply.

Alternatives to further fuel imports for electricity generation are the production of domestic coal, generation from hydro-electric power, or other renewable sources, such as wind and solar power. These options will assist in reducing Pakistan's reliance on imported oil and protect against resulting vulnerability to changes in global oil prices, which will in turn also have a positive effect on the current trade deficit and inflating import bill.

As with gas, securing future supplies of domestic coal and hydro-electric power would require significant spending on infrastructure. While Pakistan has domestic reserves of coal, it currently makes up a very small proportion of the country's total power generation. This is due, in part, to the fact that most of the reserves are located in the remote Thar Desert region. Exploiting the coal reserves would require significant upfront investment in local infrastructure (including provision of water supplies), development of mines, housing and related infrastructure, and investment in transmission lines, as a pre-requisite to any power plant development. Hydro-electric power already supplies almost 30% of the domestic electricity that is generated, and numerous sites for future investment exist. However, due to their locations, this would also require significant investment in transmission and other infrastructure. Moreover, there are various political issues relating to the development of hydro-electric and coal generation power plants, which remain to be resolved.

In light of the prevailing circumstances, wind generation appears to be a viable and environmentally friendly alternative for meeting Pakistan's urgent electricity demands. The development of wind generation projects could reduce dependence on oil-based thermal power generation, increase diversity in Pakistan's electricity generation mix, and reduce greenhouse gas (GHG) emissions, all of which will contribute towards projecting a positive image of Pakistan within the international community. Also the per kWh tariff for wind power projects are now comparatively lower than that of furnace oil projects, particularly the Rental Power Projects, which were previously inducted to meet the urgent needs of electricity shortfalls.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 24

1.4 PROSPECTS OF WIND ENERGY IN PAKISTAN

Pakistan has considerable potential for wind energy in the coastal belt of its southern provinces Sindh and Balochistan, as well as in the central desert areas of Punjab and Northern Sindh. This potential source of renewable energy has however, not been properly realized thus far. According to a study conducted by NREL, and data collected from the wind masts installed in the Gharo and Keti Bandar wind corridor, the average wind speed in this wind corridor is 7.4 m/s making a regional potential of more than 50,000 MW. The Wind Map of Pakistan as comprised by NREL is shown in Figure 1.2 below.

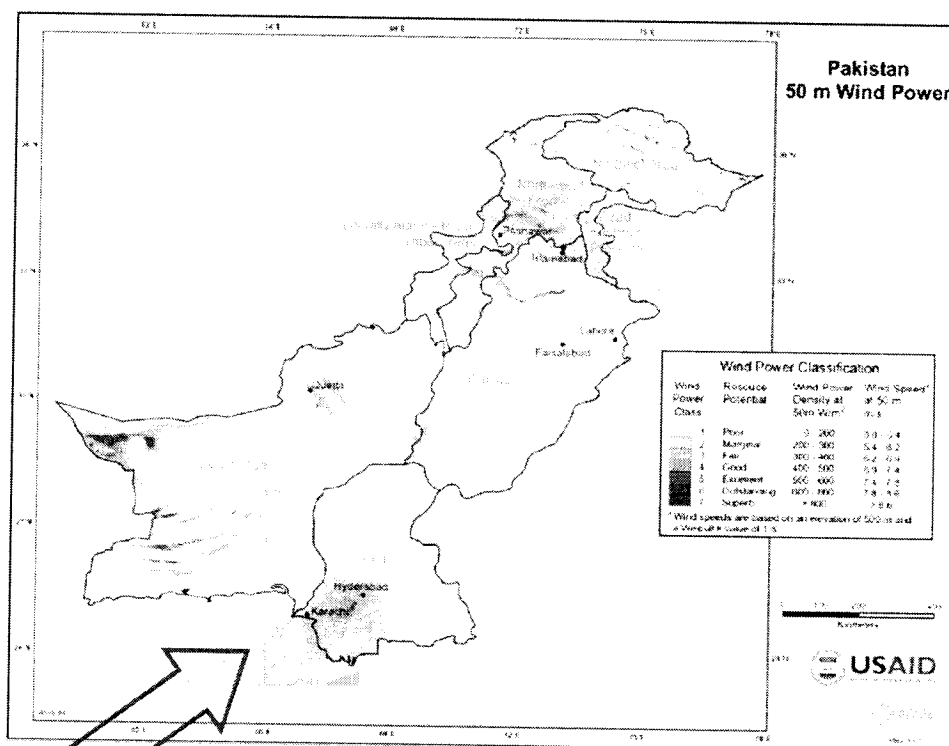


Figure 1.2: Wind Map of Pakistan by NREL

Wind Corridor

The Government of Pakistan (GOP) is diversifying its energy mix on a fast track basis to ensure Energy Security, Sustainable Development, Social Equity and Environmental Protection. Given its overall economics, wind energy is envisaged as an important ingredient of Pakistan's future energy mix.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 25

Keeping in view the anticipated future energy needs and the significant potential for renewable energy, the GOP has set a target of at least 5% of the total national power generation capacity to be generated through renewable energy technologies, especially through wind energy by the year 2030.

1.5 PROJECT OVERVIEW & OBJECTIVES

The Wind Farm Project is located in Jamshoro, which is approximately 138 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 2000 acres of land, which has been leased by the Government of Sindh. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site.

Subject to finalization of the EPC, the Project presently contemplates installing a total of 29 wind turbine generators (WTGs), each with rated output of 1.7 MW. The other options are also available as mentioned in the table given below.

The brief overview of Project is summarized in **Table 1.1** below.

Table 1-1: Project at a Glance

S. No	Particulars	Description
1	Project Site	Jamshoro, Province of Sindh, Pakistan
2	Project Capacity	50MW
3	Turbines to be installed	G.E 1.7 MW – Total 29 WTG Gamesa G114 - 2.0 MW – Total 25 WTGs G.W 121 – 2.5 MW – Total 20 WTGs Vestas V126 -3.3 MW – Total 15 WTG Nordex N117 3.0 MW – Total 16 WTG
4	Estimated Project Cost	226 million US \$

The Project is being developed with the following objectives:

- i. Contribute to meeting the electricity supply deficit in south west of Pakistan in particular; and country in general;
- ii. Provide electricity to stimulate and support the expansion of local industry and service businesses;

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document issue 01	Page 26

- iii. By using indigenous renewable resources of power generation, avoid depletion of natural resources for future generation and environmental stability;
- iv. Create employment during construction and operations and provide opportunities for developing ecotourism;
- v. Improve microeconomic efficiency of the power sector by reducing fossil fuel usage;
- vi. Reduce greenhouse gas emissions from power generation and contribute to negligible emission, effluent, and solid waste intensity of power generation in the system;
- vii. Conserve natural resources including land, forests, minerals, water, and ecosystems; and
- viii. Improve local physical infrastructure such as access roads and transmission network in the Project area.

1.6 NEED AND OBJECTIVES OF IEE STUDY

Pakistan Environmental Protection Act 1997 (PEPA 1997) requires the proponents of every development project in the country to submit either an Initial Environmental Examination or Environmental Impact Assessment to the concerned environmental protection agency.

Sindh Environment Protection Agency Act 2014 (SEPA 2014)

Sindh Assembly has passed the Sindh Environmental Protection Act 2014; Environmental protection became the provincial subject; SEPA have developed Act, regulations and sectorial guidelines to develop its own Act and regulation and guidelines.

The IEE/EIA Regulations 2000 issued under PEPA 1997 and IEE /EIA regulations issued under SEPA Act 2014

Both guidelines provide separate lists for the projects requiring IEE or EIA. This Initial Environmental Examination (IEE) report has been prepared in accordance with the provisions in the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000. According to these regulations, an IEE is required for projects falling in any category listed in Schedule-I of the regulations, and an EIA is required for projects listed in Schedule-II of the regulations.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 27

1.7 BASIS PROJECT CATEGORIZATION OF EIA STUDY

Section 12 of Pakistan Environmental Protection Act 1997 and other regulatory documents such as Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 requires that every new development project in Pakistan has to be preceded by an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) depending upon the magnitude of the project and severity of impacts anticipated at the time of commissioning of the project.

PEPA (Review of IEE/EIA) Regulations 2000 categorize projects into two separate schedules depending on whether a project requires an IEE (Schedule-I) or an EIA (Schedule-II). The Regulations also require that all projects located in environmentally sensitive areas need submission of an EIA.

Section 17 of Sindh Environment Protection Agency 2014 and Sindh Environmental Protection Agency (Review of IEE/EIA) Regulations 2014 requires wind project to conduct the IEE under schedule I,

Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulation, 2014, the list of projects requiring an EIA includes wind energy projects if it falls under any sensitive, protected area. It defines "Environmental Sensitive Areas" as the area which falls under sensitive sites like protected areas, or the sites which may have crucial and growing importance. The Project Area does not fall under the said category accordingly IEE report has been prepared.

Accordingly an IEE Study has been conducted, and the same will be submitted to seek approval prior to project initiation.

The document has also been made to comply with the requirements of **ADB's safeguard policy statement, 2009** as well as local and national standards. To comply with other lender's requirement, the IEE report also addresses **IFC's and World Bank group performance standards** which will be met by the project.

In the context of the scope of the Project, the IEE report has addressed the following objectives, where applicable:

- ❖ Category of the Project consistent with Pakistan Environmental Protection Act, 1997, Sind Environment Protection Act 2014 and IFC's and World Bank group performance standards.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 28

- ❖ Highlight baseline environmental and social conditions of the Project area along with identification of environmentally sensitive area and concerned stakeholders
- ❖ Relevant host country laws, regulations, applicable treaties and agreements
- ❖ Protection of human health, cultural properties and biodiversity including endangered species and sensitive ecosystems.
- ❖ Major hazards; occupational health and safety; fire prevention and life safety
- ❖ Socio-economic impacts; land use: land acquisition; involuntary resettlement
- ❖ Impacts on indigenous peoples and communities, if applicable
- ❖ Cumulative impacts of existing, proposed, and anticipated future projects
- ❖ Efficient production, delivery, and use of energy
- ❖ Pollution prevention and waste minimization, pollution controls (liquid effluent and air emissions), and solid and chemical waste management.

1.8 Scope of IEE Study

This IEE study is focused at developing the environmental profile of the project area so as to evaluate the existing physical, biological and socioeconomic aspects leading to respective impacts due to construction and operations at the Wind Farm.

The main purpose of the IEE study is to ensure that:

- ❖ Any major adverse impact on the environment (physical, ecological and social) during different phases of projects viz. siting, design, construction and operation are identified.
- ❖ Adverse impacts are appropriately addressed and adequate mitigation measures are incorporated in the siting, design, construction and operation phases of project.

Socioeconomic aspects are identified, and mitigation measure has been suggested.

- ❖ Alternatives to achieve the objectives are analyzed.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 29

- ❖ Environmental Management Plan (EMP) for sustainable development and operation of the project is developed for implementation and monitoring of the project activities.

The present IEE report has identified the significant environmental aspects and screened the potential aspects to ensure that the likely impacts due to proposed activities during construction, installation of masts and WTGs and operation of the proposed project, and the residual impact on adoption of mitigation measures have been critically assessed with respect to compliance with the Pakistan Environmental Protection Act 1997, Sindh Environment Protection Act 2014 and ADB, World Bank, IFC.

1.9 Methodology for Initial Environmental Examination Study

The environmental assessment (examination and evaluation) is primarily based on simple comparative evaluation approach. Initially the baseline or the profile of the project area is developed by site surveys, collecting data, records and information on physical, ecological /biological as well as socioeconomic environment. The data so compiled is then projected or modeled for different phases of projects, i.e. design, construction, and operations. The likely changes in the critical environmental aspects or significant changes in the ambient environmental parameters are identified. Identification, assessment and evaluation of significant impact either in qualitative or quantitative terms is carried out for which appropriate mitigation measures are proposed.

Project Team of environmentalists and sociologists held consultation based on the detailed contents of the Project with main stakeholders. Environmental and social considerations being an essential component of the implementation phase of this project, the following points were underscored for implementing the IEE recommendations:

Identifying the need, if any, for involuntary resettlement and for land acquisition and to prepare an appropriate Involuntary Resettlement Program.

Reducing the impact on the living environment during the construction period, selecting appropriate construction methods and construction schedule.

Accordingly the IEE study has:

- Conducted public consultation at the early stage
- Held stakeholders meetings during the study.
- Understood in detail the concerns of Persons resident in the villages that are outside the Master Green Energy Limited (MGEL) land area.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 30

- In consideration of:
- Agreement between AEDB and Mater Group of Companies allowing Master Green Energy Ltd land for installation of Wind Power Generation will require no payment for land acquisition,
- Consultation Meetings with the residents of these villages located on the outside of the land area, have confirmed the issue that establishment of the Wind Farm on MGEL land will not require land acquisition or involuntary resettlement, and insignificant impact on the ecology and living environment, It is implicit that there would be no need for involuntary resettlement or acquisition of land.
- This IEE report presents the existing environmental scenario and the results from the assessment and evaluation of the environmental aspects emerging during the installation and operation phases of wind turbines. Following screening of potential environmental aspects, the assessed and evaluated impacts requiring necessary mitigation measures are suggested in the report. The report also includes the Environmental Management and Monitoring Program that will be implemented during siting, construction operation phases and decommission phase.

The methodology specifically adopted for conducting the IEE of The Project may be summarized as follows;

1.9.1 Scoping

The key activities of this phase include:

Project Data Compilation: A generic description of the proposed activities relevant to environmental assessment was compiled with the help of the proponent.

Published Literature Review: Secondary data on weather, soil, water resources, wildlife, and vegetation were reviewed and compiled.

Legislative Review: Information on relevant legislation, regulations, guidelines, and standards was reviewed and compiled.

Identification of Potential Impacts: The information collected in the previous steps was reviewed and potential environmental issues identified.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 31

Baseline Data Collection:

Primary Data Primary data for Environmental Monitoring including Ambient Air, Ambient noise, ground water and surface water was developed through EPA Certified Laboratory (SGS), in addition to that Birdlife and wildlife survey was also conducted during this study and previous studies conducted by the Project team. A field visit was conducted to verify and collect primary data on the site alternatives. A questionnaire was developed and views of local inhabitants were taken about the wind power Project.

Secondary Data reasonable data of baseline information on the Project area was available from existing literature and other studies conducted close to the Project area have also been referred in this study.

1.9.2 Impact Assessment

The environmental, socioeconomic, and Project information collected was used to assess the potential impact of the proposed activities. The issues studied included potential Project impact on:

- ❖ Geomorphology
- ❖ Groundwater and surface water quality,
- ❖ Ambient air quality and ambient noise levels
- ❖ Ecology of area, including flora and fauna especially with reference of migratory and local 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 definition of mitigation measures to reduce impacts to as low as practicable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 32

- ❖ 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

1.9.3 Documentation

This report documenting the IEE process and results is prepared in accordance with the relevant guidelines set by the Pakistan Environment Protection Agency (Pak-EPA) in general and Sindh Environmental Protection agency in specific

1.10 METHOD FOR EVALUATING IMPACT

The description of baseline conditions represents the basis for evaluating the Project's impact. The description and evaluation of the environmental impact, and proposals for measures to be taken to mitigate and compensate for any determined environmental impact during construction and operation phase, are presented in the Environment Management Plan (EMP) (Annexure-I). In the interest of transparent presentation and evaluation, tabulated evaluation procedures have been applied. The severity of a particular environmental impact together with its general trends (i.e. negative or positive) is described on the basis of a point system. The evaluation scale applied is as follows:

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

Both national and international standards, such as those of the World Bank and WHO, are used as a basis for this judgment. According to these standards, impacts are evaluated as follows;

High	International and national standards are exceeded
Medium	Between international and national standards

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 33

SECTION 2

LEGASLATIVE REQUIREMENTS

2 LEGISLATIVE REQUIREMENTS

This chapter describes the relevant: (i) national and international policies; (ii) legal and administrative framework; and (iii) institutional setup, in respect of the environmental and social assessment of the proposed Project.

2.1 NATIONAL ENVIRONMENTAL LAWS

There are several laws in Pakistan which contain provisions relating to the protection of the environment. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is a relatively new phenomenon. Most of the existing laws on environmental and social issues have been enforced over an extended period of time, and are context specific. The laws relevant to development projects are briefly reviewed below.

2.2 POLICY GUIDELINES

2.2.1 National Conservation strategy

The National Conservation Strategy (NCS) is the primary policy document of the Government of Pakistan (GOP) on national environmental issues. The Strategy approved by the Federal Cabinet in March 1992 was also recognized by International Financial Institutions, principally the World Bank. The NCS had identified 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage. It had also recommended immediate attention to the stated core areas in order to preserve the environment of Pakistan.

A mid-term review of the NCS in 2000 concluded that achievements under the NCS were primarily awareness raising and institutional building rather than meaningful improvement of the environment and natural resources and that the NCS was neither designed nor adequately

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 34

focused as a national sustainable development strategy (GoP, November 2002). Thus the need for a more focused National Environmental Action Plan (NEAP) was formulated and approved by the Pakistan Environmental Protection Council in 2001 to practically improve the national environment with emphasis on poverty reduction, and economic as well as sustainable development.

NEAP now constitutes the national environmental agenda and its core objective is to initiate actions that would safeguard public health, promote sustainable livelihoods and enhance the quality of life of the people of Pakistan.

The GOP and United Nations Development Programme (UNDP) have jointly initiated an umbrella support programme called the NEAP-Support Programme that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-Support Programme is environmental sustainability and poverty reduction in the context of economic growth. The objectives of new policy has total 171 guidelines on sectorial and cross sectorial issues. The objectives of new policy include assurance of sustainable development and safeguard of natural wealth of country. The following are the approved Sectorial Guidelines:

- Water Supply and Management
- Air Quality and Noise
- Waste Management
- Forestry
- Biodiversity and Protected Areas
- Climate Change and Ozone Depletion
- Energy Efficiency and Renewable
- Agriculture and Livestock
- Multilateral Environmental Agreements
- Biodiversity Action Plan

The key to protection of the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of National Conservation Strategy and in becoming a signatory to, and ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 35

2.2.2 The Biodiversity Action Plan

The Biodiversity Action Plan (BAP), 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 BAP recognizes that an IEE is used as a tool at a project level to identify environmental effects of a proposed project and to plan for reducing adverse effects. The BAP further stipulates that an IEE needs to be initiated at an early stage of project development and that public participation in the review of potential effects is important.

2.3 ENVIRONMENT INSTITUTIONS AND ADMINISTRATION

The Constitution of Pakistan distributes the legislative powers between the federal and the provincial governments through Federal and Concurrent Lists. The Federal list depicts the areas and subjects on which the Federal government has exclusive powers. The Concurrent list contains areas and subjects on which both Federal and Provincial governments can enact laws.

The Ministry of Climate Change, Local Government and Rural Development are responsible for environmental issues at the federal level. The NCS unit within the Ministry ensures implementation of the National Conservation Strategy.

The Pakistan Environment Protection Agency is the federal body responsible for administering the provisions of the Pakistan Environment Protection Act. It is responsible for ensuring compliance with the NEQs, developing monitoring and evaluation systems and initiating legislation when necessary.

The provincial Environment Protection Agencies, i.e. the Environment Protection Department in Sindh, are responsible for environmental planning and development and approval of Initial Environmental Examination (IEE) and Environmental Impact Assessments (EIA) of new Projects at the provincial level.

2.4 LAWS, REGULATIONS, AND GUIDELINES

The Pakistan Environment Protection Act, 1997, is the basic law that empowers the Government of Pakistan to develop policies and guidelines for the protection of the country's natural environment. A brief description of the laws is given below.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 36
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2.5 PAKISTAN ENVIRONMENTAL PROTECTION ACT, 1997

The PEPA, 1997, is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The act is applicable to a broad range of issues and extends to air, water, soil, marine, and noise pollution, as well as to the handling of hazardous wastes.

The key features of the law that have a direct bearing on the proposed Project relate to the requirements for an initial environmental examination (IEE) and EIA for development Projects. Section 12(1) requires that: "No proponent of a Project shall commence construction or operation unless he has filed with the Federal Agency an initial environmental examination or, where the Project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Federal Agency approval in respect thereof." Pak-EPA has delegated the power of review and approval of environmental assessments to the provincial environmental protection agencies. As the proposed Project will be located near Karachi, it falls under the jurisdiction of the EPA Sindh.

2.6 SINDH ENVIRONMENTAL PROTECTION ACT, 2014

The Sindh Environmental Protection Act, 2014 (SEPA) is the basic legislative tool empowering the provincial government to frame regulations for the protection, conservation, rehabilitation and improvement of the environment. The SEPA 2014 is broadly applicable to air, water, soil, hazardous waste, marine and noise pollution. Penalties have been prescribed for those contravening the provisions of the Act. The powers of the provincial Environmental Protection Agencies (EPAs) were also considerably enhanced under this legislation and they have been given the power to conduct inquiries into possible breaches of environmental law either of their own accord, or upon the registration of a complaint. Sindh Environmental Protection Act, 2014 (SEPA) attached as Annexure IV.

- ❖ 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.
- ❖ Under section 17 of SEPA, "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. "

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 37

- ❖ 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 sixty days its approval or otherwise from the date IEE is filed failing which the IEE shall be deemed to have been approved.

2.7 PAKISTAN ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2000

The Pakistan Environment Protection Agency Review of IEE and EIA Regulations provide the necessary details in respect of the preparation, submission, and review of the IEE and EIA. Categorization of Projects of IEE and EIA is one of the main components of the Regulations.

The following is a brief step-wise description of the approval process:

- ❖ A project is categorized as requiring an IEE or EIA using the two schedules attached to the Regulations.
- ❖ An EIA or IEE is conducted as per the requirements of the EPA guidelines.
- ❖ The EIA or IEE is submitted to the concerned EPA—provincial EPAs if the project is located in the provinces, or the Pak-EPA if it is located in Islamabad.
- ❖ A fee, depending on the cost of the project and the type of the report, is submitted along with the document.
- ❖ The submittal is also accompanied by an application in the format prescribed in Schedule IV of the Regulations.
- ❖ EPA conducts a preliminary scrutiny and replies within 10 days of the submittal of a report by: (a) confirming completeness; (b) asking for additional information, if needed; or (c) returning the report requiring additional studies, if necessary.
- ❖ EPA is required to make every effort to complete the IEE and EIA review process within 45 and 90 days, respectively, upon confirmation of completeness.
- ❖ If the EPAs accord their approval subject to certain conditions, then before commencing construction of the project, the proponent is required to submit an undertaking accepting the conditions as per mentioned in schedule vii.
- ❖ Before commencing operation of the project, the proponent is required to obtain from the EPA a written confirmation of compliance with the approval conditions and requirements of the IEE.
- ❖ An Environment Management Plan (EMP) is to be submitted with a request for obtaining confirmation of compliance.
- ❖ The EPAs are required to issue confirmation of compliance within 15 days of the receipt of request and complete documentation.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor. Master Group	Document Issue 01	Page 38

- ❖ The IEE approval is valid for three years from the date of accord.

A monitoring report is to be submitted to the EPA after completion of construction, followed by annual monitoring reports during operation.

Complete guidelines of Preparation of EIA/IEE along with details of other concerned laws and regulations outlined in the Pakistan Environment Protection Act 1997 are provided in Annexure- III for reference

2.8 SINDH ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2014

The SEPA review of IEE and EIA regulations, 2014 (the 'regulations'), prepared by the SEPA under the powers conferred by section of Sindh Environmental Protection Act, 2014 provide the necessary details on the preparation, submission and review of the IEE, EIA and environmental checklist of the project

These regulations classify projects on the basis of expected degree of severity of environmental impacts and list them in three separate schedules. Schedule-I lists projects that may not have significant environmental impacts and require an IEE. Schedule-II lists projects of potentially significant environmental impacts requiring preparation of an EIA. Schedule-III list projects of screening and requiring preparation of environmental checklist. The Regulations also require under the schedule-II Clause-A6: Wind energy projects if falls under any sensitive, protected area and under the Clause-J: that all projects located in environmentally sensitive areas require preparation of an EIA. SEPA (Review of IEE /EIA regulations) 2014 has been provided in the report . The Project Area does not fall under the protected area; accordingly IEE report has been prepared. Wind Projects, transmission lines less than 11KV and grid station falls in Schedule I - lists of projects requiring an IEE while the wind energy projects if fall under any sensitive, protected areas and transmission lines (11KV and above) and distribution projects fall in Schedule II - lists of projects require an EIA.

Complete guidelines of Preparation of EIA/IEE along with details of other concerned laws and regulations outlined in the Sindh Environment Protection Act are provided in Annexure- IV for reference

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 39

2.9 SECTORAL GUIDELINES FOR ENVIRONMENTAL REPORTS-WIND POWER PROJECTS

The wind power sectorial guidelines form part of a package of regulations and guidelines, to be read in conjunction with the overall EIA /IEE guidelines package. These guidelines have been prepared by the Federal EPA in collaboration with other key stakeholders, which include: the provincial EPAs; the Federal and Provincial Planning Development Divisions; NGOs; representatives of chambers of commerce and industry; and other consultants.

These guidelines consist of comprehensive guidelines and procedures for the environmental assessment of wind power projects in Pakistan. It is emphasized that the various guidelines should be read as a package; reliance on the sectorial guidelines alone is inadequate.

2.10 POLICY FOR DEVELOPMENT OF POWER GENERATION PROJECTS, 2006

The Alternative Energy Development Board was established as an autonomous body attached to the Cabinet Division on 12th May 2003. The AEDB was established to act as a central agency for the development, promotion, and facilitation of renewable energy technologies; the formulation of plans and policies; and the development of a technological base for manufacturing of renewable energy equipment in Pakistan. In February 2006, the administrative control of the AEDB was shifted from the Cabinet Division to the Ministry of Water & Power. The AEDB has developed the national policy for promoting renewable energy sources in the medium and long term, which is known as the Policy for Development of Renewable Energy for Power Generation, 2006 (Power Policy). AEDB is also responsible for procuring land leases from the Revenue department for wind farm projects.

The current Project is developed under provisions of the Policy for Development of Renewable Energy for Power Generation, 2006.

2.11 PROJECT DEVELOPMENT IN TERMS OF POLICY FRAMEWORK

The following paragraphs describe the progress of the Project in terms of the Power Policy:

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 40

2.11.1 Letter Of Intent (LOI)

The first step for the development of a project pursuant to the Policy is to register with the GoS and obtain a Letter of Intent. The sponsors of the Project successfully filed their application and obtained their LOI from the GoS on October, 1st, 2015, after depositing their bank guarantee. The LOI is the official mandate for the Project Company to commence working on the Project, with the support of the GoS and other government departments. The LOI heralds the commencement of activities leading to the preparation of a feasibility study and acquisition of land for the Project.

2.11.2 Acquisition of Land

The land is being allocated or leased by the Government of Sindh, Pakistan. Land measures 2000 acres of area.

2.11.3 Submission of Feasibility Study

The Project Company is required to submit a detailed feasibility study, including Technical Feasibility, Electrical Grid Studies, and Environmental Studies, to the GoS for their approval.

2.11.4 Generation License

In order to produce and sell electricity in Pakistan, a project is required to obtain a "Generation License" from the regulator, NEPRA. The Project Company is therefore required to make an application to NEPRA for its Generation License.

An application for the generation license along with necessary documents will be submitted to NEPRA after submission of Feasibility Study to GoS.

2.11.5 Tariff Determination

A separate application will be submitted by the Project Company to NEPRA for approval of its power tariff. This application will be submitted simultaneously with the application of Generation License.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 41

2.11.6 Letter of Support (LOS)

Once the tariff has been approved, the Project Company can engage with its lenders to finalize its financing terms and conditions. At this stage, GoS will issue a Letter of Support to the Project Company as soon as the Project Company submits a bank guarantee in respect of its obligation to achieve Financial Close. The amount of the Bank Guarantee is calculated at US\$2,500 per MW.

The Letter of Support provides the Project Company with a continued mandate to develop the Project, and provides certain assurances of support from governmental entities and departments. The Letter of Support remains valid until the effectiveness of the EPA and IA.

2.11.7 Energy Purchase Agreement (EPA)

The agreement between the Power Purchaser and the Project Company is called the Energy Purchase Agreement (EPA). This agreement lists terms and conditions for the sale and purchase of electricity between the two parties. Discussions relating to the EPA normally commence as soon as the feasibility study is submitted and the tariff petition is filed with NEPRA.

2.11.8 Implementation Agreement (IA)

The Implementation Agreement (IA) is an agreement between the Project Company and the GOP, where in the GOP mandates the Project Company to develop the power project, and provides certain assurances and concessions to the Project, its lenders, shareholders and contractors. Importantly, the IA provides certain guarantees in respect of the performance of the power purchaser. The IA also assures the project of compensation in case of any termination resulting from a default or force majeure. These discussions normally commence alongside the EPA.

2.11.9 Financial Close

Upon approval of feasibility study, grant of generation license, approval of tariff, and the signing of Project documents (EPA and IA); the Project Company shall move forward to financial close.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 42

2.12 NATIONAL AND INTERNATIONAL ENVIRONMENTAL STANDARDS

2.12.1 National Environmental Quality Standards

The National Environmental Quality Standards (NEQS) were first promulgated in 1993 and were last revised in 2010. The NEQS specify the standards for industrial and municipal effluents, gaseous emissions, ambient air requirements, vehicular emissions, noise levels and water quality standards.

The National Environmental Quality Standards (NEQS) specify the following standards:

- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources
- Maximum permissible limits for motor vehicle exhaust and noise
- For power plants operating on oil and coal:
 - Maximum allowable emission of sulfur dioxide
 - Maximum allowable increment in concentration of sulfur dioxide in ambient air
 - Maximum allowable concentration of nitrogen oxides in ambient air
 - Maximum allowable emission of nitrogen oxide for steam generators as function of heat input
 - Maximum allowable concentration of effluent pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment and sea (three separate set of numbers)

Selected NEQS for liquid effluents discharged to inland waters, gaseous emission from industrial sources, emissions from motor vehicles, noise, ambient air quality and water quality standards are provided in Annexure-V

2.12.2 National Environmental Policy, 2005

The National Environmental Policy (NEP) was approved by the Pakistan Environmental Protection Council in its 10th meeting in 27th December 2004 under the chairmanship of the Prime Minister of Pakistan and there after approved by the Cabinet on 29th June 2005. NEP is the primary policy of the Government of Pakistan that addresses the environmental issues of the country.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 43

The broad Goal of NEP is, “{to protect, conserve and restore Pakistan’s} environment in order to improve the quality of life of the citizens through sustainable development.” The NEP identifies the following set of sectorial and cross-sectorial guidelines to achieve its Goal of sustainable development.

a. Sectorial Guidelines:

Water and sanitation; air quality and noise; waste management; forestry; biodiversity and protected areas; climate change and ozone depletion; energy efficiency and renewable; agriculture and livestock; and multilateral environmental agreements.

b. Cross Sectorial Guidelines

Poverty; population; gender; health; trade and environment; environment and local governance; and natural disaster management. The NEP suggests the following policy instruments to overcome the environmental problems throughout the country:

- Integration of environment into development planning
- Legislation and regulatory framework
- Capacity development
- Economic and market based instrument
- Public awareness and education
- Public private civil society partnership

Even though NEP is a policy document that does not apply to the Project directly, development projects, such as wind power generation projects, are not expected to negatively impact the environmental issues identified by NEP. In any event, mitigation measures would be adopted to minimize or avoid any negative impact. Furthermore, renewable sources of energy, such as wind power projects, provide an environmentally positive means for increasing power production and development.

2.12.3 Land Acquisition Act, 1984

The Land Acquisition Act (LAA) of 1894, amended from time to time, has been the de-fact o policy governing land acquisition and compensation in the country. The LAA is the most commonly used law for acquisition of land and other properties for development projects. It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and apportionment awards and dispute resolution, penalties and exemptions.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 44

For the proposed Project, the proponents have leased land from the Government of Sindh and no settlement or structure exists at the site. The LAA is therefore not applicable to the acquisition of land for the proposed Project.

2.12.4 Telegraph Act, 1985

This law was enacted to define the authority and responsibility of the Telegraph authority. The law covers, among other activities, installation and maintenance of telegraph lines and posts (poles). The Act defines the mechanism to determine and make payment of compensation associated with the installation of these lines and posts.

Under this Act, the land required for the poles is not acquired (or purchased) from the owner, nor the title of the land transferred. Compensation is paid to the owner for any structure, crop or tree that exists on the land; cost of the land is not paid to the owner.

2.12.5 The Sindh Wildlife Protection Ordinance, 1972

The Sindh Wildlife Protection Ordinance, 1972 empowers the government to declare certain areas reserved for the protection of wildlife and control activities within these areas. It also provides protection to endangered species of wildlife. As no Project activities are planned in declared protected areas, provision of this law is not applicable to the proposed Project

2.12.6 The Sindh Fisheries Ordinance, 1972

The Sindh Fisheries Ordinance, 1980 regulates fishing in public waters, including the coastal areas of Sindh. It empowers the Government of Sindh to issue licenses for fishing in public waters, place restrictions on the type of equipment that can be used for fishing, restrict fishing in certain areas or of certain species of fish, regulate the onshore trade of fish catch, and regulate the fish processing industry. Article 8 of the Ordinance prohibits the discharge of wastewater to public waters without the consent of the Director Fisheries.

As no activities are planned for this Project which can breach this Ordinance, provision of this law is not applicable to the proposed Project.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 45

2.12.7 The Forest Act 1927

The Forest Act, 1927 empowers the government to declare certain areas as reserved forest areas. As no reserved forest exists in the vicinity of the proposed Project, the provisions of this law are not applicable to the proposed Project.

2.12.8 Canal and Drainage Act, 1873

The Canal and Drainage Act (1873) prohibits corruption or fouling of water in canals (defined to include channels, tube wells, reservoirs and watercourses), or obstruction of drainage. This Act will be applicable to the construction and O&M works to be carried out during the proposed Project.

2.12.9 The Antiquities Act, 1975& the Sindh Cultural Heritage (Preservation) Act, 1994

The Antiquities Act of 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 Government of Pakistan 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 61m (200 ft.) of a protected antiquity, and to report to the Department of Archaeology, Government of Pakistan any archaeological discovery made during the course of the Project. 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. No antiquity protected under these two laws was identified in the vicinity of the proposed Project.

2.12.10 Factories Act, 1934

The clauses relevant to the proposed Project are those that address the health, safety and welfare of the workers, disposal of solid waste and effluents, and damage to private and public property. The Act also provides regulations for handling and disposing toxic and hazardous

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 46

substances. The Pakistan Environmental Protection Act of 1997 (discussed above), supersedes parts of this Act pertaining to environment and environmental degradation.

2.12.11 Employment of Child Act, 1991

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth year of age. The ECA states that no child shall be employed or permitted to work in any of the occupations set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, bidi (kind of a cigarette) making, cement manufacturing, textile, construction and others. United Energy and its contractors will be bound by the ECA to prohibit any child labor at the Project sites or campsites.

2.12.12 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 air crafts registered, acquired or operating under these rules, wherever they may be. The rules with relevant significance to the power Project:

- 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.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 47

- 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.
- As there is no airport in close proximity to the Project area, it is highly unlikely that the aforementioned rules would apply to the Project's construction and operation activities. However, it is often recommended for projects to seek the relevant permission from Civil Aviation Authority for the installation of wind turbines. The blade tips of wind turbines will be marked in red to make the structure more visible from a distance to aircrafts.

2.12.13 Pakistan Penal Code, 1860

The Code deals with offences where public or private property or human lives area affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions and disposal of effluents. Most of the environmental aspects of the Code have been superseded by the Pakistan Environmental Protection Act, 1997.

2.12.14 National Resettlement Policy / Ordinance

The Ministry of Environment, Local Government and Rural Development formulated a draft policy in 2004 on involuntary resettlement with technical assistance from ADB. The policy aims to compensate for the loss of income to those who suffer loss of communal property including common assets, productive assets, structures, other fixed assets, income and employment, loss of community networks and services, pasture, water rights, public infrastructure like mosques, shrines, schools and graveyards.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 48

The government has also developed a document entitled "Project Implementation and Resettlement of the Affected Persons Ordinance, 2002", later referred to as the "Resettlement Ordinance", for enactment by provincial and local governments, after incorporating local requirements. The Ordinance, being a new law, shall be supplementary to the LAA as well as other laws of Pakistan, and wherever applicable under this policy. However, if necessary, appropriate amendments to the LAA 1894 will also be proposed to facilitate the application of the Resettlement Ordinance.

There has not been much progress on the enactment of the Resettlement Ordinance; hence this is not relevant for the proposed project.

2.12.15 Sindh Local Government Ordinances, 2001

These ordinances were issued under the devolution process and define the roles of the district governments. These ordinances also address the land use, conservation of natural vegetation, air, water and land pollution, disposal of solid waste and wastewater effluents, as well as matters relating to public health.

2.12.16 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 are that the Houbara bustard would disappear as the species by 2015.

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

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 49

Wetland of International Importance Especially as Waterfowl Habitat (RAMSAR) and Convention on the Conservation of Migratory Species of Wild Animals (CMS).

2.12.17 Motor Vehicles Ordinance, 1965, and Rules, 1969

The Motor Vehicles Ordinance, 1965, was extended in 1978, to the whole of Pakistan. The ordinance deals with the powers of motor vehicle licensing authorities and empowers the Road Transport Corporation to regulate traffic rules, vehicle speed and weight limits, and vehicle use; to erect traffic signs; and to identify the specific duties of drivers in the case of accidents. It also describes the powers of police officers to check and penalize traffic offenders at the provincial level. At the same time, the ordinance also empowers the Regional Transport Authority to operate as a quasi-judicial body at the district level to monitor road transport, licensing requirements, and compensations for death or injury to passengers on public carriers.

2.12.18 Cutting of Trees (Prohibition) Act, 1975

This Act prohibits cutting or chopping of trees without permission of the Forest Department.

During the site survey conducted by the team of environmentalist and socialist, there is no tree on the site. Hence this law is not relevant to the proposed project.

2.13 OPIC- ENVIRONMENTAL AND SOCIAL POLICY STATEMENT

This Environmental and Social Policy Statement ("Policy Statement") addresses OPIC's commitments regarding the environmental and social dimensions of sustainable development and provides Applicants notice of the general environmental and social requirements that OPIC applies in evaluating prospective Projects seeking OPIC support and monitoring on-going OPIC-supported Projects.

This Policy Statement implements applicable environmental and social requirements and procedures contained in U.S. law. Additionally, this Policy Statement reflects specific policy commitments that have been made by OPIC with respect to environmental and social policies and procedures. Finally, this Policy Statement adopts, as a standard for the environmental and social review process, the International Finance Corporation's ("IFC") Performance Standards on Social and Environmental Sustainability and Industry Sector Guidelines and any subsequent revisions to those standards.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 50

2.13.1 Screening and Categorization

OPIC categorizes projects based on OPIC's preliminary assessment of (1) the potential environmental and social risks and impacts of a project in the absence of any required mitigation, (2) the Applicant's commitment and capacity to effectively manage the environmental and social risks and impacts, including the ability to implement any required mitigation and (3) the potential role of third parties in achievement of successful outcomes. OPIC categorizes all projects as Category A, B, C, or D based on environmental and social factors.

The wind energy projects fall in "Category C" as these are likely to have minimal adverse environmental or social impacts. In categorizing projects, OPIC considers direct, indirect, induced, regional, trans-boundary and cumulative environmental and social impacts. Risks are assessed at key stages in the project life cycle including pre-construction, construction, operations, decommissioning, and closure.

2.13.2 Applicant Role and Responsibilities

For Category C Projects, applicants are required to submit sufficient information necessary to confirm the absence of potential adverse environmental and social risks.

OPIC requires essential Environmental and Social Action Plan (ESAP) only for Category A and Category B Projects. ESAP is not necessarily required for Category C Projects.

2.13.3 Tailored Reviews

OPIC undertakes detailed, tailored environmental and social reviews for certain sectors and types of Projects in response to OPIC policies and practices and new OPIC products or initiatives, which are based on emerging trends in international best practices related to environmental and social safeguards.

The detailed OPIC Environmental and Social Policy Statement is attached as Annexure-VI.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 51

2.14 ASIAN DEVELOPMENT BANK (ADB) POLICIES & STANDARDS

The following ADB policies and standards designed to manage social and environmental risks and impacts are considered:

- Safeguards Policy Statement
- Policy on Gender and Development
- Social Protection Strategy
- Public Communications Policy
- Core Labor Standards

2.14.1 2009 Safeguard Policy Statement

ADB operational policies include three basic safeguard policies mentioned below. This safeguard policy statement applies to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects, and their components regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees (hereafter broadly referred to as projects).

The Involuntary Resettlement Policy: Minimize, mitigate, and/or compensate for adverse project impacts, on the environment and affected people when avoidance is not possible.

Policy of Indigenous Peoples: Help borrowers/clients to strengthen their safeguard system and develop the capacity to manage environmental and social risks.

Environmental Policy: Avoid adverse impacts of projects on the environment and affected people where possible.

2.14.2 Policy on Gender and Development

The Asian Development Bank (ADB) first adopted the Policy on the role of Women in Development (WID) in 1985 and over the passage of time has progressed from WID to Gender and Development (GAD) approach that allows gender to be seen as a cross cutting issue influencing all social and economic processes.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 52

ADB's Policy on GAD will adopt mainstreaming as a key strategy in promoting gender equity. The key elements of ADB's policy will include the following:

Gender sensitivity: to observe how ADB operations affect women and men, and to take into account women's needs and perspectives in planning its operations.

Gender analysis: to assess systematically the impact of a Project on men and women, and on the economic and social relationship between them

Gender planning: to formulate specific strategies that aim to bring about equal opportunities for men and women

Mainstreaming: to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision making process in development activities

Agenda setting: to assist Developing Member Country (DMC) governments in formulating strategies to reduce gender disparities and in developing plans and targets for women's and girl's education, health, legal rights, employment, and income-earning opportunities.

2.14.3 Social Protection Strategy

It is the set of policies and programs designed to reduce poverty and vulnerability by promoting efficient labor markets, diminishing people's exposure to risks and enhancing their capacity to protect themselves against hazards and interruption/loss of income. Social Protection consists of five major elements:

Labor Markets policies and programs designed to facilitate employment and promote efficient operation of labor markets;

Social Insurance programs to cushion the risks associated with the unemployment, health, disability, work injury, and old age;

Social Assistance and Welfare Service program for the most vulnerable groups with no other mean of adequate support;

Micro and Area Based Schemes to address vulnerability at the community level; and

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 53

Child Protection to ensure the healthy and productive development of future Asian workforce.
Social Protection System in Asia and Pacific Region

In considering the demand of social protection with Asian sub regions, it is important to identify the circumstances faced by their vulnerable groups. A common trait to all countries in the region is the need to address child and youth priorities, extend coverage to poorer communities, improve governance, and promote institutional development.

2.14.4 2005 Public Communications Policy

ADB's public communications policy provides a framework to enable ADB to communicate more effectively. The policy aims to enhance stakeholders trust in an ability to engage with ADB. The policy promotes:

- ❖ Awareness and understanding and results of ADB activities, policies, strategies, objectives and results;
- ❖ Sharing and exchange of development knowledge and lessons learned, so as to provide fresh and innovative perspectives and development issues;
- ❖ Greater two-way flow of information between ADB and stakeholders, including Project affected people, in order to promote participatory development; and
- ❖ Transparency and accountability of ADB operations.

2.14.5 Core Labor Standard

ADB adopted a commitment to Core Labor Standards (CLS) as part of its Social Protection Strategy in 2001. Since then, ADB ensures that CLS are duly considered in the design and implementation of its investment Projects. In this regard, a handbook for CLS has been developed by ADB with the cooperation of the International Labor Organization (ILO). The objective is to convince decision makers that the introduction of CLS and labor standards in general will not impede development. The labor standards are simply the rules that govern the treatment of workforce. Labor standards cover a very wide variety of subjects, mainly concerning basic human rights at work, respect for safety and health and ensuring that people are paid for their work. CLS are a set of four internationally recognized basic rights and principles at work:

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 54

- ❖ Freedom of association and the effective recognition of the right to collective bargaining;
- ❖ Elimination of all forms of forced or compulsory labor;
- ❖ Effective abolition of child labor; and
- ❖ Elimination of discrimination in respect of employment and occupation.

The detailed ADB guidelines of Safeguard Policy Statement 2009 are attached as Annexure-VI.

2.15 WORLD BANK GUIDELINES ON ENVIRONMENT

The principal World Bank publications that contain environmental guidelines are listed below.

- ❖ Environmental Assessment Operational Policy 4.01. Washington, DC, USA. World Bank 1999. Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross Sectorial Issues. World Bank Technical Paper Number 139, Environment Department, the World Bank, 1991, Pollution Prevention and Abatement Handbook: Towards Cleaner Production, Environment Department, the World Bank, United Nations Industrial Development Organization and the United Nations Environment Program, 1998. Environmental Health and Safety (EHS) guidelines, International Finance Corporation (IFC) World Bank Group, 2007.
- ❖ The first two publications listed here provide general guidelines for the conduct of an IEE, and address the IEE practitioners themselves as well as project designers. While the Sourcebook in particular has been designed with Bank projects in mind, and is especially relevant for the impact assessment of large-scale infrastructure projects, contains a wealth of information which is useful to environmentalists and project proponents.
- ❖ The Sourcebook identifies a number of areas of concern, which should be addressed during impact assessment. It sets out guidelines for the determination of impacts, provides a checklist of tools to identify possible biodiversity issues and suggests possible mitigation measures. Possible development project impacts on wild lands, wetlands, forests etc. are also identified and mitigation measures suggested. The Sourcebook also highlights concerns in social impact assessment, and emphasizes the need to incorporate socio-economic issues in IEE exercises.

The EHS guidelines published by IFC are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimizing, and

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 55

controlling EHS impacts during construction, operation, and decommissioning phase of project or facility.

The World Bank Guidelines for noise are provided in Table 2-1

Table 2-1 World bank Guidelines for Noise levels			
No.	Receptor	Day (07:00-22:00)	Night (22:00-07:00)
1.	Residential & Institutional educational	55	45
2.	Industrial & Commercial	70	70
Source: Pollution Prevention and Abatement Handbook World Bank Group (1998)			
Notes: Maximum allowable log equivalent (hourly measurements) in dB(A)			

2.16 Equator Principles

The Equator Principles are a set of guidelines, promoted by the International Finance Corporation (IFC) that address the environmental and social issues associated with major development projects worldwide. They provide a common baseline and framework for the implementation of internal environmental and social procedures and standards for project financing activities across all industries.

Principle 1: Review and Categorization (of projects)

Principle 2: Social and Environmental Assessment

Principle 3: Applicable Social and Environmental Standards

Principle 4: Action Plan and Management System

Principle 5: Consultation and Disclosure

Principle 6: Grievance Mechanism

Principle 7: Independent Review

Principle 8: Covenants

Principle 9: Independent Monitoring and Reporting

Principle 10: EPFI Reporting

Review and categorization

An EPFI will categorize a project, based on the magnitude of the potential social or environmental impacts and risks of that project, in accordance with IFC classification criteria.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 56

These categories are:

Category A: Projects with potential significant adverse social or environmental impacts that is diverse, irreversible or unprecedented.

Category B: Projects with limited adverse social or environmental impacts that is few in number, generally site specific, largely reversible and readily addressed through mitigation measures.

Category C: Projects with minimal or no social or environmental impacts.

Wind Energy projects, by their nature; tend to fall into Categories B or C, being medium or low risk. Certain EPFIs as a matter of policy for example treat every wind turbine project as

Category D: The Equator Principles apply to projects over 10 million US dollars. The Principles state that adopting financial institutions will provide loans directly to projects only under the following circumstances:

This IEE study has adequately addressed the Equator Principles applicable to risky projects as stated hereunder:

Principle 1 (Review and Categorization): The study has reviewed the National and International Laws and Guidelines on different environmental aspects and has categorized the MGEL Wind Power Project in Category C Low Hazard).

Principle 2 (Social and Environmental Assessment): The Study has been prepared to respond to the National and International requirements and to satisfactorily address the key environmental and social issues.

Principle 3 (Applicable Social and Environmental Standards): For the purpose of this IEE Study, primary data on the baseline environmental and social conditions have been generated wherever necessary to address the requirements of National laws and regulations; applicable International Treaties and Agreements; sustainable development and use of renewable natural resources; protection of human health, cultural properties, and biodiversity and other physical, ecological and socioeconomic issues required to be addressed under this Principle.

Principle 4 (Action Plan and Management System): Section-6 of this study screens the potential environmental impacts and proposes/provides Mitigation Measures to reduce the severity of impact. The study also includes the Environmental Monitoring and Management Plan.

Principle 5 (Consultation and Disclosure): Being a project of Category B, the public consultation is limited to the scoping sessions with stakeholders and an extensive socio economic survey of the villages/hamlets that are all outside the boundary of the Project area. The surveys and

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 57

consultation meetings have established that no major resettlement or temporary relocation or acquisition of land is involved.

Principle 6 (Grievance Mechanism): This Principle will not apply since 'no' resettlement or temporary relocation or acquisition of land is involved.

Principle 7 (Independent Review): Being placed in Category C, an independent review is not required.

Principle 8 (Covenants): The IEE study has incorporated Covenants linked to compliance. Moreover, No Objection Certificates are issued to Proponents of Project under conditions of compliance with the Mitigation and Performance Monitoring Plan. Needless to say that if the proponent does not comply with the agreed terms, Sindh EPA is authorized to take corrective and even coercive action.

Principle 9 (Independent Monitoring and Reporting): This Principle will be not be applicable to the MGEL Wind Power Project since it falls in category of projects requiring an IEE .

Principle 10 (EPFI Reporting): The concerned EPFI may safely commit to report publicly at least annually about its Equator Principles implementation processes and experience.

2.17 IFC Performance Standards on Social and Environmental Sustainability

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards are also applied to the projects in emerging markets. Together, the eight Performance Standards establish standards that the Proponent is to meet throughout the project.

The objectives of Performance standards are given below:

- ❖ To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence
- ❖ To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities , and the environment

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE7/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 58

- ❖ To promote improved social and environment performance of companies through the effective use of management systems.

Performance Standard-1: Social & Environmental Assessment and Management System

This Performance Standard seeks to:

- ❖ Identify and assess social and environment impacts in the project's area of influence;
- ❖ Avoid, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment;
- ❖ Ensure that affected communities are appropriately engaged on issues that could potentially affect them; and
- ❖ Promote improved social and environment performance of the project through the effective use of management systems.

Under this Standard, the project is required to establish and maintain a social and environmental management system appropriate to the nature and scale of the project and in accordance with the level of social and environmental risks and impacts. The management system is required to incorporate the following elements:

- Social and Environmental Assessment;
- Management program;
- Organizational capacity;
- Training;
- Community engagement;
- Monitoring; and
- Reporting

This IEE study has been conducted to respond to requirements of national legislation and international Guidelines as well fulfills the above requirements of the IFC Performance Standards PS1.

Performance Standard-2: Labor and Working Conditions

This PS seeks to establish, maintain and improve the worker-management relationship; promote fair treatment, non-discrimination and equal opportunity for workers, and compliance with national labor and employment laws; protect the workforce by addressing child labor and forced labor issues;

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 59

and promote safe and healthy working conditions, and to protect and promote the health of workers.

The Sponsors of proposed project and their contractors will be required to adhere to this PS, in particular with regard to compliance with national labor and employment laws; employment of child labor, and promoting safe and healthy working conditions, besides protecting and promoting the health of workers.

Performance Standard-3: Pollution Prevention and Abatement

The PS 3 seeks to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities, and to promote the reduction of emissions that contribute to climate change. The Standard requires the project to consider during its entire lifecycle ambient conditions and apply pollution prevention and control technologies and practices that are best suited to avoid or, where avoidance is not feasible, minimize or reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective.

PS 3 will be applicable to all stages of the MGEL Wind Power Project. Various aspects of pollution prevention and abatement of the proposed project are discussed separately in this report.

Performance Standard-4: Community Health, Safety and Security

The PS 4 seeks to avoid or minimize risks and impacts on the health and safety of local community during the project lifecycle from both routine and non-routine circumstances, and to ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security. The PS requires the project to evaluate the risks and impacts to the health and safety of the affected community during the design, construction, operation, and decommissioning of the project and establish preventive measures to address them in a manner commensurate with the identified risks and impacts.

The present assessment addresses the requirement of PS 4 for the proposed project, and has evaluated the impacts of sitting the project on health, safety and security of the community in the microenvironment as well as the macro-environment. The Environmental Management Plan also addresses company community aspects.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 60

Performance Standard-5: Land Acquisition and Involuntary Resettlement

This PS aims to address the adverse impacts associated with land acquisition and involuntary resettlement caused by the project. The PS seeks to:

- ❖ Avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs.
- ❖ Mitigate adverse social and economic impacts from land acquisition or restrictions on affected person's use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
- ❖ Improve or at least restore the livelihoods and standards of living of displaced persons.
- ❖ Improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites.

The project site is the property of the government. Moreover there is no permanent settlement or hamlet within the designated area. Project Land has been leased by the Government of Sindh to the project company.

Performance Standard-6: Biodiversity Conservation and Sustainable Natural Resource Management

The PS 6 seeks to protect and conserve biodiversity, and promote sustainable management and use of natural resources through adoption of practices that integrate conservation needs and development priorities.

The present environmental assessment addresses the potential impacts of the proposed project on the biodiversity. This IEE has recommended measures for the conservation of flora, fauna and other natural resources.

Performance Standard-7: Indigenous Peoples

The PS 7 seeks to address the impacts of the project on the indigenous people. Specifically, the objectives of the PS are to:

- ❖ Ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 61

- ❖ Avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner.
- ❖ Establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project.
- ❖ Foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples.
- ❖ Respect and preserve the culture, knowledge and practices of Indigenous Peoples
No indigenous people - with a social and cultural identity distinct from the existing dominant society that makes them vulnerable to being disadvantaged in the development process of the proposed project are known to exist in and around the proposed site. No such people were found in the area during the present study either. Therefore, this PS is not applicable for the proposed project.

Performance Standard-8: Cultural Heritage objectives have been set in the IFC performance standards to achieve sustainable development.

The objectives of this PS-8 are to protect cultural heritage from the adverse impacts of project activities and support its preservation, and to promote the equitable sharing of benefits from the use of cultural heritage in project activities.

No sites of cultural heritage are known to exist at or in the immediate vicinity of the project location. There are also no indications of any old settlement in the area, nor is there any site covered under the listing of cultural heritage sites. This PS will therefore not be applicable to the Project.

2.18 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).

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 62

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, 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;

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 63

- 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

IFC Guidelines for Environment Health Safety specific to Wind Power Project are attached as Annexure VI

2.19 INSTITUTIONAL SETUP FOR ENVIRONMENTAL MANAGEMENT

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided by the Prime Minister (referred to as the "Chief Executive") of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and environmental tribunals. The EPAs were first established under the 1983 Environmental Protection Ordinance (PEPO, 1983); PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports (IEEs and EIAs) of the proposed projects, and provide their approval (or otherwise). The proposed Project would be located in the Sindh Province, hence this IEE report will be sent to the Sindh-EPA for review.

2.20 OBLIGATION UNDER INTERNATIONAL TREATIES

Pakistan is signatory of several Multilateral Environmental Agreements (MEAs), including:

- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal
- Convention on Biological Diversity (CBD)
- Convention on Wetlands (Ramsar)

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 64

- Convention on International Trade in Endangered Species (CITES)
- UN Framework Convention on Climate Change (UNFCCC)
- Kyoto Protocol
- Montreal Protocol on substances that deplete the ozone layer
- UN Convention to Combat Desertification
- Convention for the Prevention of Pollution from Ships (MARPOL)
- UN Convention on the Law of Seas (LOS)
- Stockholm Convention on Persistent Organic Pollutants (POPs)
- Cartina Protocol

These MEAs impose requirements and restrictions of varying degrees upon the member countries. However, the implementation mechanism for most of these MEAs is weak in Pakistan, and administrative/institutional setup is practically on existent. Although almost all of the above MEAs would apply to the Project in one way or the other, the ones which have direct relevance for the proposed Project include the Basel Convention, Montreal Protocol, Stockholm Convention, UNFCCC, and Kyoto Protocol.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 65

SECTION 3

DESCRIPTION OF PROJECT

3 DESCRIPTION OF PROJECT

3.1 PROJECT LOCATION

The wind farm Project is located in Jamshoro District, which is located approximately 138 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 2000 acres of land, which has been leased by the GoS to the project company. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site.

The Project site has very sparse vegetation consisting of small shrubby bushes and flat terrain area. Location of the Project is shown in Figure 3.1.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 66

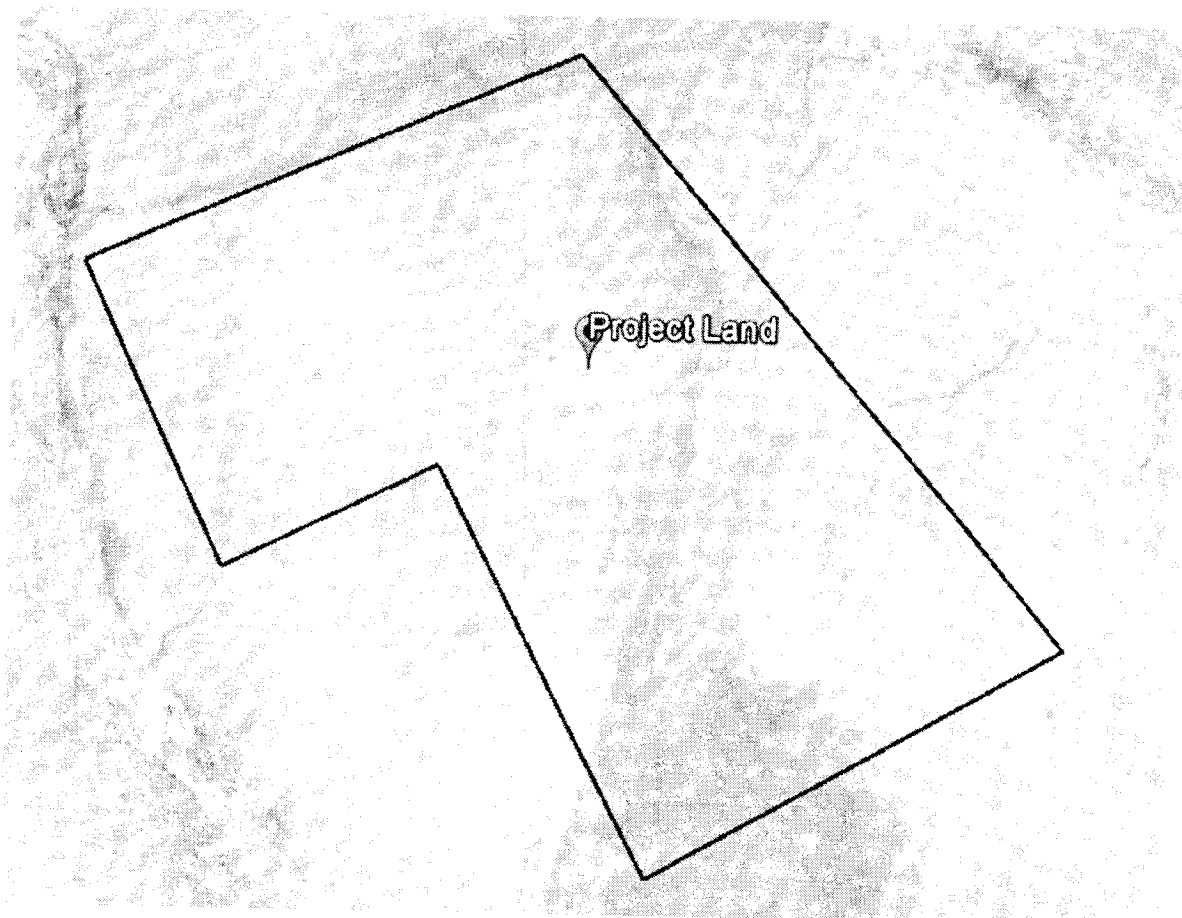


Figure 3.1: MGEL Project Site Layout

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 67

Table 3-1: Land Coordinates

S. No	Latitude	Longitude
1	25°23'30.22"N	68° 7'20.81"E
2	25°24'9.35"N	68° 8'39.36"E
3	25°22'31.31"N	68° 9'55.31"E
4	25°22'0.01"N	68° 8'55.75"E
5	25°22'57.41"N	68° 8'21.72"E
6	25°22'41.68"N	68° 7'50.66"E

The Project area is open and can be seen from images below in Figure 3.3;

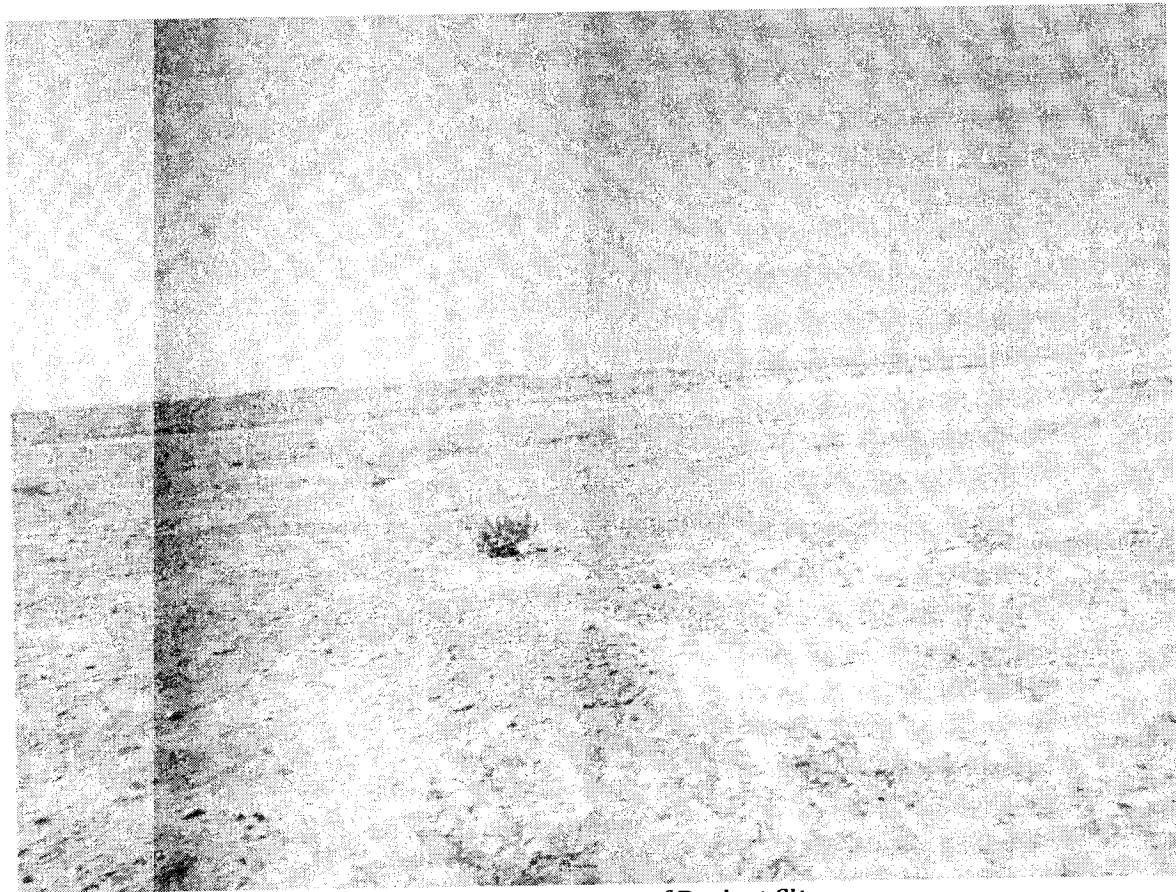


Figure 3.2: A View of Project Site

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 68

3.2 ROAD ACCESS

The Project site is easily accessible throughout the year.

The major track from Karachi to Jamshoro is via the Karachi-Hyderabad Motorway, and another access to the Project site is through M-9 road. When travelling via the Karachi-Hyderabad Motorway, the access from Karachi to the site is a double track with metaled road, which turns toward the site. However, the terrain is flat and long and heavy vehicles can easily navigate through this road.

The satellite overview of the track from Karachi to the Project site through Karachi-Hyderabad Motorway is shown in Figure 3.4.

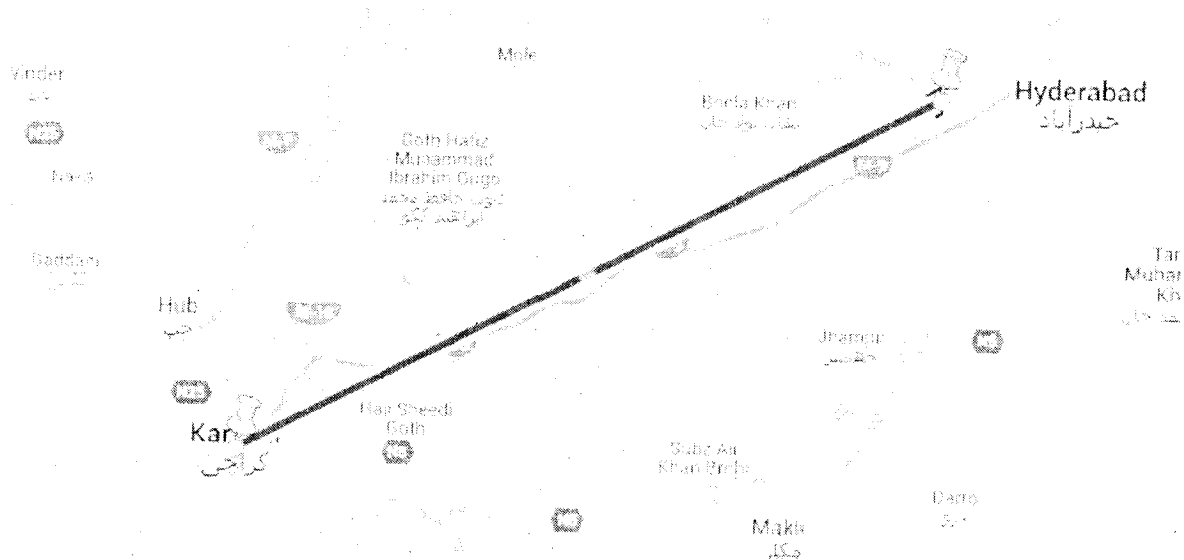


Figure 3.3: Ariel View of Complete Track (Through Karachi-Hyderabad Motorway)

The Port Qasim is the one of the major port of Pakistan and is the point of delivery of equipment for the proposed wind power project. It is located towards South of the site as shown in Figure 3.3.

Aerial distance of the port from the site is 103 km. Total track length between Port Qasim Karachi and site is approximately 128 km. The track from Port to the Site is good but Karachi Hyderabad Motorway that turns to the Site needs minor development.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 69

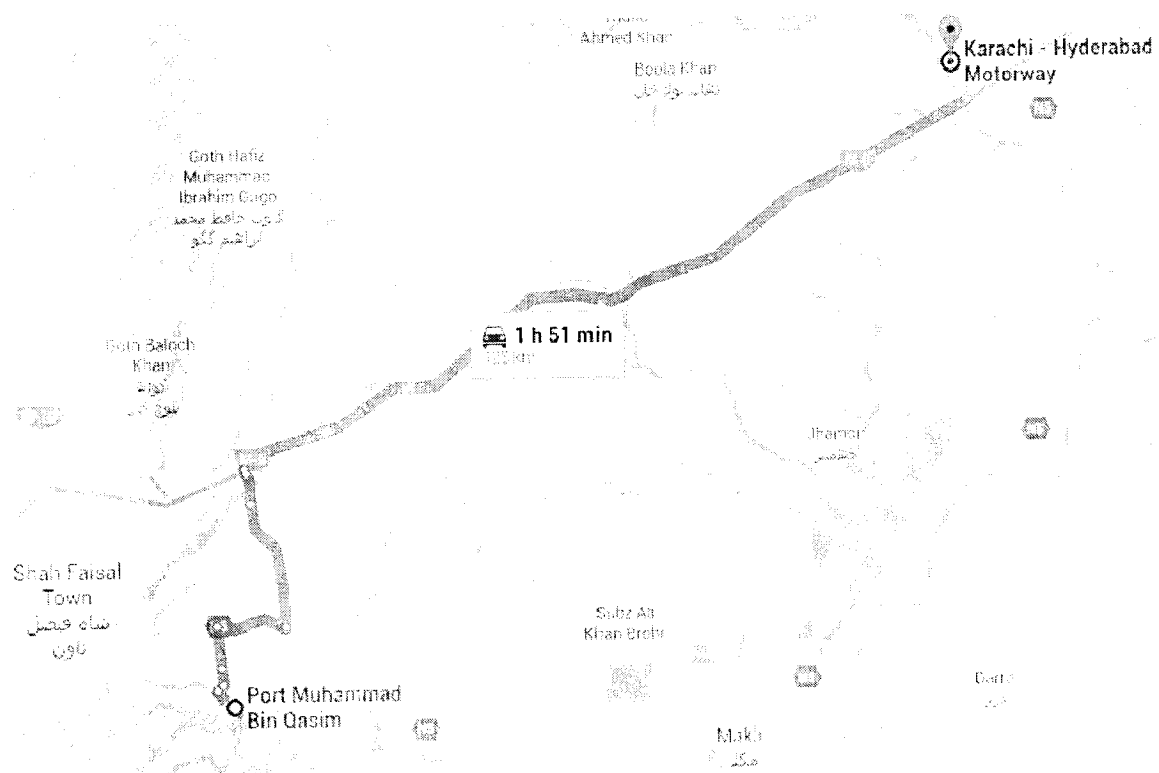


Figure 3.4: MGEL Site from Port Qasim

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 70

3.3 PROJECT SIZE AND COMPONENTS

The Project is of 50 MW capacities. Following WTGs will be installed:

- Gold Wind 2.5 MW each –Total 20 WTGs.
- Nordex 3.0 MW each – Total 16 WTGs.
- Vestas N117 3.3 MW each – Total 15 WTGs.
- GE 1.7 MW each – total 29 WTGs.

The Project can be divided into four major phases:

- Pre-Construction Phase
- Construction Phase
- Operation and Maintenance Phase
- Decommissioning Phase

3.3.1 Preconstruction Phase

Pre-construction phase consists of:

- Land Procurement
- Soil and topographic Survey
- Installation of wind measuring mast
- Wind Resource Assessment and Micrositing
- Approvals from Government Departments (discussed in section 2.9)

3.3.2 Construction Phase

Construction Phase of the Project will be awarded to an EPC firm selected through a competitive bidding process. It is estimated that direct manpower required during the Construction phase will be approximately 500 persons, with unskilled jobs being offered mainly to local inhabitants, particularly during the Construction Phase.

Construction activities will be comprised mainly of:

- Construction of site roads and crane pads at each wind turbine site

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 71

- Construction of turbine foundation and transformer pads
- Installation of electrical systems, underground and some overhead lines
- Assembly and erection of the wind turbines
- Construction and installation of substation
- Commissioning and Testing

All supplies both for construction and for the camp will be transported by trucks from Karachi. This will include all fuels and oils, drilling equipment, spare parts for construction machinery, and food supplies for construction camps.

3.3.3 Operation and Maintenance Phase

In order to maintain a high level of performance, a maximum staff of 10 persons per shift will be maintained for the wind farms, in addition to the security staff.

3.3.4 Decommissioning Phase

The Project's wind power generation systems, if operated prudently, should maintain certain residual value upon decommissioning, following the estimated 20 year life-cycle of the Project, as agreed in the EPA. Its continued performance would demand up-gradation rather than decommissioning of the plant. The tower and turbine may need replacement while the old ones may be sold as scrap to be appropriately disposed-off.

However, if the site is to be decommissioned prior to the designated plant life, it will be initiated by dismantling the turbines, supporting towers and substation, and transporting them out of the Project area. The activity will take approximately six (06) months and will require 400-500 truck- loads to transport the material. The turbine material and the tower will be sold as scrap, and concrete will be broken and moved to the landfill site. The stored fuel or oil will be transported out of the area for sale or disposal at a suitable landfill site. The site will be leveled to make it available for regular use.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 72

3.4 PROJECT SCHEDULE

The Project is presently preparing its feasibility study, which is expected to be completed within the 4th Quarter of 2015. It is expected that the Tariff would be applied soon after completion of the feasibility study. This would be followed by the execution of the EPA, and thereafter the financial closing of the project by the 4th Quarter of 2016. The planned COD is the 1st Quarter of 2018.

The EPC contract would be locked with tariff approval, which is expected to be available by September, 2016.

No	Milestone	Anticipated Date
1	Submission of Feasibility Study	4 th QTR of 2015
2	Tariff Application	1 st QTR of 2016
4	EPC Contract Signing	1 st QTR of 2016
5	Tariff Approval	1 st QTR of 2016
6	EPA/IA	2 nd QTR of 2016
7	Financial Close	4 th QTR of 2016
8	Project COD	1 st QTR of 2018

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 73

3.5 LOCATION OF GRID

Pakistan has a vast transmission and distribution system ranging from Northern areas to the farthest corner of Balochistan and Sindh. National Transmission and Dispatch Company (NTDC) is the main authority which manages all the transmission facilities and the National Grid with the help of 08 distribution companies, the HESCO.

The Project is planned to be built in the Jamshoro district. The electrical network within the vicinity of the site of the plant comprises of LV (11 kV) and HV (132 kV and 220 kV) lines. For projects with installed capacity in excess of 10 MW, connection must be made with HV lines.

Hyderabad Electrical Supply Company 132/11 kV grid station is in Jamshoro. The distance of the grid station from the Project site is approximately ten (15) Kilometers.

A separate electrical and grid interconnection study will be conducted for the project including Power Quality, Load Flow, Short Circuit and Power Evacuation.



Figure 3.5: Nearest HESCO grid station

Another Grid Station of 220kV is under construction and will be available by end of 2017 as per the plans of NTDC.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 74

3.6 WIND TURBINE DETAILS

Brief technical specification of wind turbine model is given in Table 3.2.

Table 3-2: Technical Specifications of Wind Turbine

Make	G.E
Rated Power	1.7
Hub Height	80 meters
No of Turbines	29

3.7 INFRASTRUCTURE DETAILS

Under the project following supporting infrastructure and facilities will also be constructed; their design details are still in planning stage;

- Administration Building
- Switch yard Building
- Dormitories Building
- Maintenance Building
- Internal Connecting roads
- Green belts

3.8 NET ENERGY YIELD AND CAPACITY FACTOR

The net energy yield and capacity factor of 50 MW wind farm is calculated and presented in Table 3.1.

Table 3-3: Annual Energy Production Estimates

Number of WTG	29
Approximate Net Energy Production [MWh/a] of G.E 1.7 MW	151,153.8MWh/a
Capacity Factor [%] of G.E 1.7 MW	35.0%

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 75

SECTION 4

BASELINE ENVIRONMENTAL CONDITIONS

4 BASELINE ENVIRONMENTAL CONDITIONS

A data collection survey that included geology, meteorology, hydrology, ambient air quality, water quality, soil characteristics, noise levels, flora and fauna, land use pattern, and socioeconomic conditions was undertaken, based on available secondary information or data collected in the field. Primary data was collected to establish baseline conditions for the soil, water (surface and ground) quality, flora and fauna, and noise. Secondary data was collected for land, ecology, climate, and socioeconomic factors.

4.1 CLIMATIC CONDITIONS

The climate of the Project area can be broadly classified as arid, moderate, hot and humid. The mild winter is restricted to the November-February period. The summer extends from May to September, which overlaps the short spells of the main rainy season during July-August. The weather tends to be very humid during June, July, and September and is pleasant during March and April.

The climate of this area is characterized by fluctuating temperatures and sparse rainfall. The summer seasons are hot and humid with average temperatures ranging between 33°C to 37°C. The temperature in summer seasons may reach up to 45°C. The winters are pleasant with average temperature in the range of 15°C to 25°C. The months of July and August generally observe the annual monsoon rainfalls. The meteorological stations of Badin and Hyderabad are located within the wind corridor. However, the meteorological data from Karachi station is also representative of the prevailing climatic conditions of coastal areas in the wind corridor. The climate information of Jamshoro is shown in Table 4.1.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 76

The climatic conditions of Jamshoro, Thatta and Badin districts may be taken as moderate as a whole. The climate is tempered by the cool sea breeze which blows for eight months of the year from March to October. During the monsoon season the sky is overcast but there is very little precipitation. The climate in summer is generally moist and humid. The cold weather in the districts start from the beginning of November when a sudden change from the moist sea breeze to the dry and cold north-east wind brings about as a natural consequence, an immediate fall in temperature. The data has been gathered or extracted through by using Meteoronorm 7.1. The annual average of maximum and minimum temperatures of Jamshoro is given in Table 4.1 and presented in Figure 4.1.

Table 4-1: Average Maximum and Minimum Temperatures in Jhampir Region (°C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
24	28	33	38	41	40	37	35	36	36	31	26
12	15	19	23	26	28	27	26	25	23	19	14

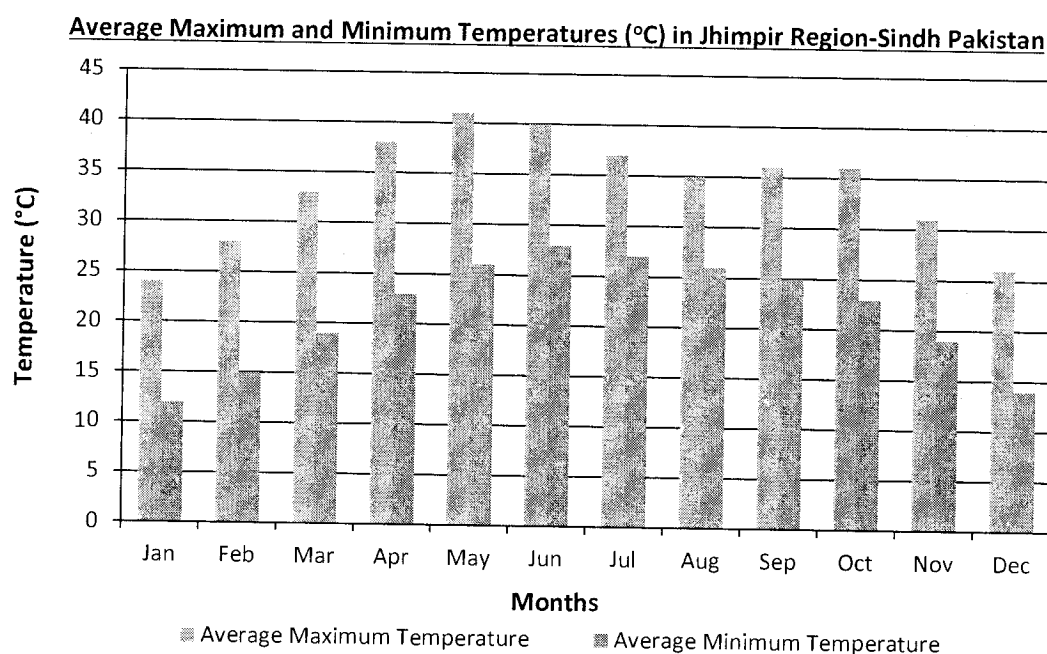


Figure 4.1: Graph of Average Maximum and Minimum Temperature (°C)

The annual precipitation takes place mainly during summer. It is unevenly distributed. Average rainfall as per meteorological record is given in Table 4.2, most of which occurs in monsoon season, from April to September.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 77

Table 4-2: Average Precipitation and Rainfall Days in Jhimpir Region

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
14mm	6mm	7mm	6mm	5mm	12mm	21mm	50mm	13mm	3mm	0mm	16mm
2	1	0	1	0	1	3	4	1	0	0	1

4.2 SURFACE AND GROUND WATER HYDROLOGY AND DRAINAGE

Major water reserve of the area is Keenjhar Lake, also known as Kalri Lake. The lake is located approximately 38 km from the Project site. It is 24 km long and 6 km wide and has an area of 14000 ha (35,583 acres). The lake is fed by the Kalri Bagar feeder canal from the North-West as well as by small seasonal streams entering into 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. Keenjhar Lake which is shown in Figure 4.3.



Figure 4.2: Satellite View of Keenjhar/Kalri Lake near Project Site

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 78

The only perennial water channel in the area is the KalriBaghar (KB) Upper Feeder which feeds Keenjhar Lake with Indus water from Kotri Barrage. The KB Feeder is approximately 38km away from the Jamshoro wind farm MGEL and lies on its eastern side. The KB feeder is about 61km long and its design discharge is about 258 cubic meters per second (cumecs). Kinjhar Lake is also being fed by hill torrents during floods from the western side. The catchment area of these hill torrents are about 1664 sqkm and have their outfall into the Kinjhar Lake. These hill torrents include RodhNai and LiariNai. BaraNai, which is the principal source of flood drops into the River Indus downstream of Kotri barrage.



Figure 4.3: View of Kinjhar/Kalri Lake near Project Site

Kinjhar Lake is the main source of fresh water for drinking and irrigation for the areas downstream of Jhimpir including the city of Karachi. Kinjhar Lake is an artificial water storage reservoir located in District Thatta. 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 Kinjhar Dhands. The gaps between the surrounding hills of the dhands were closed with the construction of earthen embankments having an average height of about 7.6m. Apart from KB Feeder, hill torrents and Kinjhar Lake there is no other source of surface water available in the area. The quantity of water in Kinjhar Lake is ample to fulfill the requirements of the downstream areas for irrigation and drinking purposes.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 79

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.

During social survey, it is learned that the availability of drinking water is the major problem of the area. The average water table in project area is 100 - 150 feet. The water of shallow wells present in the expansion areas contains higher values of TDS and mostly saline in nature therefore is not suitable for human consumption. The normal quality of water in the town is having TDS value of about 2220 mg/l.

The depth of water table is also depleting over the period. Due to increased number of private tube wells being installed in the location of sub project, the ground water is depleting. Recharge from surface /rain water is helping in reduction of depth of sub soil water table. During dry periods, the situation sometimes becomes quite serious.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 80

4.3 AMBIENT AIR QUALITY

The area in and around the Project site is underdeveloped with no industrial development nearby, but the area is likely to develop into a modern city after development of wind power projects in the area. The primary sources of air pollution include traffic near Karachi Hyderabad Motorway. The impact of exhaust emissions from vehicular traffic operating on Highway N5 is Ltd to the microenvironment of the highway. No sources of anthropogenic sources of air pollution exist in the immediate vicinity of the site; therefore the ambient air of the area is likely to be free from the key pollutants such as carbon monoxide (CO), oxides of nitrogen (NOx), sulfur dioxide (SO2) and particulate matter (PM). But in very minor quantities. In general, the air quality of the area is high with no significant air pollutants.

4.4 NOISE QUALITY

There is no continuous source of noise emission within or around the proposed project wind farm site.

The Noise level recorded at the unpolluted site in ranges between 36.2 dB (A) and 45 dB (A) with the average at 45.0 dB (A), which is characteristic of wilderness and well within 75 dB (A) the level suggested by NEQS.

There is very minor human settlement near the Project area. Traffic near the Project site is consequently very low. Industrialization is also very low, thus baseline noise levels are low.

4.5 SEISMIC HAZARDS

According to the seismic zoning map of Pakistan, the Jamshoro region falls in **ZONE II-A** with minor to moderate damage area probability with G Factor of $g=0.1-0.3$, as shown in the map in Figure 4.5. Earthquake records indicate that this region has experienced several earthquake tremors in the past, as well as recently. The region has some major tectonic features, including the Runn Kutch-Karachi fault, Pab fault, Ornach-Nal fault, Surjan fault, and Jhimpir fault. There is no earthquake recorded in the history of region above Richter scale 4.5. Also no damage to the infrastructure and human settlement is reported in the area.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 81

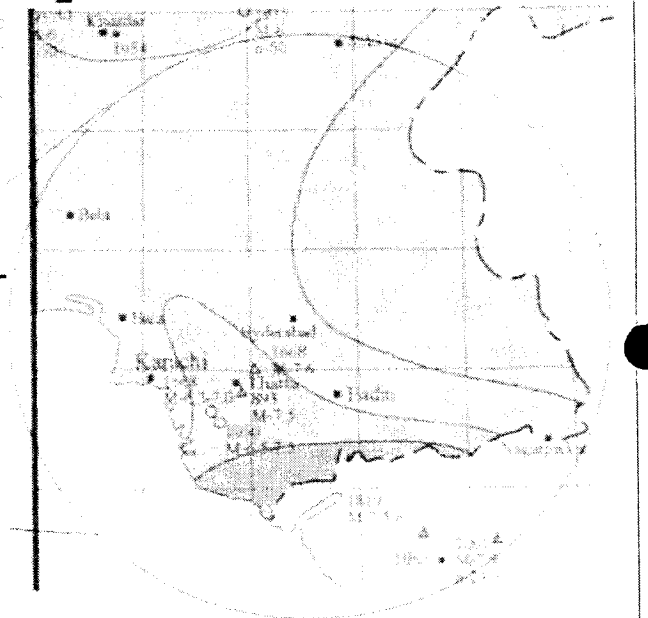
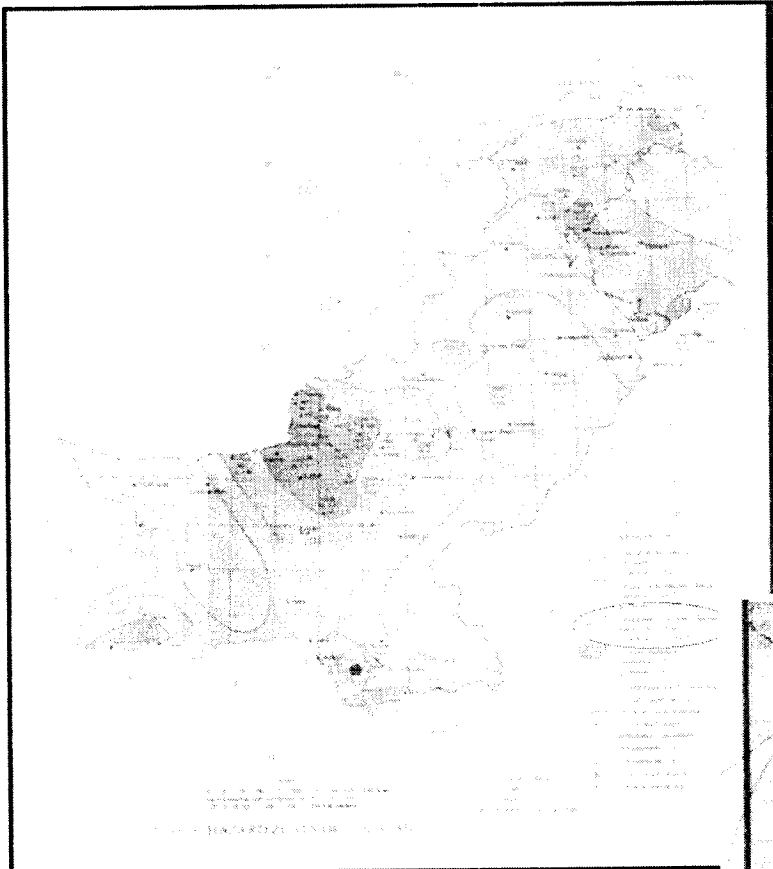


Figure 4.4: Seismic Hazard Zones of Pakistan

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 82



Figure 4.5: Seismic Map of Pakistan

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 83

4.6 FLOODS

Sindh province has two sources of flooding. The Riverine flood is more predictable and allows ample time to react, whereas the torrential floods leave almost no time to respond. Torrential floods have lesser frequency and duration but very high intensity; therefore, impact is often severe. These floods normally occur in monsoon months of July and August when the catchment areas in Balochistan receive heavy rains. The Western boundary of Sindh is connected with Balochistan through the Khirthar hills.

Jamshoro is situated on the right bank of Indus River, approximately 18 km Northwest of Hyderabad and 150 km northeast from the provincial Capital of Sindh. Most of the villages which were present very near to river area are called as KACHA. Flood had destroyed villages from this portion. Floods can be critical natural hazard in the project with respect to solar PV project due to River Indus flowing around 10-15 km from the project area. Jamshoro is considered as not a flood prone district of Pakistan according to the map released by Emergency Resource Center (ERC).

According to the flood map of Pakistan, Sindh province falls under a moderate to heavy flooding zone.

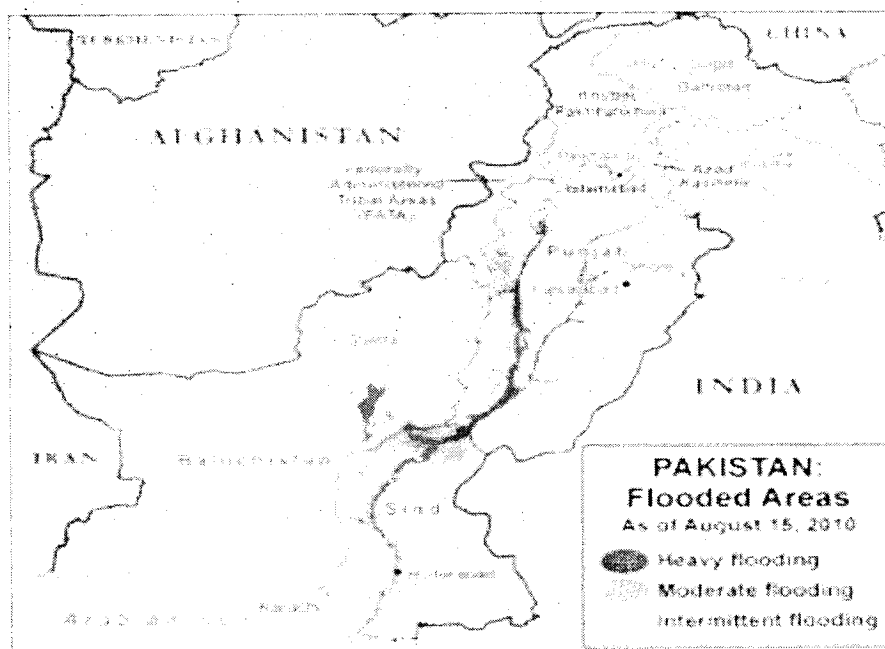


Figure 4.6: Flood Map of Pakistan

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 84

4.7 GEOLOGICAL SETTINGS

The Project area has a wide range of soil types due to its diverse land forms, which include sandy, deltaic, alluvial, gravel, coastal, and mountainous.

The Prevailing geologic conditions in the region are the results of extensive sedimentation, coastal movements, and erosion 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. This has resulted 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 freely visible, particularly in the Indus plain. Ultimately, it is only by considering the geology on a broader regional scale, as well as in site specific detailed, that the effect can be appreciated.

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 is some exposure of rocks belonging to the next older system; the cretaceous with the exceptions of some volcanic beds associated with these cretaceous strata, all the rocks formation of western Sindh are the sedimentary origin. All of the more important hills masses consist of limestone. A vast majority of this limestone deposit is from the nummulitic period and is largely built up of the accumulated shells of foraminifera; principally those belonging to the genus nummulites.

Table 4-3: Geological Formations covered in the Wind Corridor of Jhimpir

Geological Symbol	Description	Percentage (%) of Total Area
Q	Unconsolidated surface deposits of silt and gravel of recent period	32.57
Te	Eocene Sedimentary Rocks (Mostly Limestone) of Tertiary Ages	67.43

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 85

4.8 SOIL CLASSIFICATION

The texture of soils in the wind corridor ranges from loamy saline, silty, and clayey in the coastal areas to gravely, mainly loamy, and clayey soils in the inland areas.

The loamy soils in the coastal areas are strongly saline (hence devoid of any agriculture), moderately alkaline (pH of 7.9 to 8.4) and strongly calcareous (CaCO_3 content greater than 15%). The soil in the inland areas, especially those areas covered under the lower Indus basin, consists mainly of loamy and clayey soils. These soils have little or no salinity (0 to 4dSm-1) and are moderately alkaline (pH of 7.9 to 8.4). The soils are generally non-saline, non-sodic except local saline patches in inter-dual valleys and some parts of the alluvial plain.

The soil of Jamshoro is classified as mainly loamy saline and part gravely. The soil is similar in nature to the soil of Jhampir area. However the soils in some patches may be different with a slight salinity (between 4dSm-1 to 8dSm-1). This type of soil is usually neutral (with a pH of 6.6 to 7.3), and moderately calcareous (with CaCO_3 content in the range of 3% to 15%). Properties of soil in some patches of the wind farm may be different to the ones stated above with moderately alkaline (pH of 7.9 to 8.4), strongly calcareous (with CaCO_3 content of greater than 15%) with little or no salinity (between 0dSm-1 to 4dSm-1). This type of soil is usually neutral (with a pH of 6.6 to 7.3), and moderately calcareous (with CaCO_3 content in the range of 3% to 15%). This information has been extracted through topographic and geotechnical investigations report done by PAES

4.9 LAND USE CAPABILITY

The land area of the Project consists of a complex of agriculturally unproductive (rock) land and some poor grazing (gravely land) (Class VIII, VII). This area constitutes about 38.3% of the total wind farm area and is also incapable of agriculture as the soil underneath mainly consists of rock and gravel. The remaining portion (about 61.7%) of the land is a complex of poor torrent-watered crop land and poor (loamy) grazing land. Some part of this land is capable of agriculture being fed by torrent water whereas the remaining portion comprises of grazing area (capable of growing grass and shrubs).

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 86

Table 4-4: Land Use Capability Class in Jamshoro

Classification No	Soil (Class)	Capability	Percentage (%) of Total Area
7	IV, VII	Complex of poor torrent-watered cropland and poor (loamy) grazing land	61.68
10	VIII,VII	Agriculturally un-productive(rock) land and some poor grazing (gravely) land	38.32

The Project site consists of areas that have variable land use. The rocky and gravely soil formation devoid the major land area for any agricultural use. However the land area is also influenced by perennial grazing consisting of short grasses shrubs and scrubs. This area is dependent on residual moisture from torrent overflows. The major bushes found in the area include Devi, Chali, Damral, and Darathi (local names). No medicinal value is associated with these plant species found in the area.

4.10 SOCIO ECONOMIC FEATURES

4.10.1 Local Settlement Pattern and Population

Jamshoro is situated at 25.43° North latitude, 68.28° East longitude. Jamshoro is a small community in Pakistan, having about 1,176,969 inhabitants in 2011. The city of Jamshoro is located at an altitude of 220 feet 67 m from sea level, having terrestrial coordinates 68.28° east and 25.43° north. It is also the narrowest point of the lower Indus course.

Jamshoro is a district of Sindh province, Pakistan. Jamshoro district was split from Dadu district in December 2004. It consists of four Talukas Sehwan, Manjhand, Kotri and Thano Bola Khan. It is situated on the west bank of River Indus. The district has taken its name from its headquarters Jamshoro, known as Educational City.

The settlements and their population near the project site is Goth Nawab Khan Khoso, Goth Nabi Buskh Khoso, Goth Tando Khan Khoso and Goth Soomar Khan is about 01 kilometer to 03 kilometers from the Project site. In Goth Nawab Khan Khoso, having population of approx. 200 - 250 persons and 20- 30 houses is located around the project boundaries, in Goth Nabi Buskh Khoso, having population of approx. 300 - 350 persons and 50 - 60 houses is located around 03 kilometers away from the project boundaries, which will not be affected due to the construction and operation activities. Therefore, there is no threat to the existing land use or degradation, and there is no net impact on the land use.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 87

Table 4-5 List of Settlements and Population details

S.No	Name of Settlement/Goth	Coordinates	Distance from Project Site (km)	Population	Status /Type
1.	Goth Nabi buskh khoso	N25°20'33.1" E068°09'22.9"	2.79km	350	Permanent
2.	Goth Tando khan khoso	N 25°21'24.3" E068°08'53.4"	1.2km	90	Permanent
3.	Goth Mahram khan khoso	N 25°21'44.3" E068°08'34.0"	800m	25	Permanent
4.	Goth Nawab khan khoso	N25°20'36.6.4" E 068°09'33.7"	2.7km	230	Permanent
5.	Goth Soomar khan	N 25°20'54.6" E068°09'53.1"	2.57km	60	Permanent
6.	Temp settlement	N 25°22'28.8" E068°09'34.9"	900m	35	Seasonal/Temporary
7.	Temp settlement (Rano khan)	N 25°21'44.0" E 068°08'38.2"	700m	30	Seasonal/Temporary
8.	Temp goth	N 25°21'04.7" E 068°09'06.8"	1.75km	25	Seasonal/Temporary

Table shows the GPS coordinates of the settlements observed during the survey. During Micrositing study of the towers, due consideration will be given to avoid any disturbance to locals.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 88

4.10.2 Health and Education Facilities

The health infrastructure in District Jamshoro is scant. There is not having any Rural Health Centre or any Veterinary Dispensary. A particular problem of access to health services is the scattered nature of the population. Thus, many people have no access to health services within a convenient location from their homes. Serious ailments have to be treated at Jamshoro, Hyderabad, or Karachi. Many of the diseases occurring in the area are water- borne and are due to lack of sanitation facilities. A basic health care centre is not present in the area.

Jamshoro city is located in the Province Sindh named as Jamshoro District; the overall literacy rate in Jamshoro is 48% and increasing day by day due to governmental educational policies. Numerous educational institutions are there which are providing up to date educational services for the community of Jamshoro. Colleges/universities in Jamshoro are offering latest course and programs to build the career of students. The students can get the education from these educational institutions to compete the entire world during by getting the career growth techniques. Among the list of Colleges/universities in Jamshoro University of Sindh, Mehran University of Engineering and Technology and Liaquat University of Medical and Health Sciences are offering best educational policies for the students to get the latest education according to the competing trend of career growth. Colleges/Universities in Jamshoro are offering their unique educational services for the students to build the healthy sound mind nation.

The present situation of education in District Jamshoro is that there are 776 primary schools with the total enrolment of 70838 children. Total middle schools in the district are 31 with the enrollment of 2375 children. There are 39 high schools in the district having 14040 students going therein. So the total number of all schools from primary to high is 846 with the total enrollment of 87253, which can be enhanced up to 40% if the facilities to which there is no access are provided specially to the children living in far-flung areas. So far as access to electricity is concerned, many of the schools are devoid of this advantage which, if provided, will be very instrumental in providing basic facilities and eventually in enhancing enrollment.

There is no education facility in the project area especially for the peoples who are living near the project site. There is only one primary school for boys in surrounding area. Also there is not any health facility available in the nearby project area and the nearest hospital is located in Jamshoro which is approximately 15 kilometers away from the project area.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 89

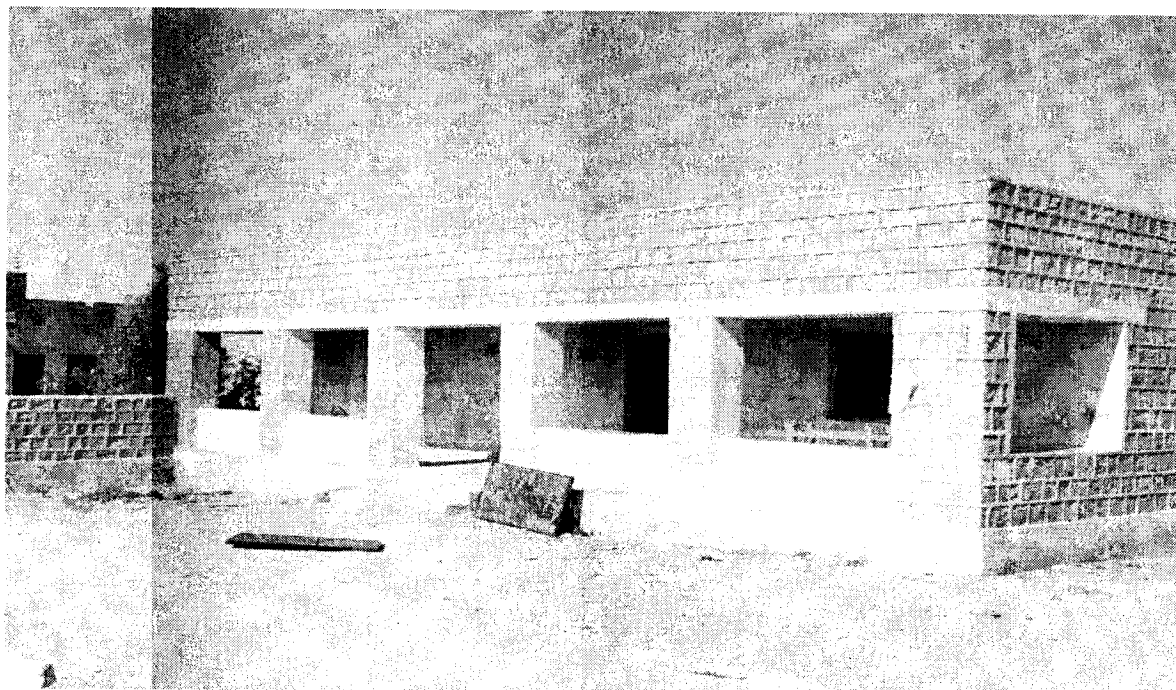


Figure 4.9: A View of School nearby Project Area

4.10.3 NGOs Working in the Area

Different national and international NGOs are working in District Jamshoro with the help of their local partners. Their scope of work ranges from relief operations in the coastal areas of Jamshoro to social welfare and livelihood improvement initiatives. Certain NGOs are working on CPI (Community Physical Infrastructure) projects, and others have found their way in providing microfinance to local communities through social collateral. A few of these NGOs are also working on awareness and advocacy. NGOs and institutions working in the area includes NRSP (National Rural Support Program), Aga Khan Planning and Building Services (AKPBS), PPAF (Pakistan Poverty Alleviation Fund), IUCN and WWF.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 90

4.10.4 Income Source

The area does not offer opportunities for employment and the population is primarily engaged as cheap unskilled labor force either in Nooriabad, Thatta, Jamshoro, Hyderabad or Karachi. Skilled labor from this area mainly comprise of vehicle drivers, agriculture activities, Shepherd, welders, plumbers, and electricians.

Main occupation of the residents of Jamshoro district is agriculture and construction labour. The main crops grown in the district are cotton, corn, wheat and sugar cane etc. Jamshoro is of many small and large scale industries. Among important industries are cotton textiles, cement, paint and varnish, pharmaceuticals, agriculture implements, hand pumps, lock making, pipes making, and sugar mills. Bricks factories, thread ball spooling, trunk making brass-wares, cutlery and ceramics. The land use pattern is characterized by almost entire residential and limited commercial activities in majority of the central area while institutional and commercial activities are located along main roads. This has been seen during the social survey and public consultation. During the social assessment visit it was observed that peoples are barely meeting their dietary needs. This in a way is exciting for the local population because the Master Green Energy Limited project is expected to bring job opportunities and raise the living standard of locals.

4.10.5 Infrastructure and Industry

The district is linked by road with other districts. The National Highway from Karachi to Peshawar passes through Janshoro for a length of approximately 200 km.

The main railway line from Karachi to Peshawar also connects the district. The nearest railway station is Jamshoro.

The district is also equipped with digital and non-digital telecommunication systems, besides postal service and telegraph service.

From an industrial point of view, Jamshoro is of many small and large scale industries. Among important industries are cotton, textiles, cement, paint and varnish, pharmaceuticals, agriculture implements, hand pumps, lock making, pipes making, and sugar mills. Bricks factories, thread ball spooling, trunk making brass-wares, cutlery and ceramics.

Nearest industrial hub is Jamshoro at the distance of approximately 20 kilometers, has different type and size of industries; which includes Textile, cotton, Cement, etc.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 91

4.11 ECOLOGY

RE2 project team (Flora and fauna experts) done by Dr. Syed Ali Ghalib have conducted the field survey for the study following were the methodology.

A. Methodology

Data in respect of fauna and flora were gathered both from primary and secondary sources. The sampling locations were randomly selected, ensuring that representative locations are sampled for each habitat and the maximum possible number of species belonging to each habitat is recorded.

Prior to the start of actual field work, there is a need to collect a sift of information to form a general overview on the wildlife populations on the site (and nearby areas) and their likely sensitivity.

This is largely a secondary data collection exercise during which information is sought and collected on:

- (i) Mammals, birds, reptiles, amphibians and plants:
- (ii) Habitats:
- (iii) Designated / protected / sensitive sites in the vicinity of the proposed development

After having made a general overview of the likely animal populations on the site, their likely sensitivity and the proximity of the designated / protected sites forms the main objective of the field survey programme. This allows the selection of target / key species¹ and their principal habitats in the Area.

Data in respect of fauna and flora were gathered from both primary and secondary sources. The sampling locations were randomly selected, ensuring that representative locations are sampled for each habitat and the maximum possible number of species belonging to each habitat is recorded.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 92

Secondary data were collected through literature search including the studies conducted within and in the surroundings of the Project Area and information collected from the local communities and from the Sindh Wildlife Department.

The vegetation surveys were carried out by laying 20 x 20m quadrates within the study area. The plant communities were determined within the habitat.

Field Surveys were undertaken in the project area to collect data about the fauna of the area. Standard direct and indirect methods were applied to record the occurrence, distribution and population of various animal species in the area, which included point count surveys, roadside or track counts, line transect method and tracks/signs counts.

4.11.1 Flora

It is situated in Deh Sonwalhar, District Jamshoro. It is a plain wasteland with very scarce vegetation of *Rhazia stricta*.

Flora of the district has been greatly modified by human agency of the old open forests of small trees and shrubs; there remains only a few Rakhs or portions of forest which are kept as grazing ground for cattle etc. Amongst trees the most important Main trees in Jamshoro district are *Acacia nilotica* Babul (Keekar), *Eucalyptus camaldulensis* (Safaida), *Dalbergia sissoo* (Shisham), *Azadirachta indica* (Neem), *Salvadora Parida* (Khabar) and *Ficus religiosa* (Peeple). *Calotropis procera* (Akk), and (*Prosopis juliflora* (Mesquit) in bush form are seen in abundance along the roadside. In Project area there is no plantation and vegetation cover present in the area and it's nearby surrounding. The data or information is gathered through conducting the survey.

The main fruit grown in the Project Area is date. Besides date, banana, guava and grape fruits are also grown in the area. The major agricultural crops are cotton, wheat, corn and sugar cane and also the seasonal vegetables are onion, radish, potatoes, peas, spinach, carrot and turnips. No endemic rare plant species was recorded from the Project Area during the survey.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 93

4.11.2 Fauna

The fauna recorded includes Indian Porcupine, Indian Gerbil, Desert Hedgehog, Ring Dove, Little Brown Dove, Chestnut-bellied Sandgrouse, Grey Partridge, Common Quail, Saw-scaled Viper,

Sand Boa and Spiny-tailed Lizard.

Jackal (*canis svreus*), wild lizzards (Goh, Kirli, kirla, Gohira and Sanda) snakes mostly scorpions which are poisons to human. Domestic animals include goats, sheep, camel, cows and buffaloes. Another important domestic animal of the area is donkey, which is used for pulling carts, etc.

The wildlife in the area has been affected by colonization of the area, and many wild life species have either diminished or vanished. No threatened wildlife species has been reported from the Project Area.

Methodology

Survey of Mammals

For large and medium size mammals, several direct and indirect methods were used such as roadside counts, counts of tracks, footprints, burrows, pellet counts, point surveys and line transects. One effective way to survey small mammals is active searching, particularly during the daytime. This method is equally applicable to both nocturnal and diurnal species, particularly in potential and suitable microhabitats along the canal banks, open plains, bushy areas and agriculture fields. Active searching is very effective for inventory of Gerbillus, Meriones and Hemiechinus spp.

For small mammals, active searching, traps and trapping procedure were used. Specifically, Sherman traps were used to collect the live specimens of rodents.

Survey of Birds

Each major habitat type in the sturdy area was first identified and surveys were made to record the species of bird found in each discrete habitat such as lakes, canals, ponds, marshes, forest, agriculture fields, vicinity of human habitation and fallow lands. The number of birds observed in each habitat type was also recorded with particular emphasis on the key species and to relate the data to other components of the study area such as vegetation, water and soil etc.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 94

Line transects method was used as the most common field method. It is based on recording birds continually along a predefined route within a predefined survey unit. This method is suitable for extensive, open and uniform habitats and for large and conspicuous species.

Survey of Reptiles and Amphibians

Various methods were employed for observation of reptiles and amphibians.

A. Direct Counting:

In direct counting method, one-hour plot searching, use of pitfall traps, spot lighting or night observation, turning of stones, rock and rotten trees and study of basking behavior were used for searching and observing reptiles and amphibians.

B. Indirect Counting

Indirect counting method was also used for counting and observing reptiles and amphibians including presence of signs like faecal pellets, tracks, den or tunnels (egg laying excavation), evidences from the impression of finger or foot prints, or tail assisted in determining the existence, range and rough population of reptilian fauna.

Results

During the present survey, 12 species of Mammals, 21 species of Birds, 06 species of Reptiles and 05 species of Plants were recorded.

List of Flora and Fauna found in the Project area is attached as Annexure VIII

4.12 NATURAL MINERAL RESOURCES

There are no mines or minerals found in the district of Jamshoro.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 95

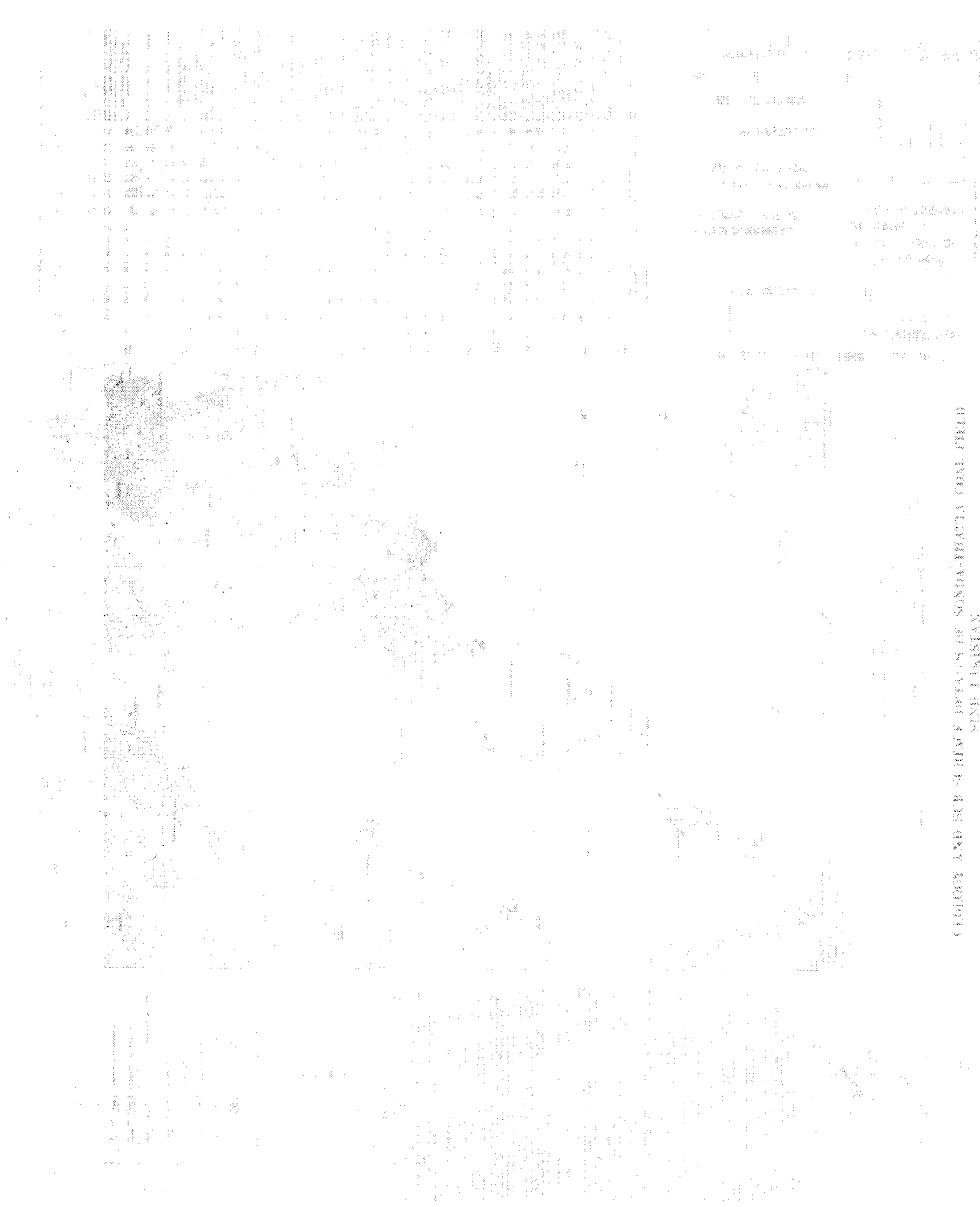


Figure 4.7: Geological and Sub Surface Details of Jhimpir

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 96

SECTION 5

ANALYSIS OF PROJECT ALTERNATIVES

5 ANALYSIS OF PROJECT ALTERNATIVES

Setting up of a wind power project involves selection of environmentally and techno economically suitable site, land characteristics, meteorology, infrastructure, grid availability, water availability, rail and road connectivity, accessibility and shading aspects etc. This chapter elaborates analysis of project alternatives, which can be considered in the project area.

5.1 WITH OR WITHOUT PROJECT

Pakistan's major electricity sources are thermal and hydro generation, meeting approximately 70% and 28% (respectively) of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil and gas. While both are produced domestically, demand already outstrips supply by a considerable amount. Oil import is a significant burden on the national exchequer and the increasing import bill continues to exert further pressure on the foreign exchange reserves.

Alternatives to further fuel imports for electricity generation are the use of domestic coal, or generation from hydro-electric or other renewable sources, such as wind and solar power. These options will assist in reducing Pakistan's reliance on imported oil, and consequent vulnerability to changes in global oil prices which will in turn have a positive effect on the current trade deficit and inflating import bill. As with gas, securing future supplies of coal and hydro-electric power would rely on significant spending on infrastructure. Pakistan has domestic reserves of coal. However, coal currently makes up a very small proportion of total generation, largely the result of most of the reserves being located in one area, the Thar Desert. Exploiting the reserves would require huge and costly upfront investment in local infrastructure (including provision of water supplies), development of mines, housing and related infrastructure, and investment in transmission lines before power plant development could commence. Hydroelectric power already supplies almost 30% of electricity, and numerous sites for future investment exist, but due to their locations, this would also require significant investment in transmission to meet the expected power needs. Moreover, there are varying political stands on hydro-electric power options.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 97

Looking at how the country's future electricity needs might be met in a way that supports the environmental objectives of the Government of Pakistan; wind power generation has the potential of being a strong contributor. The development of wind power generation projects could reduce dependence on fuels for thermal power generation, increase diversity in Pakistan's electricity generation mix, and reduce greenhouse gas (GHG) emissions avoiding thermal power generation. The project will also add to the power generation from Renewable energy resources and help in meeting target of Government to achieve 5 % power generation from RE by 2015.

In view of the above, the "Without Project" option is not a preferred alternative.

5.2 ALTERNATIVE FUEL

The only viable generating options for energy production to meet the supply-demand gap in project region are fossil fuel energy. Pakistan is already facing huge short fall in fulfilling the coal requirement for already existing thermal power plant. The quality of coal is also low to medium in the region resulting in fly ash, carbon footprints and sulphur fume emission when it's burnt.

Coal power generation cause serious environmental threats including air pollution, coal dust, contamination of ground water, emissions of heavy metal pollutants which in turn can cause serious health issues.

So, it is imperative to look for alternatives to fossil fuel based power generation to achieve long term power solution of the country.

5.3 Location Alternative

The area where the project is located is the identified wind corridor of Jamshoro. The location of the project is selected on the base of suitable terrain and wind speed availability in the area.

Jamshoro Wind Corridor is also considered as most suitable land for wind power project other than Gharo. Also there are number of wind farms already in the development stage in the nearby area. Therefore the infrastructure for the development of wind power generation in this area is already in development phase. The availability of land in this area is also a major reason for the selection of land in this area. As there are number for wind masts already installed in the Jhimpir area, therefore it's easier to use reference wind data of the neighbouring wind masts for the feasibility study which is more reliable and actual site based.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 98

The major reasons for the selection of this site are;

- Adequate wind resource that allows for the operation of utility-scale wind turbines;
- Proximity and sufficient access to an adequate electric transmission/Grid;
- Contiguous areas of available land resource;
- Compatible land use;
- Limited sensitive ecological issues;
- Sufficient distance from major population centers; and
- Compliance with Provincial, and Federal laws and regulations.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 99

SECTION 6

POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6 POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 LAND USE

The total land allocated for the Project is 2000 acres. At the Project site, there has been an absence of the following since the past few decades:

- Any agricultural activity on the land
- Any commercial activity on the land to support the livelihood of local residents nearby
- Any green field, wetland or protected area

There are four settlements/Goths near the project area, which are located 01 kilometer away from the project site. Out of eight only one Goth having population of 400 persons and 60-70 houses is located near the project boundaries which is seasonal/temporary and will not be affected due to construction and operation activities.

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



Low Impact



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 100
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6.2 AIR QUALITY

The Project involves power generation using wind energy—a clean source of energy (i.e., no fuels are used). Air pollution will increase during construction 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-metalled road, etc. Also, the use of construction vehicles and equipment and idling of vehicles carrying construction raw materials will add to the emissions during the construction period.

However, the increase in air pollution is temporary. Also, the nearest major human habitat is approximately 01 km away from the project site. Thus, the impact of the construction activity on air pollution will be low and temporary. Construction emissions will be higher than emissions from Project operation activities, but still limited in volume. Emissions will be monitored and controlled through effective implementation of EMP.

Impact on Air Quality	 = Low
-----------------------	--

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

6.3 NOISE QUALITY

Project construction involves a variety of noise generating activities that include the use of grading, excavating/drilling/, 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.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 101

Construction activities at site are expected to produce noise levels in the range of 75–85 dB (A), with most 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 be restricted to a few months, therefore the intermittent impact from construction noise is deemed to be negligible.

During Project operation, noise will be generated from rotor movement through the air, turbine operation, 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.

Impact on Noise Quality during Construction		Low
Impact on Noise Quality during Operation		Low



=High



=Medium



=Low



=No impact



=Locally Favorable



=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 102

6.4 NOISE FROM WIND TURBINES

No landscape is ever completely quiet. The modern tubular towers contribute toward minimizing the noise emissions. Birds and human activities emit sound, and at wind speeds around 4-7 m/s and up to the noise from the wind in leaves, shrubs, trees, masts etc. will gradually mask (drown out) any potential sound - from wind turbines. This makes it extremely difficult to measure sound from wind turbines accurately. At wind speeds around 8m/s and above, it generally becomes a quite abstruse issue to discuss sound emissions from modern wind turbines, since background noise will generally mask any turbine noise completely.

The sound power level from a single wind turbine is usually between 90 and 105 dB (A). This creates a sound pressure level of 50-60 dB (A) at a distance of 40 meters from the turbine, i.e. about the same level as conversational speech.

Figure 6.1 is released by GE, which shows the comparison of various common sounds with respect to the sound generated from Wind turbines. The research explains that a large wind turbine isn't very loud from an objective standpoint. According to this data, at a distance of 300 meters, a turbine will be somewhere between an air conditioner (50 decibels) and a refrigerator (40 decibels). At about 500 meters, the levels drop to about 38 decibels, which is well below the typical 40-45 decibels of background noise in a populated area.

Therefore, wind turbines are not any louder than what an average person is already used to.

The quality of wind farm noise is one factor. Researchers are looking at whether the low-frequency sound of blades has a different psycho-social impact than noise from highways or airports. It's very common that people living close to turbines call the sound "penetrating." Of course, different people handle the sound in different ways. Many residents are unfazed by turbines at close distances.

However, noise analysis have been done to make the baseline data which ranges between 36-44 dB (A), close noise monitoring will be performed during construction and operation phases to keep in permissible limits.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 103

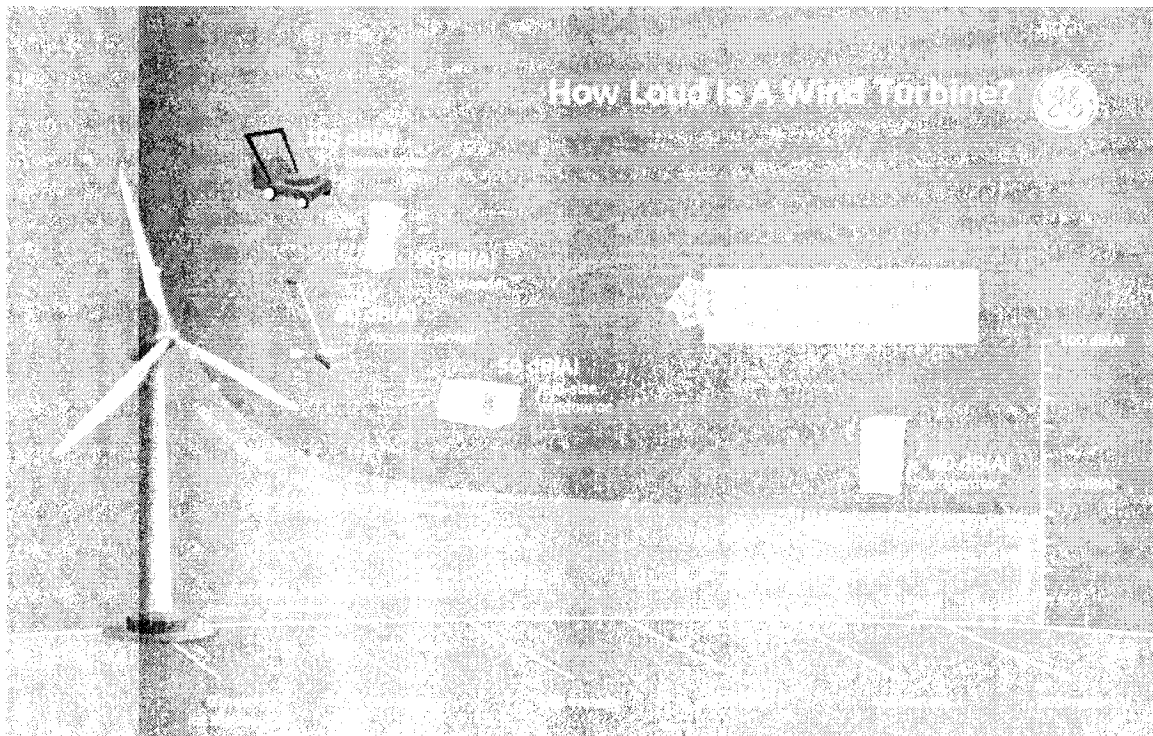


Figure 6.1: Noise Generating from Wind Turbine²

The Project will use modern wind turbine models, which have advanced technology that includes upwind rotors, tubular towers and sound proof nacelles to reduce mechanical noise. 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. Nearest communities are located at 1-3 kilometers.

² GE Global Research; National Institute of Deafness and other Communication Disorders (NIDCD part of NIH)

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 104

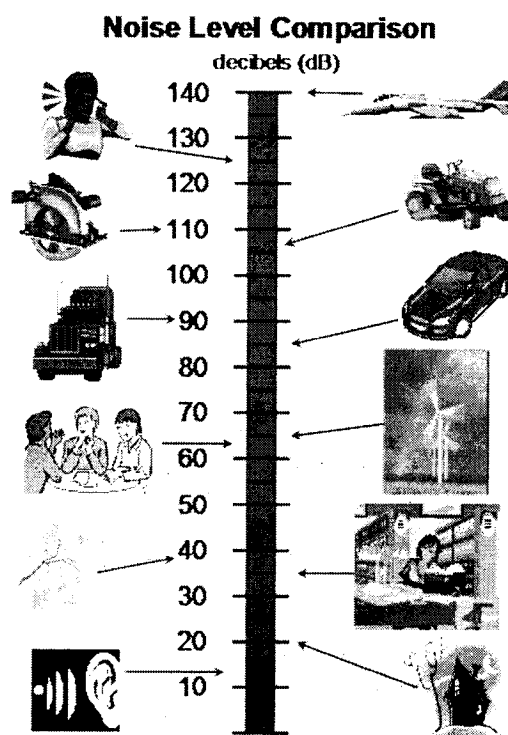


Figure 6.2: Noise Generating from Wind Turbine³

Impact of Noise Generated from Turbine

◊ = Low



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

³ GE Global Research; National Institute of Deafness and other Communication Disorders (NIDCD, part of NIH)

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 105

6.5 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.

The probability of when and for how long there may be a flicker effect may be predicted. 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.

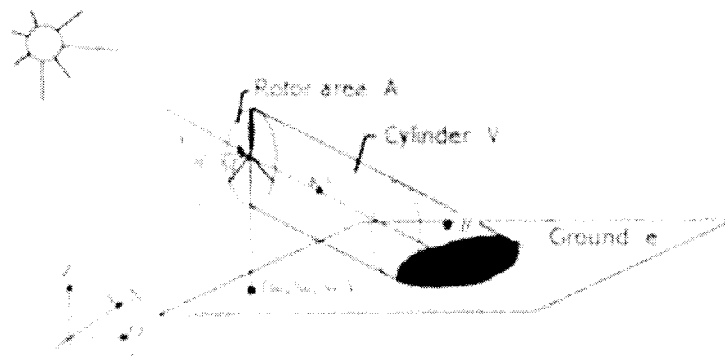


Figure 6.3: Shadow Flicker of Wind Turbine

In a study conducted by the 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.⁴

⁴<http://www.decc.gov.uk>

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 106

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. Moreover, in Pakistan, there is a common trend for people to build homes in shady areas.

Impact of Shadow flicker

 Low



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

6.6 WATER USE AND QUALITY

The volume of water used during Project construction and operation is low. i.e, approximately 200 gallons per day water is required during construction of the project. Water required for plant civil works, will be sourced from ground water. During operation phase, approx. 100 gallons per day water is required. RO Plant will be installed to make water free from any contamination. Water is available and quantities required are negligible than requirement.

Once the wind farm is operational, water is only required for the domestic use of Project staff at the site.

Water Use & Quality

 Low



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

Document Title:
Initial Environmental Examination
(IEE) 50 MW Master Green Energy
Ltd Wind Power Project in
Jamshoro, Sindh Pakistan

Consultant Name:
Renewable Resources (Pvt.)
Ltd

Project Sponsor:
Master Group

Document No
RE2/131/174/001

Document Issue
01

Date of Approval
December, 2015

Page

107

6.7 GROUNDWATER CONTAMINATION

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.

Ground Water Contamination	○ = No Impact
----------------------------	---------------



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

6.8 Solid Waste Generation

Solid waste generated on site may spread over or create hazard for community and employees of the project.

Two type of solid waste will be generated during construction and operation phases; it is estimated that average 200kg/day domestic (non-hazardous waste) will be generated, which will be disposed at TMA identified waste disposal point at Jamshoro city.

All the hazardous waste material will be handled and disposed of through EPA certified waste disposal contractors like, Petro waste, KMC). Therefore, there will be no effect on general sites condition and cleanliness of project boundaries.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 108

Solid Waste Generation

○ = No Impact



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

6.9 Wastewater Generation

Wastewater will be generated on site from domestic activities; and from construction activities; Wastewater from camp (Black water) will be stored in the septic tanks this must be transferred through tankers to the nearby located TMA disposal point. (if hazardous waste water is present). The effluent water will be transported to the evaporating pond that will be constructed temporarily within project premises. The effluent water will then be evaporated naturally. The protected fence and all other precautionary measures will be taken in place. It will be ensured that wastewater from site shall not enter into the water body. It will be ensured that wastewater from site shall not enter into the water body.

Wastewater from construction activities must be stored in the settling tanks after settling of the particles it can be re-used for the sprinkling at the connecting roads for dust supersession.

Wastewater Generation

◇ = Low Impact



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

Document Title:
Initial Environmental Examination
(IEE) 50 MW Master Green Energy
Ltd Wind Power Project in
Jamshoro, Sindh Pakistan

Consultant Name:
Renewable Resources (Pvt.)
Ltd

Project Sponsor:
Master Group

Document No
RE2/131/174/001

Document Issue
01

Date of Approval
December, 2015

Page

109

6.10 BIOLOGICAL ENVIRONMENT

6.10.1 Wetland and Wildlife Sanctuaries

Around 1967, an exploration sponsored by WWF—UK revealed that wildlife and wetlands resources in Pakistan were severely threatened and, in most areas, declining in condition. The expedition report prepared by Mountfort (1967) recommended that a range of wetland sites be declared Protected Areas. The Convention on Wetlands came into force for Pakistan on 23 November 1976. Pakistan presently has 19 sites designated as Wetlands of International Importance, with a surface area of 1,343,627 hectares.

The wetlands of Pakistan are shown in Figure 6.4.

Wetlands of Pakistan

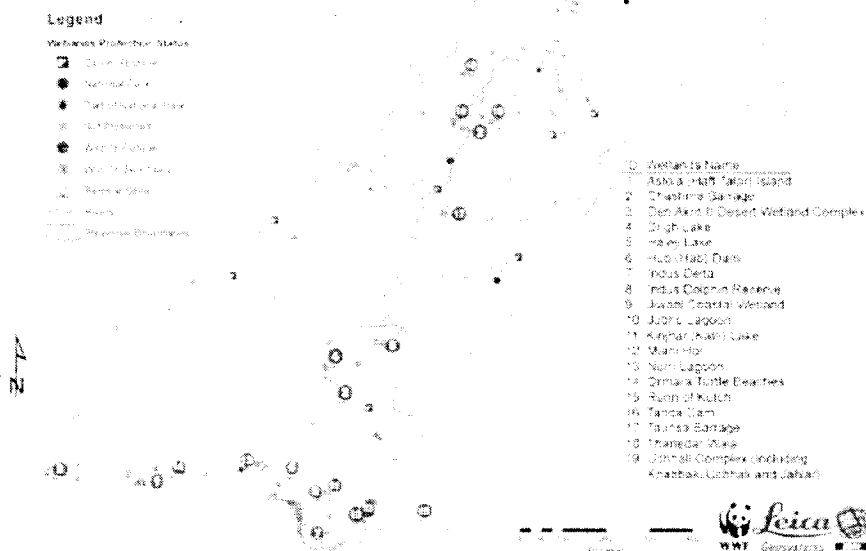


Figure 6.4: Wetlands of Pakistan⁵

⁵ www.pakistanwetland.org

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 110

Out of 19 Ramsar sites, 10 sites are located in the province of Sindh, which are shown in Figure 6.5.

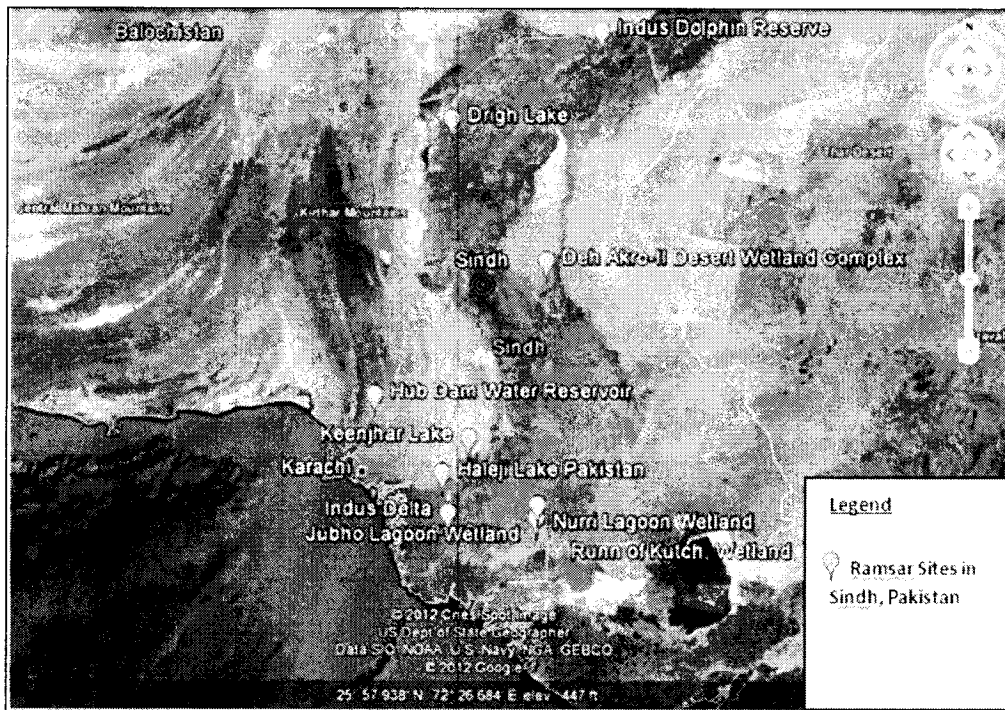


Figure 6.5: Wetland located in Sindh

Keenjhar Lake is the declared wildlife sanctuary, and the Ramsar site is located at a distance of 50 miles Approx. from the Project site. It is the largest fresh water lake in Pakistan. It is an important source that provides drinking water to Thatta District and Karachi city. This area is favored as a habitat for winter migratory birds like ducks, geese, flamingos, cormorants, shorebirds, herons, egrets, ibises, terns, coots, and gulls. It has been observed that it is the breeding area of the night heron, cotton teal, purple moorehen, and pheasant tailed jacana. The natural vegetation of the surrounding area is tropical thorn forest. The lake is rich in fish and fauna, and supports the livelihood of about 50,000 local people. Main activities at this Ramsar site are commercial fishing, nature conservation, and public recreation.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 111

6.10.2 The Indus Flyway

Pakistan is one of the principal wintering grounds for water birds in South Asia. The lakes in the Indus Valley are major refuge for the migratory water birds which breed in Northern Eurasia. Pakistan forms part of their "Indus River Green Route". When the climate in their breeding grounds in Russia becomes too rigorous and the food gets scarce, then the birds leave the place and disperse to their winter resorts further south along the following distinct flyways.

1. Northern Europe Scandinavia-North Sea.
2. Central and Southern Europe-Black Sea-Mediterranean.
3. West Siberia-Caspian Sea-Nile.
4. Siberian-Kazakhstan-Pakistan/Central Asian Flyway.
5. East Siberia- Tibet-Ganges/ East Asian- Australian Flyway.
6. Far East- Kamchatka –China / Japan. West Pacific Flyway.
7. North East Siberia- Chokotka- California / Pacific Flyway.

Most of the sub-continent's visitors come through Pakistan route to India and Sri Lanka or Africa. Majority of winter visitors to the sub-continent enter via Indus Plain. Some come down the Indus River Valley and its far northern tributaries as well as the Chenab and Jhelum rivers further east. A very significant number enter from further west coming over the Peiwar Pass and following down the Kurram River. Some of these autumn migrants fan out eastwards into Northern India and thus avoid the Rajasthan Desert to the South, while other follow the Indus River down to the Indus Delta.⁶

⁶ Roberts, T.J. 1991. The Birds of Pakistan. Volume 1. Oxford University Press, Karachi

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 112

Table 6-1: Migratory and Local Birds of Keenjhar Lake⁷

List of Migratory Birds of Keenjhar Lake	List of Local Birds of Keenjhar Lake
White pelican	Marsh Harriers
Dalmatian pelican	Ospreys
Large cormorant	Cuckoos
Grey heron	Swifts
Large egret	Swallows
Black bittern	Pigeons
Yellow bittern	Doves
Spoonbill	Parrots
Flamingo	Sandgrouses
Pintail	Mynas
Common teal	Shrikes
Mallard	Larks
Gadwall	Grebes
Wigeon	Pelicans
Garganey	Carmorants
Shoveller	Flamingos
Common pochard	Hérons and Bitterns
White eyed Pochard	Ibises and Spoonbills
Tufted duck	Ducks
Common coot	Morhens/Waterhens
Grey plover	Coots
Dunlin	Waders
Little stint	Gulls and Terns
Avocet	Babblers
Ruff	Sunbirds
Herring gull	Bushchats
Blackheaded gull	Bee-eaters
Whiskered tern	Drongos
	Crows
	Prinias
	Warblers
	Wagtails
	Sparrows
	Weaverbirds

⁷ www.wwfpak.org

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 113

6.10.3 Birds/Avian Collision

Birds can be affected by wind farm development through loss of habitat, disturbance to their breeding and foraging areas, and by collisions caused by the rotating turbine blades. Pakistan receives a large number of migratory birds from Europe and Central Asian States every year. These birds spend the winter seasons in Pakistan and go back to their native habitats in the summer. The route these birds take from Siberia to Pakistan is known as International Migratory Birds Route Number 4. It is also called the Green Route or Indus Flyway. Out of seven flyways of the world, the Indus Flyway is one of the busiest routes. Birds begin their journey in November. February is the peak time, and by March they start flying back.

At present there is no atlas available for bird migratory routes within Pakistan. However, extensive research has been done based on the literature available on bird migratory flyways and the wetlands map developed by Pakistan Wetland Organization. A map of Indus flyway also known as Green Route or Migratory Route No 4 is shown in Figure 6.6. The Indus flyway route is marked with arrows in red.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 114

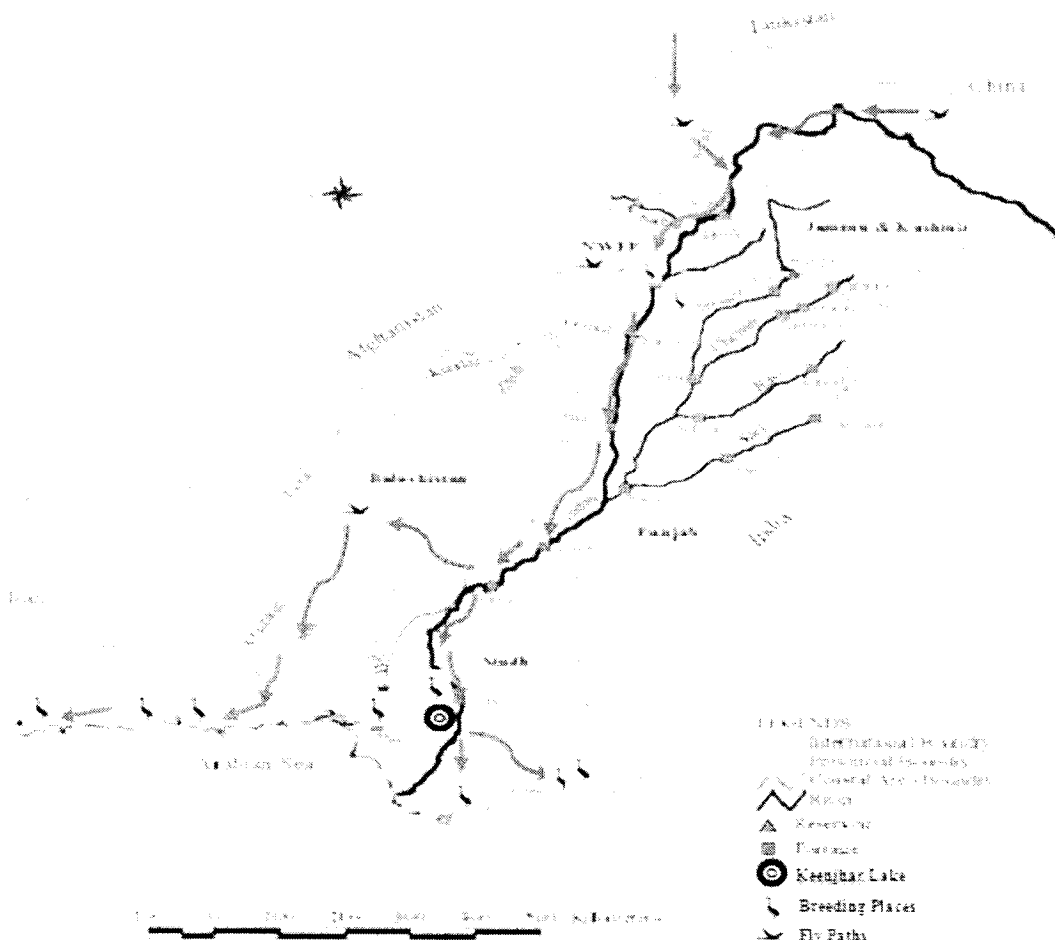


Figure 6.6: Indus Flyway for Migratory Birds/Green Route No.04

The main migrants to South during the winter season are the Water birds, Raptors, Houbara Bustard and the Passerines (Warblers, Pipits, Wagtails and Buntings).

The water birds migrate fairly large number in winter. They are very diverse group of species comprising mostly of Pelicans, Flamingo, Cormorants, Darter, Herons, Egrets, Bitterns, Storks, Ibises, Spoonbill, Ducks, Cranes, Water Cock, Rails, Crakes, Coot, Waders, Gulls and Terns.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 115

The wintering birds of Prey include: Eurasian Griffon, and Cinereous Vulture, Marsh Harrier, Montagu's Harrier, Common Buzzard, Long legged Buzzard, Booted Eagle, Greater Spotted Eagle, Steppe Eagle, Common Kestrel, Merlin and Eurasian Hobby.

A list of 236 species of birds is available, both resident and migratory, whose range of occurrence covers the most important wetland of the surrounding area of the Wind Farms in the Jhimpir Wind Corridor viz. Keenjhar Lake. The list is quite comprehensive and is based mainly on the experience gained during the water bird surveys undertaken during the last ten years. It gives an overall idea about the resident and migratory birds, many of which may be expected to be observed on their migration / local movement to and from the lake and the surrounding areas.

From the review of literature and interviews with local residents of the area, it was observed that migratory birds come and land on the Eastern side of the Keenjhar Lake, which is towards the river Indus. Whereas all the wind farm sites are located towards the West and Northwest direction of the Keenjhar Lake. The detailed view and description of the bird's living areas in Keenjhar Lake is described in Figure 6.7. It is found from the study that there is very little probability of bird hit from the wind farms as the Project is located approximately 50 km away from eastern side of Keenjhar Lake, and birds usually do not land and stay in the western part of Keenjhar Lake.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 116

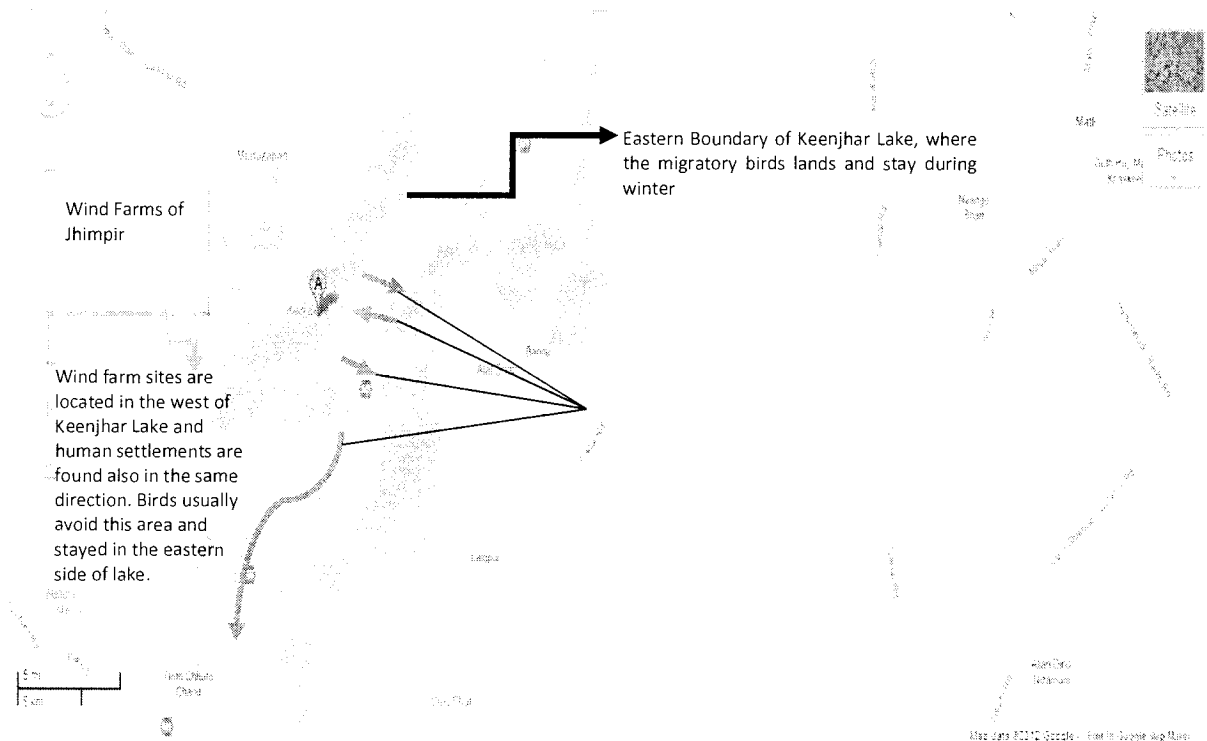


Figure 6.7: Birds Flying and Staying Patterns on Keenjhar Lake with Respect to Wind Farms

Compared to other causes of mortality among birds, the effect of wind power is relatively minor. Non-collision impacts on birds such as site avoidance and disruption of migratory behavior could also be significant. However, according to a survey conducted by WWF in 2009, the number of birds in and around Keenjhar Lake has reduced drastically in recent years. Furthermore, these birds have a tendency to fly at an altitude of 400 to 500 meters, thereby negating any chance of collision with wind towers at this specific Project site.

As a general rule, birds notice new structures and learn to avoid them in movements, thereby sustaining their ability to continue feeding and breeding in the location. Wind farm technology is new to Pakistan, but this technology has now been used in western and developed countries for over a decade. A study report (Sept. 2005) by the U.S Government Accountability Office (GAO) on the effects of wind energy development on wildlife determined that fewer birds fly into wind turbines than is generally thought.

Although several hundred utility-scale wind farms currently operate across the United States, such problems appear to be limited to two project areas, according to the report. In the context

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 117

of other sources of avian mortality, it does not appear that wind power is responsible for a significant number of deaths, the report states in its conclusion⁸.

The impact of wind energy development on bird populations came to prominence due to the high number of mortalities associated with one of the world's largest wind farm developments in California's Altamont Pass.⁹ This wind farm had up to 5,600 wind turbines in operation and is located in a year-round, high activity, area for raptors. Additional factors included prey abundance; high-speed rotor blades; lattice tower structures, which provided horizontal cross-bars for perching; rapid blade movement; and the close proximity of turbines.

Another research cited by the European Wind Energy Association shows that the risk of bird deaths through collision with wind turbines is low. For example, it is estimated that 33,000 birds are killed annually by wind turbines operating in the U.S., an average of 2.2 fatalities for each of the 15,000 turbines.

In Spain, a study showed 0.13 dead birds per year per turbine. Furthermore, in the U.S., over 100 million birds are estimated to die each year from colliding with vehicles, buildings, power lines, and other structures, with wind power responsible for just 1 out of every 5,000 – 10,000 avian fatalities.

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.

However, due to the minimal expected impact of bird's collision with the wind turbines, the following mitigation measures are proposed:¹⁰

The wind towers to be erected minimum at a distance of 300 meters to avoid the avian collision and to give the birds a wider corridor for access in the Project area

- Regular checking of the vacuums or holes in the towers to avoid nesting facility of any of the birds monitoring the birds during the migratory season be undertaken to record their distribution and migratory pattern and use of the area during the season.
- Hunting, feeding or harassment of wildlife is strictly prohibited during the entire course of construction and operation phases.

⁸<http://www.gao.gov/new.items/d05906.pdf>

⁹American Wind Energy Association: Facts about Wind Energy & Birds, 5pp.-Internet Article

¹⁰ Ghalib, S.A., Khan, M.Z., Ahmed, S.M., Begum, A., Hussain, B. and Ahmed, W. 2014. Study of the Wildlife of Jhimpir Wind Corridor, district Thatta, Sindh and Development of Bird Monitoring Strategy in the Area. African Journal of Science and Research. 6(3) : 01-09.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 118
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- Food wastes not to be disposed of in the open. Food wastes collected in waste segregation unit is disposed of according to waste disposal procedure on a regular and strict basis.
- Night work during construction be prohibited, night travelling not be allowed unless absolutely necessary.
- Operation camp is located 500m away from perennial water bodies.

Impact on Migratory Birds	 = No Impact
Impact on Local Birds	 = Low

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 119

6.10.4 Flora and Vegetation

As there is no dense vegetation or forestation in the Project site area, there will be no damage to any kind of vegetation or forests. However, it is anticipated that once the Project is operational, new plants shall be re-planted in the empty spaces around wind turbines. Enough space will be allocated for green belts.

Impact on Flora and vegetation	 No Impact
--------------------------------	---

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

6.11 SOCIO ECONOMIC ENVIRONMENT

6.11.1 Archeological Sites

No archaeological sites are present near the Project site.

Archeological Sites	 Regionally Favorable
---------------------	--

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 120

6.11.2 Re-Settlement

Project is located on Government land leased by the Government of Sindh. The settlements are located outside of project boundary; there are some seasonal houses located near the project boundary which will not be affected, and no resettlements are required. However, any involuntary resettlements, if required, will be done as per IFC performance standard PS-5.

Resettlement	 = Low Impact
--------------	--

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 121

6.11.3 Visual Impact on Landscape

The addition of the Project to the local landscape will have a significant visual impact, as it would be the first such structure in Pakistan. In European countries, wind turbines are considered to give insignificant visual impact due to the fact that wind power technology is very common there and large numbers of wind turbines are installed. But as far as Pakistan is concerned, wind power is an emerging technology for local inhabitants, and it would give a noteworthy positive visual impact.

Visual Impact on Landscape	 = Regionally Favorable
----------------------------	--



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 122

6.11.4 Aviation Hazard

No aviation hazard will be created by the Project as it is located 140km 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
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

6.11.5 Traffic Management

The impact on traffic will be minimal and 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 population and/or endanger public safety.

Traffic Management	 = Low
--------------------	---

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 123

6.11.6 Labor Welfare and Safety

Large amounts of labor will be deployed during construction. The labor camps need to provide proper water supply and sanitation facilities (toilets with septic tanks). Otherwise insects 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. Local will be preferred for the unskilled jobs, to reduce potential of the spread of STI/STD disease. Overall impact will be low.

Labor Welfare & Safety	 = Low
------------------------	---



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 124

6.11.7 Seismic Hazards

The damage zone classification of the 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 Hazards	 =Low
-----------------	--



=High



=Medium



=Low



=No Impact



=Locally Favorable



=Regionally Favorable

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 125

SECTION 7

PUBLIC CONSULTATION

7 PUBLIC CONSULTATION

This section provides the details of the consultation meetings held with stakeholders as part of the environmental and social soundness assessment process requiring information disclosure and sharing. For this purpose consultation meetings were held at the outset for the scoping process of IEE study, followed by a series of meetings at the proletarian level. Dr. Syed Ali Ghalib and our team member Mr. Farooq Ali Khan (RE2) has perform the consultations with different departments and officials. These stakeholders are the different government officials and NGOs like IUCN Pakistan, WWF department, Karachi (Senior Director, Mr. Rabnawaz), SEPA representative (Dr. Aashiq Hussain Langah), Sindh Wildlife department Hyderabad office (Mr. Ghulam Muhammad Gadani, (Deputy Conservator Wildlife), Sindh Forest department, Karachi (Divisional Forest officer), Archeological department, Karachi.

7.1 Objectives of Public Consultation

The overall objectives of the consultation process were as follows:

- To inform all interested people on the likely positive and negative effects of the wind power proposed project and encourage feedback from stakeholders on IEE findings, principally the impacts and proposed mitigation measures;
- To gain a consensus on the impacts identified, their importance and the relevance and effectiveness of the mitigation measures proposed;
- To provide confidence that all relevant issues and mitigation measures have been identified, agreement that the mitigation measures are adequate, and that nothing significant has been missed;

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 126
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- To enable incorporation of stakeholder views and concerns in the IEE.

7.2 Consultation Process

7.2.1 Scope

The social survey team conducted meetings and interviews with local communities. During these meetings a description of the project was given along with an overview of the projects likely social and environmental impact.

7.2.2 Community Consultation

Community consultations consisted of formal and informal meetings at Jamshoro residential area, and project vicinity. The consultation exercise was conducted in both Sindhi and Urdu languages. A non-technical oral description of the project was given providing an overview of all likely positive and negative impacts. Following which, an open discussion was held so that the participants could voice their concerns and opinions. All participants were encouraged to voice their concerns and opinions. Participants were also asked to suggest alternatives where they had particular concerns.

Feedback obtained from the stakeholders was documented, and all issues and suggestions raised were recorded in survey forms. Both social and environmental issues were raised.

The people interviewed (Table 7-2) had worries /concerns related to basic needs and generally agreed that most of the effects would be temporary only during construction. Some common concerns regarding the lack of educational facility, shortage of clean drinking water, lack of basic health unit, lack of waste disposal, lack of electricity, poor roads condition and minimal employment opportunities issues were raised. None of these issues related specifically to proposed wind power project but were general complaints. Most of the participants appreciated the project and said that it would boost the local employment opportunities, while some said that business and economic situation in the area will also improve.

A matrix of concerns by community members was prepared as given in Table 7-1. The register of attendance is provided as Table 7-2. A pictorial record of the meetings is included as **Annexure XI**.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 127

Table 7-1: Summary of Concerns Raised during Stakeholder Consultation

Issues	Concerns raised by community	Remarks
Health Care Facilities	Healthcare centers particularly for women and children Schools	Basic health unit is available in the Jhimpir with very little facilities, A dispensary may be provided.
Employment	Provision of semi-skilled and unskilled jobs for local labor in the project construction period.	Unskilled jobs will be given to locals people where possible. Training will be provided.
Safety of Community	Comply with the traffic management rules.	Proper traffic management will be resorted to during the construction period.
Drinking water	Community member rated Safe drinking water at highest priority during our survey.	As part of the Social development program GEL shall provide the safe drinking water through RO filter plant to nearby communities
Educational Facility	Unavailability of Teachers, and School (Primary and Secondary) Vocational training	NGO working in social sector and proponent shall provide the required facilities for the local peoples.
Other issues	Black top link roads	Linking roads will be developed as part of the project component will benefit the local residents as well.

Document Title:
Initial Environmental Examination
(IEE) 50 MW Master Green Energy
Ltd Wind Power Project in
Jamshoro, Sindh Pakistan

Consultant Name:
Renewable Resources (Pvt.)
Ltd

Project Sponsor:
Master Group

Document No
RE2/131/174/001

Document Issue
01

Date of Approval
December, 2015

Page

128

Table 7-2 General Public Interviewed during Public Consultation at Jamshoro

S.N O	NAME	OCCUPATION	LOCATION
1	Nooh Khan	Labour	Goth Soomar Khan
2	Gul Hassan	Labour	Goth Soomar Khan
3	Wali Muhammad	Labour (Driver)	Goth Soomar Khan
4	Abdul Nabi	Labour	Goth Soomar Khan
5	Fatehi	House wife	Goth Soomar Khan
6	Khanzadi	House wife	Goth Soomar Khan
7	Gulab Khan Hasan	Labour	Goth Soomar Khoso
8	Karim Buskh	Labour	Goth Nawab Khoso
9	Ali Sher	Labour	Goth Nawab Khoso
10	Ameer Zad	Labour	Goth Nawab Khoso
11	Nabi Bushk	Labour	Goth Nawab Khoso
12	Shah Murad	Labour	Goth Nawab Khoso
13	Zulfiqar Khoso	Labour	Goth Nawab Khoso
14	Murad Khan	Driver	Goth Nawab Khoso
15	Tour Khan	Unemployed	Goth Nabi Buskh Khoso
16	Fayaz Khan	Student	Goth Nabi Buskh Khoso
17	Niaz Ahmed	Teacher	Goth Nabi Buskh Khoso
18	Maqbool Ahmed Khoso	Labour	Goth Khando Khan Khoso
19	Rasool Buskh	Labour	Goth Khando Khan Khoso
20	Saleem	Unemployed	Goth Mahram Khan

7.2.3 Government Agencies

Stakeholders including provincial government officials, international NGOs, and related stakeholders were consulted at their offices. All the stakeholders were given maximum project information and were shown a detailed map of the area. Their concerns and suggestions are reproduced below. Attendance lists of the stakeholders consulted in the proposed project was collated and reproduced in Table 7.3. Pictures of the meetings are provided in **Annexure- XII**.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 129

a) Environmental Protection Agency (Karachi Head Office) (Director Technical EIA/IEE)

The Karachi head office of EPA is responsible for general environment protection in the project area. A meeting was held on January, 28, 2016 with the Mr. Aashiq Hussain Langah (Director EIA) and Mr. Waris Gabool (Deputy Director Technical). The project team provided information about the proposed project site with the help of the project area map and briefed about the salient features of the project and requested the officers that express their views /suggestion and concerns of the Department. Their views concerns / suggestions are re-produced as follows;

- ❖ Analyze Cumulative effect on community.
- ❖ Attach the following documents with IEE report.
- ❖ Land Lease Document.
- ❖ Approvals from Energy Department.
- ❖ NOC from DC (Deputy Commissioner) of the concern area.
- ❖ LOI Copy.
- ❖ NOC from Wildlife.
- ❖ Laboratory test for air, noise, surface and ground water must be attached with IEE report.
- ❖ Flora and Fauna survey report must be attached with IEE report.
- ❖ Drinking water availability shall be ensured by the proponent throughout the project period.
- ❖ Project activities will support the area at large, and activities will not cause any harm.

b) Sindh Wild Life Department (Conservator)

A consultation meeting was held on February 02, 2016 with Mr. Ghulam Muhammad Gaddani Conservator Wildlife Department at his Hyderabad office along with his team. The project team provided information about the proposed project site with the help of the project area map and requested the officers to identify any protected wildlife sanctuary or other concerns of the Department. During the meeting the Conservator expressed his views regarding the project and overall appreciated project activities. Their views and concerns / suggestions are re-produced as follows;

- The Project Area does not fall in to the limits of any designated Protected Area.
- Mr. Ghulam Muhammad Gaddani along his team identified that the wildlife is very scarce in the Project Area as the area is an open desolate land devoid of ample vegetation and favorable area for the wildlife species.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 130

- The area does not fall on the Indus Flyway, as the River Indus is about 30 km away from the site. Moreover there are no water points in the area serving as staging areas for the water birds.
- He also proposed that to provide the basic facilities to the communities like School, clean drinking water and sanitation etc.

c) Sindh Forest Department (Karachi Office)

A consultation meeting was held on January 26, 2016 with Divisional Forest Officer Mr. Shahzad Sadiq Gill, Range Forest Officer Mr. Tahir Latif, Range Forest Officer Mr. Raja Karim and Sub.Division Forest Officer Mr. Rab Dino Khatti at his Karachi office along with his team. The project team provided information about the proposed project site with the help of the project area map and requested the officers to identify any protected wildlife sanctuary or other concerns of the Department. During the meeting the forest officers expressed his views regarding the project and overall appreciated project activities. They do not have any issue / objection with the project in Jamshoro. As they know that this is the barren land and there is very rare vegetation or even no vegetation. Only the concern was, Euphorbia (Tree species) is very common in that area, so be careful with the removal.

7.2.4 Non-Governmental Organizations

A number of NGO's, other than the government sector were consulted for the proposed projects who are highly involved in protection of wildlife and nature conservation.

a) International Union for Conservation Nature IUCN

A consultation meeting was held on January 28, 2016 with Mr. Muhammad Tahir Qureshi Senior Coastal Ecosystem Advisor and Mr. Kamran Ahmad Naqvi Urban Specialist Technical at IUCN Karachi Office. RE2 team provided information about the proposed project site with the help of the project area map and requested the experts to share their views or other concerns of the IUCN as expert. During the meeting the Mr. Qureshi and Mr. Kamran expressed their reservation regarding the project. Their views and concerns / suggestions are re-produced as follows;

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 131

- Care may be taken to avoid removal of native vegetation particularly *Euphorbia caducifolia*.
- Employment opportunities shall be provided locals must be preferred in the unskilled jobs under social development program of proponent.
- Mr. Qureshi said that sustainable development shall be carried out.
- They also suggested that development should be sustainable.

b) WWF (World Wide Fund)

A consultation meeting was held on January 22, 2016 with Senior Director WWF-Pakistan Mr. Rab Nawaz and Technical Advisor WWF and Ex. DG Marine Fisheries department Mr. Mohammad Moazzam Khan. RE2 team provided information about the proposed project site with the help of the project area map and requested the experts to share their views / concerns / suggestions as the expert conservationist. Mr. Rab Nawaz and his team supported and appreciated the project activities; they do not have any objection / issue even they are well satisfied with the green energy project and the way the consultant (RE2) making consultation with all concern departments.

c) List of Public and NGO Sector Stakeholder Consulted

A number of stakeholders, other than the general public, who are likely benefitted be involved during the project execution phase, were also consulted (Table- 8.3)

Table 8.2 List of Public and NGO Sector Stakeholders

Name of Stakeholder Representative	Type of Stakeholder	Department / Occupation/ Designation
Mr. Aashiq Hussain Langah	Sindh EPA	Director (EIA)
Mr. Waris Gabool	Sindh EPA	Deputy Director Technical
Mr. Ghulam Muhammad Gadani	Sindh Wildlife Department	Deputy Conservator Wildlife
Mr. Tahir Qureshi	IUCN	Senior Coastal Ecosystem Advisor
Mr. Kamran Ahmad Naqvi	IUCN	Urban Specialist

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 132

Name of Stakeholder Representative	Type of Stakeholder	Department / Occupation/ Designation
Muhammad Moazzam Khan	WWF	Technical Advisor & Ex. DG Marine Fisheries department
Mr. Rab Nawaz	WWF	Senior Director
Mr. Shahzad Sadiq Gill	Sindh Forest department	Divisional Forest Officer
Mr. Tahir Latif	Sindh Forest department	Range Forest Officer
Mr. Raja Karim	Sindh Forest department	Range Forest Officer
Mr. Rab Dino Khatti	Sindh Forest department	Sub. Division Forest Officer

Mitigation Measures:

The following mitigation measures have been suggested.

1. Disturbance to the habitat of the Indian spiny tailed Lizard be minimized / controlled.
2. As far as possible, the burrows / holes of the lizard are safeguarded against any developmental activity. The animals are specially protected during the construction phase.
3. Monitoring the birds during the migratory season be undertaken to record their distribution and migratory pattern and use of the area during the season.
4. Hunting, feeding or harassment of wildlife is strictly prohibited during the entire course of operation.
5. Vegetation clearing and land uptake during the operation be minimized.
6. Development of new access tracks during operations is minimized.
7. Routes involving minimum clearing of vegetation are selected.
8. Operation must avoid disturbing live bird nests and small mammal and reptile holes.
9. Food wastes not to be disposed off in the open. Food wastes collected in waste segregation units is disposed off according to waste disposal procedure on a regular and strict basis.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 133

10. Night work during construction be prohibited, night traveling not be allowed unless absolutely necessary.
11. All mitigations related to minimizing noise are adhered to.
12. Construction work near areas which show small mammal and reptile populations should commence after a soft start up and be randomly monitored.
13. Vehicle speeds on access road be controlled to avoid incidental mortalities of reptiles. Any such incident is reported and vehicle speeds be randomly checked.
14. Movement of all project personnel is restricted to work areas.
15. Movement of project vehicles is restricted only to the project access road or to routes approved.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December,2015 Page 134
--	---	--	--

SECTION 8

ENVIRONMENT MANAGEMENT PLAN

8 ENVIRONMENT MANAGEMENT PLAN

8.1 PURPOSE AND OBJECTIVE OF EMP

The purpose of Environmental Management Plan (EMP) is to provide a summary of the predicted impacts associated, mitigating measures and monitoring actions so as to minimize potential negative impacts and enhance positive impacts from the Project. The EMP will provide a guide (almost checklist) for the main stakeholders, namely the owner, contractor and operator of the Wind Power Project, on what mitigating actions need to be taken and where and when they are needed. It will thus help to improve the likelihood that adverse impacts are mitigated, project benefits are showcased, and an environmentally beneficial standards of best practice is provided to all those involved. In particular, the EMP:

- ❖ Defines roles and responsibilities for those involved in the implementation of the EMP and identifies areas where these roles and responsibilities can be shared with other stakeholders
- ❖ Define the implementation mechanism for the mitigation measures identified during the present study.
- ❖ Provides concise instructions to project personnel and contractors regarding procedures for protecting the environment and minimizing environmental impact, making these legally binding through their inclusion in contract specifications
- ❖ Defines the requirements for communication, documentation, training, management and implementation of the mitigating measures; and,
- ❖ Specifies actions required to assess compliance with and effectiveness of the mitigation measures through compliance and effects monitoring mechanism, defined in the EMP's two action tables.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 135

8.2 COMPONENT OF EMP

The EMP consists of the following:

- Institutional Arrangements
- Mitigation and Monitoring plan
- Grievance Redressing Mechanism
- Reports and Documentation
- Environmental and social trainings
- Public disclosure requirements
- Budgetary estimates for EMP implementation

All the components of EMP are discussed from Sections 8.3 to 8.9

8.3 INSTITUTIONAL ARRANGEMENT

8.3.1 PROJECT DEVELOPER

The Project Developer (i.e. MGEL) is the 'owner' of the project and as such is responsible for ensuring that the conditions of the environmental authorization issued in terms of Sindh Environmental Protection Act, 2014 (should the project receive such authorization) are fully satisfied, as well as ensuring that another necessary permits or licenses are obtained and complied with. It is expected that the Project Developer will appoint the contractor, and the consultant.

Master Green Energy Limited (MGEL) will establish an Environment & Social Management Cell (ESMC) at Corporate and site level, headed by a Project Director to be responsible for day-to-day implementation of the Project. Master Green Energy Ltd is responsible for undertaking the Project in accordance with the Environmental Impact Assessment (EIA) and implementing the Environmental and Social Management Plan, which will be consistent with the standards set by IFC and World Bank Group.

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 MGEL to

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 136
--	---	--	---

look after environmental, social and safety issues. The ESMC will be empowered to implement safeguard planning and monitor implementation.

The safeguard specialist provides guidance to the Project Manager and his staff to adopt environmental good practices while implementing the Project. The safeguard specialist is responsible for implementing safeguard issues associated with the Project through a site team composed of Master Green Energy Ltd (MGEL) site staff and the contractor's staff, to be assigned by the ESMC as necessary.

The duties of the Environmental and Social Unit of the ESMC at the 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.
- Advise and coordinate field unit activity towards effective environment management.
- Prepare environment health and safety manual for the operation of transmission lines/substations.
- Advise during Project planning/design and 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 the site level are to:

- Implement the environment policy guidelines and environmental best practices at the sites.
- Advise and coordinate the contractor(s) activity towards effective environment management.
- Implement environment and safety manual.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 137

- Carry out environmental and social survey in conjunction with the 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.

8.3.2 Supervision Consultant (RE)

The supervision consultant / Project Monitoring Consultant (PMC) (RE) has qualified environment health and safety staff on board to which will be responsible for overseeing the implementation of the EMP during the construction.

8.3.3 Lead Contractor

The contractor will be responsible for the following:

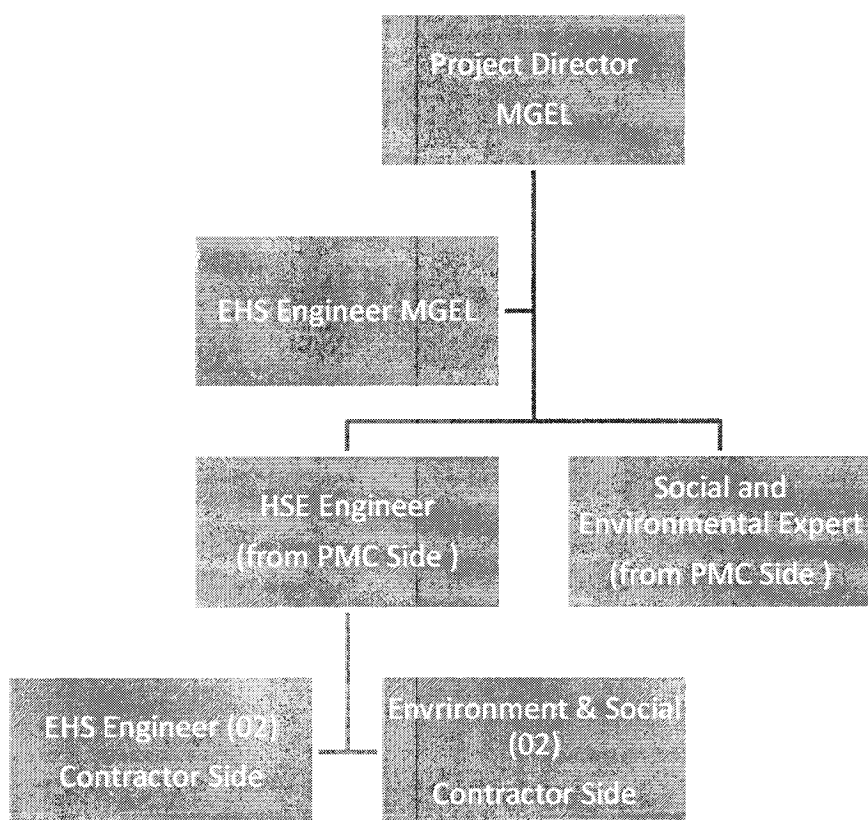
- ❖ Overall construction program, project delivery and quality control for the construction for the wind project.
- ❖ Overseeing compliance with the Health, Safety and Environmental Responsibilities specific to the project management related to project construction.
- ❖ Promoting total job safety and environmental awareness by employees, contractors and sub-contractors and stress to all employees and contractors and sub-contractors the importance that the project proponent attaches to safety and the environment.
- ❖ Ensuring that each subcontractor employ an Environmental Officer to monitor and report on the daily activities on-site during the construction period
- ❖ Ensuring that safe, environmentally acceptable working methods and best practices are implemented and that sufficient plant and equipment is made available properly operated and maintained, to facilitate proper access and enable any operation to be carried out safely.
- ❖ Meeting on site with the Environmental Officer prior to the commencement of construction activities to confirm the construction procedure and designated activity zones;
- ❖ Ensuring that all appointed contractors and sub-contractors are aware of this
- ❖ Environmental Management Plan and their responsibilities in relation to the plan;
- ❖ Ensuring that all appointed contractors and sub-contractors repair, at their own cost, any environmental damage as a result of a contravention of the specifications contained

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 138

in the Environmental Management Plan, to the satisfaction of the Environmental Officer.

At the time of preparing this draft EMP, the appointment of a lead contractor has not been made and will depend on the project proceeding to the construction phase.

The Framework of Environment and Social Management Cell are shown in **Figure8.1** and Key responsibilities of ESMC are summarized in **Table7.1**.



Environment and Social Management Cell (ESMC)

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 139

8.4 MITIGATION & MONITORING 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 the 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 and Monitoring Plan (EMMP) for construction and operation phase is given in Annexure-I.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 140

8.5 GRIEVANCE REDRESSAL MECHANISM

Environmental and social grievances will be handled in accordance to the Project Grievance Redress Mechanism. Open and transparent dialogue will be maintained with Project affected persons as and when needed, in accordance with ADB safeguard policy requirements. The Grievance Redress Mechanism (GRM) for the Project provides an effective approach for complaints and resolution of issues made by the affected community in a reliable way. This mechanism will remain active throughout the life-cycle of the Project.

Master Green Energy Ltd shall have a standard mechanism to:

- i. inform the affected people (AP) about GRM and its functions;
- ii. set the procedures and mechanisms adopted for making the complaints;
- iii. support the complainants in communicating their grievance and attending the GRM meetings; and
- iv. Implement compliance with a GRMs' decision, its monitoring and communication to the people.

Under the GRM, the ESMC will maintain the Social Complaint Register (SCR) at the sites to document all complaints received from the local communities or any other stakeholder. The information recorded in the Register will include the date of the complaint, particulars of the complainant, description of the grievance, actions to be taken, the person responsible to take the action, follow up requirements and the target date for the implementation of the mitigation measure. The register will also record the actual measures taken to mitigate these concerns.

As soon as a complaint is received, the ESMC will determine the remedial action. If required, consultations will also be undertaken with the contractor's site manager. Once the remedial action is decided, implementation responsibility as well as schedule will be determined.

The proposed remedial action will be documented in the SCR, with complete details (by whom and by when). The proposed remedial action will be shared with the complainant. Similarly, the actual action taken will also be documented in a register and shared with the complainant. The complainant's views on the remedial action taken will also be documented in the register.

The SCR will be reviewed during the fortnightly meetings at the site during the Project, and the action items discussed. The progress on the remedial actions will also be reviewed during the meetings.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December,2015
	Project Sponsor: Master Group	Document Issue 01	Page 141

8.6 REPORTS AND DOCUMENTATION

The ESMC will produce periodic reports based on the information collected. These will include reports for:

- ❖ Project initiation meetings with each contractor
- ❖ Non-compliances
- ❖ Effects monitoring
- ❖ Summary of SCR under GRM

The reports will also be made available for review, to the external monitoring teams, and to any other stakeholders who visit the site. In addition, the Social and Environmental Monitoring expert will prepare reports for each monitoring visit.

At the end of the Construction Phase, a final report will also be prepared.

8.7 ENVIRONMENTAL AND SOCIAL TRAININGS

Environmental and social trainings will help to ensure that the requirements of the EIA and EMP are clearly understood and followed by all Project personnel throughout the Project period. The primary responsibility for providing training to all Project personnel will be that of the ESMC.

The environmental and social training program will be finalized before the commencement of the Project, during the detailed design phase. The training will be provided to the MGEL staff, the construction contractors, and other staff engaged for the Project. Training will cover all staff levels, ranging from the management and supervisory to the skilled and unskilled personnel. The scope of the trainings will cover general environmental awareness and the requirements of the EIA and the EMP, with special emphasis on sensitizing the Project staff to the environmental and social aspects of the area.

During the O&M phase of the Project, these trainings will continue to be conducted by ESMC for all relevant staff of the Company.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 142
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8.8 PUBLIC DISCLOSURE REQUIREMENTS

Master Green Energy Limited will disclose this IEE and EMP to all the stakeholders before the commencement of the proposed Project. The IEE report will be made available to the stakeholders at the sites designated by the EPA, in accordance with the national legislation (PEPA 1997) and Sindh EPA Act 2014. In addition, the executive summary of the IEE will be translated into the local (Urdu / Sindhi) languages (if necessary), and made available to the affected communities (and also kept at the Project site). This will ensure that the local communities are aware of the Project, its key impacts, the mitigation measures and the implementation mechanism. In addition, the Executive Summary will be disclosed through the MGEL official website.

8.9 COST ESTIMATES FOR EMP IMPLEMENTATION

The cost of implementation of the environmental safeguards includes both the direct cost of the mitigation measures and the costs of monitoring the execution of the EMP such as laboratory costs and monitoring visits, training costs, etc. Contractor cost to be included in the BOQ items, while MGEL cost shows the environmental monitoring / training cost that will be borne by the MGEL through the EMSC. Detailed cost is shown in Annexure –II.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 143

SECTION 9

INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

9 INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

The field studies were conducted for preliminary scoping, survey, and assessment activities and in order to coordinate the field survey and analysis.

A questionnaire was developed to assess the general concerns of the local residents of nearby villages in respect of this Project. Mr. Umair Ali Khilji of Renewable Resources Pvt. Ltd himself filled the questionnaires after directing the questions to the native people. Snapshots of consultative meetings are also attached in **Annexure-XI**.

During the construction phase, residents of the local areas selected representatives, local councilors, and informal community leaders, including members of NGOs, will be asked to state their current perceptions of priorities for improvements to the urban environmental infrastructure in their areas and the likely impacts of the Project during construction and operation phases.

The stakeholder consultation is a continuous process, and should be maintained throughout the Project. The consultations carried out during the present IEE and reported in this Chapter are essentially a first step in this process.

During the present IEE, the stakeholder analysis was carried out to identify relevant stakeholders on the basis of their ability to influence the Project or their vulnerability to be negatively impacted from it. This approach ensured that no relevant groups were excluded from the consultations, and appropriate engagement strategies were developed for each stakeholder.

During the stakeholder consultations carried out in the communities near the proposed site, the participants were first provided the salient information about the proposed Project.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 144

Since the Project would not directly affect them, the villagers generally did not have any apprehension or reservation about the Project. On the contrary, they expected that the Project would bring employment and small business/trade opportunities for the local population.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 145

SECTION 10

CONCLUSION AND RECOMMENDATION

10 FINDING AND RECOMMENDATION

Prime benefit of the Project will be the replacement of conventional power generation with renewable energy. Wind energy will replace fossil fuel powered generation, and therefore reduce suspended particulate matter and greenhouse gas emissions into the atmosphere.

Impacts are manageable and can be managed cost effectively - environmental impacts are likely to result from the proposed 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 covered with shrubs, thus there is no need for removal of any significant vegetation for the construction of the wind power Project.

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

- ❖ Significant improvement in the economic activities in the surrounding areas due to generation of direct and indirect employment opportunities.
- ❖ The Project Area does not fall under any sensitive, protected area.
- ❖ No threatened / Near-Threatened species of wildlife was recorded in the Project Area.
- ❖ There is negligible removal of trees for the Project, which is the main positive impact to the proposed Project area.
- ❖ Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, black smoke,

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd Project Sponsor: Master Group	Document No RE2/131/174/001 Document Issue 01	Date of Approval December, 2015 Page 146
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vibration are the short term negative impacts due to proposed Project with mitigations being properly taken care.

Proper GRM will have to be implemented by Master Green Energy Limited 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 Master Green Pvt. Ltd (MGEL) 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 Master Green Energy limited (MGEL), 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. At least, one year bird monitoring is recommended to compile substantive data about the impacts of wind power plants on the birds and other important wildlife of the area.

The environment and social impact associated with the 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.

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 an options 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 movement of soils.

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

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document Issue 01	Page 147

The project has been discussed with local people, government officials and NGO. The consultations elicited general support for the project. There were no serious environmental issues raised or matters that the Consultant had overlooked. The main concerns expressed were to ensure that local people got employment on the project and that measures were in place to avoid excessive noise or dust and bird mortality.

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. 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 Ltd adverse environmental and social impact which can be mitigated following the EMP & shall be pollution free Renewable source of Power generation with low Environmental foot prints.

This IEE study concludes that the proposed Wind project will not lead to significant adverse environmental and social impacts of such nature or magnitude that would require a more detailed report 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.

Document Title: Initial Environmental Examination (IEE) 50 MW Master Green Energy Ltd Wind Power Project in Jamshoro, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/174/001	Date of Approval December, 2015
	Project Sponsor: Master Group	Document issue 01	Page 148