METRO WIND POWER LIMITED

7th Floor, Al-Tijarah Centre, 32-1-A, Block 6, P.E.C.H.S. Main Shahra-e-Faisal Road, Karachi-75400 – Pakistan
Phone +92 21 34540270-73 Ext. 112 Fax +92 21 34540274

Date: 27 April 2017

THE REGISTRAR
National Electric Power Regulatory Authority,
NEPRA Tower, Attaturk Avenue (East)
G-5/1,
Islamabad

SUBJECT: APPLICATION FOR THE GRANT OF A GENERATION LICENSE ON BEHALF OF METRO WIND POWER LIMITED IN RELATION TO ITS 60 MW WIND POWER GENERATION PROJECT TO BE LOCATED AT JHIMPIR, DISTRICT THATTA, PROVINCE OF SINDH

I, **DANISH IQBAL,** being the duly authorized representative of Metro Wind Power Limited (a company incorporated under the laws of Pakistan with its registered office located at Karachi) hereby, certify that the Generation License Application dated 27 April 2017 and the documents in support thereof have been prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Generation) Rules 2000, and I undertake to abide by the terms and provisions of the same.

I further undertake and confirm that the information provided in the attached documents in support is true and correct to the best of my knowledge and belief.

Sincerely,

For and on behalf of
METRO WIND POWER LIMITED

DANISH IQBAL
CHIEF EXECUTIVE

METRO WIND POWER LIMITED

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EXTRACT OF THE CIRCULAR RESOLUTION PASSED BY THE BOARD OF DIRECTORS OF METRO WIND POWER LIMITED ON 19 APRIL 2017

The following Resolutions were passed by the Board of Directors of Metro Wind Power Limited through Circulation on 19 April 2017:

RESOLVED THAT the Company do file an application to the National Electric Power Regulatory Authority for seeking a generation license for the 60 MW wind power project to be constructed at Jhimpir, pursuant to and under Sections 7(2)(a) and 15 of the NEPRA Act read with other enabling provisions of the NEPRA Act, the National Electric Power Regulatory Authority Licensing (Application & Modification Procedure) Regulations 1999, National Electric Power Regulatory Authority Licensing (Generation) Rules 2000, and in accordance with the Policy for Development of Renewable Energy for Power Generation 2006.

FURTHER RESOLVED THAT Mr. Danish Iqbal, Chief Executive of the Company and Mr. Saad Iqbal, Director of the Company, be and each of them are hereby authorized to singly do, execute, transact and perform for and on behalf and in the name of the Company all such acts deeds and things as may be necessary or required or desirable to be done or executed by the Company for or in connection with or in relation to the application to the National Electric Power Regulatory Authority for seeking a generation license under the NEPRA Act and without limiting the generality of the foregoing and in connection therewith to do any or all of the following acts deeds and things, namely, to file, withdraw or re-file applications, swear affidavits, review documents and information, make correspondence, letters, submissions, claims, objections of all kinds and to file or submit them before the National Electric Power Regulatory Authority, either themselves or through an authorized person or attorney, and to appear and represent the Company before the National Electric Power Regulatory Authority or any other regulatory authority or body and to accept the terms and conditions on which a Generation License is granted by the National Electric Power Regulatory Authority.

CERTIFICATION

CERTIFIED, that, the above resolution was duly passed by the Board of Directors of Metro Wind Power Limited through Circulation, on 19 April, 2017.

FURTHER CERTIFIED, that the said resolution has not been rescinded and is in operation and that this is a true copy thereof.

Danish Iqbal
Chief Executive Officer
Metro Wind Power Limited

A010487

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, KARACHI

CERTIFICATE OF INCORPORATION

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

Corporate Universal Identification No. **0094947**

I hereby certify that **METRO WIND POWER LIMITED** is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is **limited by shares.**

Given under my hand at **Karachi** this **Twenty Seventh** day of **August,** Two **Thousand** and **Fifteen**.

Incorporation fee Rs. **52,000/=** only

(Saghir Ahmed Hashmi)
Joint Registrar of Companies
Karachi

Certified to be True Copy

Joint Registrar of Companies

30/5/16

Securities & Exchange Commission of Pakistan
SECP

The Companies Ordinance, 1984
(Company Limited By Shares)

ARTICLES OF ASSOCIATION

OF

METRO WIND POWER LIMITED

PRELIMINARY

1. The regulations contained in Table A in the First Schedule to the Companies Ordinance, 1984, shall not apply to the Company except in so far as the same may be expressly incorporated or deemed to be incorporated in these Articles or made expressly applicable by the said Ordinance or any statutory modification thereof.

2. In these Articles, unless the context or subject matter otherwise requires:

   i. "Board" means Board of Directors for the time being.

   ii. "Chief Executive" means the Chief Executive for the time being of the Company as defined in Section 2 (1) (6) of the Ordinance.

   iii. "Company" means the METRO WIND POWER LIMITED.

   iv. "Debenture" and Debenture Holders" includes debenture/stock and debenture stock holder respectively.

   v. "Director" means a director for the time being of the Company.

   vi. "Dividend" includes bonus.

   vii. Executors include administrators.

   viii. "In Writing" and "Written" includes printing, lithography, typewriting and other modes of representing or reproducing words in a visible form.

   ix. "Modaraba", Modaraba company" and "Modaraba Certificate" have the meaning respectively assigned to them in the Modaraba Companies and

   x. Modaraba Floatation and Control Ordinance, 1980.

xi. "Month" means calendar month according to the English Calendar.

xii. The Office means Registered Office for the time being of the Company.

xiii. The Ordinance means the Companies Ordinance, 1984.

xiv. "PTC" and "TFC" means Participation Term Certificate and Term Finance Certificate respectively.

xv. "Proxy" includes Attorney, duly constituted under a Power of Attorney.

xvi. "The Register" means the register of members to be kept pursuant to Section 147 of the Companies Ordinance, 1984.

xvii. "Seal" means the Common seal of the Company.

xviii. "Special Resolution" has the meaning assigned there to by Section 2 (1) (36) of the Companies Ordinance, 1984.

xix. Securities include Shares, Modaraba Certificate, PTCs, TFCs and Debenture Certificate.

Words importing the Singular number also include, the plural number and vice versa.

Words importing the masculine gender include all other genders.

Words importing persons include firms, associations, Corporations.

Words and phrases defined in the Ordinance shall have the same meaning when used herein.

3. None of the funds of the Company shall be employed directly or indirectly in the purchase of or lent on the security of shares of the Company, and the Company, shall not except as authorised by Section 95 of the Ordinance, give any financial assistance for the purpose of or in connection with any purchase of shares in the Company.

SHARES

4. The Authorised capital of the Company is Rs. 10,000,000 (Rupees Ten Million Only) divided into 1,000,000 ordinary shares of Rs. 10/= (Rupees Ten) each. Minimum subscription at which the Directors shall allotment shall be Rs. 3,000,000.

5. The shares shall be under the control of the Directors, who may allot or otherwise dispose off the same to such persons on such terms and conditions as the Directors think fit.

6. If two or more persons are registered as joint holders of any share, any of such persons may give effectual receipts for any dividends or other moneys payable in respect of such share.

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

SHARE CERTIFICATES

8. Every person whose name is entered as a member in the register of members shall without payment be entitled to a certificate under the Seal specifying the share or shares held by him and the amount paid thereon including in particular and without limitation such legends as the Company shall be obligated to affix to certain of the certificates by law or as the Company shall have agreed to affix pursuant to any contractual arrangements in this respect. Provided that, 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 several joint holders shall be sufficient delivery to all.

9. If a share certificate is defaced, lost or destroyed, it may be renewed on payment of such fee as may be prescribed if any and on such terms, if any as to evidence and indemnity as the Directors think fit.

10. As regards allotment from time to time, the Directors shall duly comply with the provisions of Section 67 to 73 of the Ordinance.

11. Each share in the Company shall have a distinctive number.

TRANSFER OF SHARES

12. The transfer of shares shall be effected by an instrument in Writing in the usual common form, modified so as to suit the circumstances of the parties.

13. The instrument of transfer of a share shall be duly stamped and shall be executed both by the transferor and the transferee whose execution shall be attested by at least one witness who shall add his address and occupation, and the transferor shall be deemed to remain the holder of such shares until the name of the transferee shall have been entered in the Register in respect thereof.

14. Wherever shares of different classes have been issued a separate instrument of transfer shall be required for each class of shares unless the Directors resolve otherwise.

15. The Directors may decline to recognize any instrument of transfer, unless the instrument of transfer is deposited at the office or such other place as the Directors may appoint, accompanied by the certificate or certificates of shares to

which it relates, and such other evidence (if any) as the Directors may reasonably require to show the right of the transferor to make the transfer, and if the instrument of transfer is executed by some other person on his behalf, the authority of that person so to do.

16. If the Directors refuse to register a transfer they shall within 30 days after the date on which the transferees was lodged with the Company send to the transferee and the transferor notice of the refusal as required by the Ordinance.

17. The Directors may on giving seven days previous notice by advertisement in some newspaper circulating in the Province in which the office is situated and in the province in which the Stock Exchange on which the Company is listed is situate, close the transfer book and register of members during such time as the Directors think fit, not exceeding as a whole forty-five days in each year, and not exceeding thirty days at a time.

18. Neither the Company nor its Directors shall incur anyliability for registering or acting upon a transfer of shares apparently made by sufficient parties, although the same may, by reason of any fraud or other cause not known to the Company or its Directors, be legally inoperative or insufficient to pass the property in the shares proposed or professed to be transferred, and although the transfer may as between the transferor and transferee be liable to be set aside, and notwithstanding that the Company may have notice that such instrument of transfer was signed or executed and delivered by the transferor in blank as to the name of transferee or the particulars of the shares transferred, or otherwise in defective manner, and in every such case the person registered as transferee, his executors, administrators and assignees alone shall be entitled to be recognized as the holder of such shares and the previous holder shall, so far as the Company is concerned, be deemed to have transferred his whole title thereto.

19. The instrument of transfer of any share shall be in writing in the usual common form or in the following form, or as near thereto as circumstances will admit:

METRO WIND POWER LIMITED

I_____of_____ in consideration of the sum of Rs._____paid to me by of here in after called the said transferee, do hereby transfer to the said transferee share (or shares) numbered_____ to _____ (both inclusive) in the undertaking called METRO WIND POWER LIMITED to hold upto the said transferee, his executors, administrators, and assigns, subject to the several conditions on which I, held the same immediately before the execution hereof, and I, the said transferee, do hereby agree to take the said share (or shares) subject to the conditions aforesaid.

In witness whereof we have put our hands the_____day_____20_____.

Witnesses:

1. _____ Transferor

2. _____ Transferee

20. All instruments of transfer which shall be registered shall be retained by the Company, but any instrument of transfer which the Directors may decline to register shall be returned to the person depositing the same. Any instrument of transfer retained may be destroyed after three years from the date of registration.

TRANSMISSION OF SHARES

21. In the case of death of a shareholder, the survivor where the deceased was joint holder, and the executors or administrators or nominees under Section 80 of the Ordinance of the deceased where he was a sole or only surviving holder, shall be the only persons recognized by the Company as having any title to his shares but nothing herein contained shall release the estate of a deceased holder (whether sole or joint) from any liability in respect of any share solely or jointly held by him.

22. Any person becoming entitled to a share in consequence of the death, bankruptcy or insolvency of a member may, subject as hereinafter provided, either be registered himself as holder of the share upon giving to the company notice in writing of such desire, or transfer such share to some other person. All the limitations, restrictions, and the provisions of these Articles relating to the right to transfer and the registration of transfers of shares shall be applicable to any such notice of transfer as aforesaid as if the death or insolvency of the member had not occurred and the notice of transfer was a transfer executed by such member.

23. The Company shall not be bound to recognize an executor or administrator unless he shall have obtained probate or letters of administration or other legal representation, as the case may be, provided nevertheless that it shall be lawful for the Directors in their absolute discretion to dispense with the production of probate or letters of administration or such other legal representation upon such terms as to indemnity or otherwise as the Directors may decide.

24. Save as otherwise provided by or in accordance with these Articles, a person becoming entitled to a share in consequence of the death or insolvency of a member shall be entitled to receive and may give a discharge for all dividends and other moneys payable in respect of the shares, and shall be entitled to attend and to vote at any general meeting as if he were the registered holder of such share, provided that seventy-two hours at least before the time of holding the meeting or adjourned meeting at which he proposes to vote he shall satisfy the Directors as to his right, or the Directors shall have previously admitted his rights, to vote at every meeting in respect thereof.

25. There shall be paid to the Company in respect of the registration of any probate, letters of administration certificate of marriage or death, power of attorney or other document relating to or affecting the title to any shares, or for making any entry in the register affecting the title of any share, such fee, as the Directors may from time to time, require or prescribe.

26. Any committee or guardian of a lunatic or infant member or any person becoming entitled to transfer shares in consequence of the death or bankruptcy or insolvency of any member upon producing such evidence that he sustains the character in respect of which he proposes to act under this Article, or of his title, as the Directors think sufficient, may with the consent of the Directors (which they shall not be under any obligation to give) be registered as a member in respect of such shares, or may subject to the regulations as to transfer hereinbefore contained, transfer such shares. This Article is hereinafter referred to as "The Transmission Clause".

27. All instruments of transmission which shall be registered shall remain in the custody of the Company for such period as the Directors may determine but any instrument of transmission which the Directors may decline to register or act upon shall be returned to the person depositing the same.

28. The Directors shall have the same right to refuse to register a person entitled by transmission to any shares or his nominee, as if he were the transferee named in an ordinary transfer presented for registration.

ALTERATION OF CAPITAL

29. The Company in general meeting may from time to time by ordinary resolution increase its authorised capital by such sum to be divided into shares of such amounts as the resolution shall prescribe.

30. Unless otherwise determined by the Company in general meeting any original shares for the time being unissued and any new shares from time to time be created shall be offered to the members in proportion, as nearly as may be to the number of shares held by them. Such offer shall be made by notice specifying the number of shares to which the member is entitled, and limiting a time within which the offer, if not accepted, will be deemed to be declined and after the expiration of such time, or on the receipt of an intimation from the member to whom the offer is made that he declines to accept the shares offered, the Directors shall dispose off such shares in accordance with the provisions of Section 86 of the Ordinance. The Directors may dispose off any such new or original shares as aforesaid which, by reason of the proportion borne by them to the number of persons entitled to such offer as aforesaid or by reason of any other difficulty in apportioning the same, cannot in the opinion of the Directors be conveniently offered in manner herein before provided.

31. All new shares shall be subject to the provisions of these Articles with reference

to transfer, transmission or otherwise.

32. The Company may, by ordinary resolution:

(a) consolidate and divide all or any of its share capital into shares of larger amounts than its existing shares (subject, nevertheless to the provisions to Section 92 of the Ordinance).

(b) cancel any shares which, at the date of passing of the resolution, have not been taken or agreed to be taken by any person and diminish the amount of its capital by the amount of the shares so canceled, or

(c) sub-divide its shares, or any of them into shares of smaller amount than is fixed by the Memorandum of Association (subject nevertheless, to the provisions to Section 92 of the Ordinance).

33. The resolution whereby any shares are sub-divided may determine that as between the holders resulting from such sub-division one or more of such shares shall have some preference or special advantage as regards dividend, capital, voting, or otherwise over or as compared with the others or other, subject nevertheless to the provision of Section 92 of the Ordinance.

34. Subject to confirmation by the Court, the Company may by Special Resolution reduce its share capital in any manner authorised by the Ordinance.

35. Subject to the provision of the Ordinance whenever the capital is divided into different classes of shares all or any of the rights and privileges attached to each class (unless otherwise provided by the terms of issue of the shares of the class) may be modified, commuted, affected, abrogated or dealt with by agreement between the Company and any persons purporting to contract on behalf of that class, provided such agreements are (i) ratified in writing by the holders of at least three fourths in nominal value of the issued shares of the class or (ii) confirmed by a special resolution passed at a separate general meeting of the holders of shares of that class and all the provisions hereinafter contained as to general meetings shall, mutatis mutandis, apply to every such meeting, except that the quorum thereof shall be members holding or representing by proxy one-fifth of the nominal value of the issued shares of the class and that holders of shares of that class present in person or by proxy may demand a poll. This Article is not by implication to curtail the power of modification which the Company would have if this Article were omitted.

GENERAL MEETING

36. The Company shall hold its annual general meeting within eighteen months from the date of its incorporation and thereafter once at least in every calendar year within a period of four months following the close of the financial year and not more than fifteen months after the holding of its last preceding annual general meeting. The Company shall hold a statutory meeting in accordance with Section 157 of the Ordinance.

37. All general meetings of the Company, other than the annual general meeting, referred to in section 158 and the statutory meeting mentioned in section 157 of the Ordinance shall be called extraordinary general meetings.

38. The Directors may at any time call an extraordinary general meeting of the Company to consider any matter, which requires the approval of the Company in a general meetings, and shall, on the requisition of the members representing not less than one tenth of the voting power on the date of the deposit of the requisition, forthwith proceed to call an extraordinary meeting.

PROCEEDINGS OF GENERAL MEETINGS

39. Twenty-one day's clear notice at the least 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 regulation of the Company, entitled to receive such notice from the Company; but the accidental omission to give notice by any member shall not invalidate the proceedings at any general meeting.

40. All business shall be deemed special that is transacted at an extraordinary general meeting, and 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 report of the Directors and auditors, the election of Directors, the appointment of, and the fixing of the remuneration of the auditors.

41. No business shall be transacted at any general meeting unless quorum of members as specified in Section 160(2)(a) of the Ordinance i.e. not less than three members present personally who represent not less than Twenty Five Percent of the total voting power either of their own account or as proxies.

42. 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 member or members present shall be a quorum and may transact the business for which the meeting was called.

43. The Chairman of the Board of Directors, if any shall preside as Chairman at every general meetings of the Company, but if there is no such Chairman, or if at any meeting he is not present or is unwilling to act as Chairman, and if none of the Directors as present or unwilling to act as Chairman, the member or members present shall choose one of their number to be Chairman.

44. The Chairman may, with the consent in 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.

45. At any general meeting a resolution put to 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. A declaration by the Chairman that a resolution has, on the 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 favor of, or against, that resolution.

46. Before or on the declaration of the result of the voting on any resolution on a show of hands, a poll may be ordered to be taken by the Chairman of a meeting of his own motion and shall be ordered to be taken by him on a demand made in that behalf by the persons or person specified in Section 167 of the Ordinance.

47. A poll demanded on the election of a Chairman or on a question of adjournment shall be taken forthwith and a poll demanded on any other question shall be taken at such time, not more than fourteen days from the day on which it is demanded, as the Chairman of the meeting may direct.

48. 48. When a poll is taken, the Chairman or his nominee and a representative of the members demanding the poll shall scrutinize the votes given on the poll and the result shall be announced by the Chairman.

49. Subject to the provision of the Ordinance, the Chairman shall has power to regulate the manner in which a poll shall be taken.

50. The result of the poll shall be deemed to be the decision of the meeting on the resolution on which a poll was taken. The demand of a poll may be withdrawn. In case of any dispute as to the acceptance of rejection of a vote, the Chairman shall determine the same, and such determination made in good faith shall be final and conclusive.

VOTE OF MEMBERS

51. On a show of hands every member present in person or by proxy and entitled to vote shall have one vote for every share of which he is the holder and on a poll every member present in person or by proxy shall have one vote for every share of which he is the holder.

52. In the case of joint holders of a share 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.

53. A member of unsound mind, or in respect of whom an order has been made by any court having jurisdiction in lunacy may vote, whether on a show of hands or on a poll, by his committee, curator bonis or other person appointed by such court, and such committee, curator bonis or other person may on a poll vote by proxy, provided that such evidence as the Directors may require of the authority of the person claiming to have the right to vote shall have been deposited at the office or at such other place as the Directors may appoint not less than forty eight hours before the time for holding the meeting.

54. No objection shall be raised to the qualification of any voter except at the meeting or adjourned meeting at which the vote objected to is given or tendered, and every vote not disallowed at such meeting shall be valid for all purposes. Any objections made under the provisions of this Article shall be referred to the Chairman of the meeting whose decision shall be final and conclusive.

55. On a poll votes may be given either personally or by a proxy who need to be a member of the Company. A person entitled to more than one vote need not use all his votes or cast all the votes he uses in the same way.

56. The instrument appointing a proxy shall be in writing under the hand of the appointer or of his attorney duly authorised in writing, or if the appointer is a corporation either under the common seal or under the hand of an officer of an attorney so authorised. Members not resident in Pakistan may appoint and revoke proxies by telegram.

57. Any person duly appointed for that purpose shall be entitled to act at that meeting as the representative of a corporation under Section 162 of the Ordinance.

58. 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 such power or authority, shall be deposited at the office or such other place as the Directors may appoint not less than forty-eight hours before the time appointed for holding the meeting or adjourned meeting at which the person named in the instrument proposes to vote and in default thereof the instrument of proxy may at the discretion of Directors be treated as invalid. The authority of the proxy shall be deemed to include the right to demand or join in demanding a poll, and generally to speak, vote and to act at the meeting in the same manner and extent as the member giving the proxy.

59. An instrument of proxy may be in the following form or in any other form which the Directors shall approve:

METRO WIND POWER LIMITED

I, the undersigned, being a member of the above named Company hereby appoint _____ of _____ whom failing _____ of _____ as my proxy to

vote and act for me, and on my behalf, at the ordinary (or extraordinary as the case may be) general meeting of the Company, to be held on the_____ day of _____20_____ and at any adjournment thereof.
Dated this _____ day of _____ 20 _____proxies need not be witnessed.

BORROWING POWERS

60. The Directors may borrow from members, Banks or Financial Institutions or other persons and may themselves lend any sum of money for purposes of the Company.

61. The Directors may secure payment of money in a manner and on terms and conditions as they think fit and in particular by (i) entering into Modaraba contracts, (ii) issue of perpetual or redeemable and convertible or non convertiblePTCs, TFCs debentures and their stocks, bonds, promissory notes, bills of exchange, usance bills and such other securities, (iii) furnishing guarantees and undertaking; depositing securities, shares and documents of title; (iv) hypothecating, charging and mortgaging properties and assets (both present and future) of the Company and creating liens on and pledging such properties; and (v) appointing attorneys, giving them powers of executing documents, having them registered, selling and managing the properties, undertaking any business of the Company and furnishing and creating such other securities as may be considered expedient; and for all the aforesaid purposes or otherwise execute, complete and deliver agreements and such other documents as may be required.

62. The Company may raise and secure payment of any sum by issue of TFCs or PTCs. The TFCs/PTCs may be issued at a discount, premium or otherwise with special privileges as to redemption, conversion into shares with voting rights and their subsequent reconversion into PTCs.

63. PTCs, TFCs, debentures, stocks thereof, bonds and other securities may be made assignable free from any equities between the Company and person to whom the same may be issued.

64. The Directors, shall cause a proper register to be kept in accordance with Section 125 of the Ordinance, of all mortgages and charges specially affecting property of the Company and shall comply with requirements of Section 121 and 122 of the Ordinance, in regard to registration of mortgages and charges therein specified and requirements of section 130 of the Ordinance, as to keeping a copy of every instrument creating mortgages or charge at the office, and requirements of Section 132 as to giving limitation of payment of satisfaction of charges or mortgages created by the Company.

65. Registers of holders of TFCs and debentures may be closed for any period not exceeding, in whole, thirty days in any year. Subject as aforesaid every such register shall be open to inspection of registered holders of PTCs, TFCs and

debentures and of any member; but the Company may impose any reasonable restriction so that at least two hours in each day, when such register is open are appointed for inspection.

66. Subject to the provisions of Section 76 of the Ordinance, no transfer of PTCs, TFCs or debentures shall be registered unless a proper instrument of transfer duly stamped and executed by transferor and transferee has been delivered to the Company together with certificate of concerned securities.

67. If the Directors refuse to register transfers of PTCs, TFCs or debentures they shall within thirty days from the date on which instrument of transfer was lodged with the Company, send to the transferee and transferor a notice showing the reason of refusal as required under Section 78 of the Ordinance.

68. The Company shall comply with provisions of Sections 136 of the Ordinance for allowing inspection of copies kept at the office in pursuance of Section 130 of the Ordinance and allowing inspection of Register of PTC, TFC or debenture holders, in pursuance of Section 136 of the Ordinance.

69. The Company shall comply with provisions of Section 136 of the Ordinance for supplying copies of Register of PTC, TFC and debenture holders or trust deed for securing issue of PTC, TFC or debenture.

70. Trustees for the PTC, TFC and Debenture Holders shall have the same right to receive and inspect balance sheet and profit and loss accounts of the Company and reports of Auditors and other reports as are possessed by holders of Ordinary Shares in the Company.

71. Subject to the provisions of the Ordinance, no loan or guarantee or security for loan shall be made directly or indirectly by the Company for or on behalf of any member of the Company unless the same shall have been approved by a three fourths majority of the Directors.

DIRECTORS

72. The number of Directors of the Company shall not be less than three and more than seven save as otherwise provided in the Ordinance, a Director shall be a member of the Company. The subscribers to the Memorandum of Association shall be the first Directors of the Company.

73. Any casual vacancy arising from the death, resignation or removal of a Director shall be filled by the remaining Directors.

74. Directors shall be entitled to be paid their reasonable traveling hotel and other expenses incurred in consequence of their attendance at Board meetings, and otherwise in the execution of their duties as Directors.

b) If any Director, being willing, shall be called upon to perform extra services, as Managing Director or otherwise for any of the purposes of the Company, the fixed sum or by a percentage of shares or profit or by remuneration shall be addition to his shares in the Company.

POWERS AND DUTIES OF DIRECTORS

74. 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, 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 the general meeting, subject nevertheless to the provisions of the Ordinance or to any of these regulations being not inconsistent with the aforesaid provision, as may be prescribed by the Company in general meeting but no regulation made by the Company in general meeting shall invalidate any prior act of the Directors which would have been valid if that regulation had not been made.

PROCEEDING OF DIRECTORS

75. The Directors may meet together for the dispatch of business, adjourn or otherwise regulate their meetings, and proceedings, as they think fit, and may determine the quorum necessary for the transaction of business. The quorum for Directors meeting shall be one fourth of total number of Directors or two whichever is greater.

76. Questions arising at any meeting shall be decided by a majority of votes.

77. A Director may, at any time summon a meeting of Directors. It shall be necessary to give notice of a meeting of Directors to any Director for the time being absent from Pakistan, at such facsimile number or other contact number or address as he shall from time to time provide to the Company.

78. The Chairman shall be elected amongst the Directors who shall preside all meetings of Directors as Chairman but if no such Chairman is elected or at any meeting the Chairman is not present or is unwilling to act as Chairman the Directors present may choose one of their members to be Chairman of the Meeting.

79. A meeting of the Directors at which a quorum is present, shall be competent to exercise all or any of the authorities, powers, and directions by or under the Articles of the Company for the time being vested in or exercisable by the Directors generally.

80. The Directors may delegate all or any of their powers to the Chief Executive (by whatever name called) as they think fit and may from time to time, revoke such delegation subject to the agreement with the Chief Executive or Managing

Director (by whatever name called).

81. Except for the matters specified in Section 196 of the Ordinance, a resolution in writing signed by all the Directors for the time being in office shall be as valid and effectual as if it had been passed at a meeting of the Board duly called and constituted. For this purpose, it shall be permissible to circulate the text of the proposed resolution duly signed by the Chief Executive and obtain the signatures of all the other Directors thereon separately by fax (the signed original whereof shall be sent in due course by mail or courier to the Company for its record) and such resolution shall be effective as soon as the text of the resolution signed by each of the other Directors shall have been faxed to and received by the Company.

RETIREMENT & ELECTION OF DIRECTORS

82. At the first annual general meeting of the Company, all the first Directors shall stand retired from office, and Directors shall be elected in their place In accordance with Section 178 of the Ordinance, for a term of three years. Notwithstanding that the number of persons offering themselves for election as Directors is not more than the number of Directors fixed under Article 72, the number of votes cast in favor of each candidate and the name of the member casting such votes shall be recorded in the minutes of the meeting.

83. A retiring director shall be eligible for re-election.

84. The Directors of the Company shall, subject to section 174 of the Ordinance, fix the number of elected directors of the Company not later than thirty-five days before the convening of the general meeting at which Directors are to be elected, and the number so fixed shall not be changed except with the prior approval by ordinary resolution of a general meeting of the Company.

85. No person shall be appointed as a Director of the Company if he:

(a) is minor;

(b) is found to be of unsound mind;

(c) is adjudged insolvent by a court of competent jurisdiction;

(d) has been convicted by a court of law for an offense involving moral turpitude;

(e) has been debarred from holding such office under any provisions of the , Ordinance;

(f) has betrayed lack of judiciary behavior and a declaration of this effect has been made by the. Court under section 217 of the Ordinance at any time during the preceding five years.

(g) is not a member of the Company; provided that clause (g) shall not apply in the case of;

(i) a whole-time Director who is an employee of the company.

(ii) a Chief Executive.

(iii) a person representing one or more creditors as a Director of the Company.

86. A Director shall ipso facto cease to hold office if:

(a) he becomes ineligible to be appointed a director on anyone or more of the grounds enumerated in Articles 85; or

(b) he absents himself from three consecutive meetings of the 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; or

(c) The Directors by notice In writing to the Company resigns of his office; or

(d) he is removed from office by resolution In general meeting, under Section 181 of the Ordinance; or

(e) he or any firm of which he is 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 of Chief Executive (by whatever name called) or a legal or technical adviser or a banker: or

ii) accepts a loan or guarantee from the Company in contravention of Section 195 of the Ordinance.

(f) any other event mentioned In Section 188 of the Ordinance occurs; or

87. The Company shall keep at its registered office a register of its Directors and officers including the Chief Executive (by whatever the name called), secretary, Chief accountant, auditors and legal adviser, containing with respect to each of them the following particulars, that is to say:

a) in the case of an individual, his present name in full, any former name or surname in full his father's name, in the case of a married

woman or a widow, the name of her husband or deceased husband, his usual residential address, nationality and if that nationality is not the nationality of origin, his nationality of origin, and his business occupation, if any, and if he holds any other directorship or other office the particulars of such directorship or office;

b) in the case of a corporation, its corporate name and registered or principal office, and full name, address and nationality of each of its directors; and

c) in the case of a firm, the full name, address, and nationality of each partner, and the date on which each became a partner.

The Company shall otherwise comply with the provisions of Section 205 of the Ordinance, as regards returns to the Registrar and giving inspection of the register.

In addition to the Directors elected or deemed to have been elected by shareholders, the Company may have Directors nominated by or on behalf of the "Company" 's creditors or other special arrangements by virtue of any contractual arrangements and any such contractual arrangements with respect to the appointment of Directors by creditors or other special interests approved by the Board shall be binding on the Company and every person then or at any time thereafter holding the office of Director.

ALTERNATE DIRECTORS

88. A Director may, with the approval of the Board, appoint any person (Including another Director) to be his alternate Director and such an alternate Director shall be entitled to notice of meetings of the Directors and to attend and vote thereat accordingly and generally to exercise all the rights of such absent Director subject to any limitations in the Instrument appointing him. For the purpose of the proceedings at such meetings, the provisions of these Articles shall apply as if any alternate Director (instead of his appointer) were a Director. An alternate Director shall not require any share qualification and he shall ipso facto vacate office as and when his appointer (a) vacates office as a Director; (b) removes the appointee from office; or (c) returns to Pakistan 'Provided upon each occasion upon which the appointer thereafter leaves Pakistan again, and unless the appointer shall have informed the Company to the contrary, he shall be deemed to have reappointed the appointee as his alternate Director and no further approval of the Board shall be required unless the appointer desires to approve another person not previously approved by the Board as his alternate. If an alternate Director shall be himself a Director, his voting rights shall be cumulative but he shall not be counted more than once for the purposes of quorum. Any appointment or removal under this Article shall be effected by notice in writing under the hand of the Director making the same.

CHIEF EXECUTIVE OR MANAGING DIRECTOR

89. The Directors shall appoint a Chief Executive (by whatever) name called in accordance with the provisions of Sections 198 & 199 of the Ordinance.

90. A Chief Executive shall while he continues hold that office subject to the terms of any contract between him and the Company, be subject to the same provisions as to resignations and removal as the other Directors of the Company and if he ceases to hold the office of Director from any cause he shall ipso facto and immediately cease to be Chief Executive.

91. With a view to enable the smooth and efficient functioning of the Company it is clarified that the Chief Executive (by whatever name called) shall be responsible subject to the supervision and control of the Board for the general day-to-day management of the Company and of its business transactions and in the best interests of the Company and do all such actions as may be required, and shall have control over all the employees of the Company.

92. The remuneration of a Chief Executive (by whatever name called) or a Director holding an office of profit shall, subject to the provisions of any contract between him and the Company, from time to time, be fixed by the Directors, and be by way of fixed salary, or percentage or profit, or by both, as provided in such contract.

MINUTES

93. The Directors shall cause minutes to be duly entered in books provided for the purpose:

a) of all names of the Directors present at each meeting of the Directors and committee of Directors, if any;

b) of all orders made by the Directors and committee of Directors;

c) of all resolutions and proceedings of general meetings and of meetings of the Directors and Committee. Any such minutes of any meeting of the Directors, or any committee, or of the Company, if purporting to be signed by the Chairman of such meeting, or by the Chairman of the next succeeding meeting shall be receivable as prime evidence of the matters stated in such minutes.

94. Until the contrary is proved, every general meeting of the Company or meeting of Directors or committee of Directors in respect of the proceedings whereof minutes have been so made shall be deemed to have been duly called and held, and all proceedings had thereat to have been duly held, and all appointments of Directors or any liquidators made thereat shall be deemed to be valid.

95. The books containing the minutes of proceedings of the general meetings of the

Company and those of the meetings of the Directors and committee of Directors shall be kept at the registered office of the Company and shall be open to inspection by members between such hours of working as the Directors may prescribe.

SEAL

96. The Directors shall provide for the safe custody of the Seal, and the Seal shall never be used except by the authority of the Directors, previously given, and in the presence of the Chief Executive (by whatever name called) or anyone of the Directors duly authorised by the Board who shall sign every instrument to which the Seal is affixed.

DIVIDEND AND RESERVES

97. Clause 63 to 70 of Table A shall apply.

98. Notice of the declaration of any dividend, whether interim or otherwise shall be given to the holders of registered shares in the manner hereinafter provided. Unless otherwise directed, any dividend may be paid by cheque or warrant sent through the post to the registered address of the member or other person entitled pursuant to any directions or order previously received by the Company, or in the case of joint holders, to the registered address of that whose name stands first in the register in respect of joint holding; and every cheque or warrant so sent shall be made payable to the order of the person to whom it is sent.

ACCOUNTS

99. Clauses 71 to 77 of Table A shall apply.

AUDITORS

100. Auditors shall be appointed and their duties regulated in accordance with Section 252 & 255 of the Ordinance. The Company shall at each annual general meeting appoint an auditor to hold office till the conclusion of the next annual general meeting.

NOTICE

101. Clauses 79 to 83 of Table A shall apply, save that any Director or member resident out of Pakistan shall be entitled to receive notices and such notices shall be delivered by facsimile or courier at the facsimile number or address provided

to the Company from time to time by such Director or member.

WINDING UP

102. Clause 84 of Table A shall apply.

INDEMNITY

103. Clause 85 of Table A shall apply.

30/5/16

We, the several person whose names and addresses are subscribed are desirous of being formed into a Company in pursuance of this Articles of Association, and we respectively agree to take the Number of shares in the capital of the Company set opposite our respective names:

Name and Surname (Present and former) in full (Block Letter)	*Father's / Husband's Name in full*	*Nationality with any former Nationality*	*Occupations*	*Residential Address (in full)*	*Number of shares taken by each subscriber*	*Signature*
MR. IQBAL ALIMOHAMED CNIC No. 42201-2214140-7	*HAJI ALIMOHAMMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
MR. DANISH IQBAL CNIC No. 42201-4584613-1	*IQBAL ALIMOHAMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
MR. SAAD IQBAL CNIC No. 42201-9911226-5	*IQBAL ALIMOHAMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
MS. NATASHA IQBAL CNIC No. 42000-6370872-4	*IQBAL ALIMOHAMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
Total Shares					500,000	

Dated the 30th day of July, 2015

Witness to the above signatures:

NIFT (Private) Limited, 5th Floor, AWT Plaza, I.I.Chundrigar Road, Karachi.

The Companies Ordinance, 1984

(Company Limited By Shares)

MEMORANDUM OF ASSOCIATION

OF

METRO WIND POWER LIMITED

I. The name of the Company is METRO WIND POWER LIMITED.

II. The Registered Office of the Company will be situated in the Province of Sindh (Pakistan).

III. The object for which the Company is established is the following:

A. To set up/ purchase/ operate/ establish/ manage, electric power generation projects, plants, etc.; using wind and/ or any other renewable energy power generating system and generate, accumulate, supply, transmit and distribute electric power (either directly or by establishing necessary power stations, cables, wires, lines, accumulators, lamps and works) to domestic, commercial industrial and / or agricultural organizations, sister concerns, companies/ branches and to power distribution companies / authorities both in public and private sector and any Government Department Authority for all purposes for which electrical energy can be used and to perform all acts directly or indirectly related to/ incidental to the business of the company but not limited to; import, manufacture, assemble, repair, supply and deal in all kinds of electrical and related raw materials, appliances, machineries, plants, equipments, apparatus, generators, cables, wire lines, dry cells, lamps, meters, batteries, engineering goods, air-conditioning plants and works.

(B) The Company shall be authorized:

1. To own, purchase/acquire, hire, take on lease, build, erect, install, establish, operate, use, repair, maintain and dispose of buildings, factories, machineries, plants laboratories, equipments, apparatus and other facilities.

2. To purchase, take on lease, or in exchange, or otherwise acquire, any land to sell, mortgage; to construct, alter, repair, pull down, decorate, maintain, furnish, fit up and improve buildings, and enter into contracts and arrangements of all kinds with building property owners, and any other party.

3. To purchase, acquire, take on lease or tenancy, sell, dispose of, mortgage and acquire options over any property (immovable/ movable), or rights of any kind, and develop, improve, turn to account, deal with, mortgage, sell or otherwise dispose of the same in such manner, as may be thought expedient.

4. To apply for, purchase, or otherwise acquire, protect and renew in any part of the world any patents, patent rights, copyrights, trademarks, designs, licenses, concessions and the like, conferring any exclusive or non-exclusive or limited rights to their use, or any secret or other information as to any invention, process, matter or things which may seem capable of being used for the purpose of the Company, or the acquisition of which may seem calculated directly or indirectly to benefit the Company, and to use, exercise, develop to grant licenses in respect of, or otherwise turn to account the property , rights or information so acquired, and to expend money in experimenting upon, testing or improving any such patents, inventions or rights.

5. To enter into an agreement or any arrangement for sharing profits, union of interest, co-operation, joint-ventures, reciprocal concessions, or otherwise with any company, association, firm or person for any purpose which the Company thinks expedient. .

6. To open any current, overdraft, cash credit account or fixed account in any bank and to pay money into and draw money from any such account.

7. To borrow and secure payment of money borrowed by the Company or any of its subsidiaries or associated undertakings or any other company by (i) issue of perpetual or redeemable and convertible or non-convertible PTCs, TFCs, debentures and their stocks, bonds, promissory notes, bills of exchange, usance bills and such other securities; (ii) furnishing guarantees and undertakings, depositing securities, shares and documents of title; (iii) hypothecating, charging and mortgaging properties and assets (both present and future) of the Company and creating pledge on such properties and (iv) appointing attorneys, giving them powers of executing documents, having them registered, selling and managing the properties, undertaking any business of the Company and furnishing and creating such other securities as may be considered expedient or otherwise execute, complete and deliver agreements and such other documents as may be required.

8. To guarantee the payment of money and the performance of contracts or engagements of the Company or any of its subsidiaries or associated undertakings or any other company and to secure the payment of money and the performance of any contracts or engagements entered into by this Company or any of its subsidiaries or associated undertakings or any other company and to discharge any debt or any obligations of or binding upon this Company or any of its subsidiaries or associated undertakings or any other company by a mortgage, pledge or charge upon all or any part of the undertaking, property and rights of the Company (either present or future or both), or by the creation or issue of bonds, debenture stock, or any other securities or by any other means.

9. To guarantee the payment of money unsecured or secured by or debenture stocks, contracts, mortgages, charges, obligations, instruments and securities of the Company and generally to guarantee to become sureties for the performance of any contracts or obligations concerning the business of this Company or any of its subsidiaries or associated undertakings or any other company.

10. To draw, make, accept, endorse, seal, execute, negotiate, purchase, hold and dispose of cheques, promissory notes, bills of exchange, drafts, charter parties, bills of lading, warrants and other negotiable documents and contracts, deeds and other instruments and to cancel and carry such instruments, relating to the business of the Company.

11. To apply for, purchase or otherwise acquire any patents, brevetted invention, licenses, concessions, and the like conferring any exclusive or non-exclusive or limited rights to use, or any secret or other information as to any invention which may seem capable of being used for the purposes of the Company or the acquisition of which may seem calculated, directly or develop or grant licenses in respect of or otherwise turn to account the property, rights or information so acquired.

12. To remunerate Directors, officials, agents, employees and servants of the Company and others and to benefit employees or ex-employees of the Company, and to grant pensions, gratuities and allowances and to provide bonuses, amenities and conveniences of all kinds and for the purpose of this paragraph the words "employees" and "ex-employees" shall include respectively, present and former directors and other officers, agents, employees, trainees, and servants.

13. To improve, develop, sell, exchange, taken on lease, mortgage, pledge, hypothecate, assign, transfer, or deal with all or any part of the property and assets, immovable/ movable, corporeal or incorporeal, tangible or intangible, and any right, title and interest therein of the Company, including rights, licenses, privileges, concessions and franchises as may seem expedient.

14. To payout of the funds of the Company, all expenses which the Company may lawfully pay with respect to the formation, promotion and registration of the Company or the issue of its capital, including brokerage and commissions for obtaining applications for or taking placing or underwriting or procuring the underwriting of shares, debentures, other securities of the Company.

15. To pay for rights or property acquired by the Company and to remunerate any persons or company whether by cash payment or by the allotment of shares, debentures or other securities of the Company as fully paid up.

16. To adopt such means of making known the services and products of the company as may seem expedient and in particular by undertaking educational training and demonstration programmes and by advertising in the press, by circulars and exhibitions of works of art or interest, by publication of books and periodicals and by granting prizes, rewards and donations.

17. To aid, peculiarly or otherwise, and association, body or movement having for an object the solution settlement, or surmounting of industrial or labor problems or troubles or the promotions of industry or trade.

18. To sell, improve, develop, exchange, take on lease, mortgage, dispose of, turn to account or otherwise deal with all or any part of the property and rights of the Company.

19. To distribute among the Members in specie any property of the Company, or any proceeds of sale of disposal of any property of the Company but so that no distribution amounting to a reduction of capital be made except with the sanction (if any) for the time being required by law.

20. To sell or dispose of the undertaking of the Company or any part thereof for such consideration as the Company may think fit.

21. To borrow or raise moneys, either against security or without security, in such manner as the Company or its directors may think fit and in particular by sale, negotiations, transfer, issue or against the security of bills of exchange, promissory notes and other negotiable, transferable or other instruments, debentures or issue of debentures, debenture-stocks, bonds, obligations, mortgages and securities of all kinds, either perpetual or otherwise, secured or unsecured and to secure the repayment of any moneys borrowed, raised or owing by the Company on any of the specific property, assets and rights (present and future) including the uncalled capital of the

Company, and to secure similarly any other debt or obligation of the Company or its subsidiaries or associated undertakings and to guarantee the performance by the Company or any other body corporate or other person whatsoever of any obligation undertaken by the Company or by such body corporate or person.

22. To form, constitute, float, lend money to assist and control companies, associations or undertakings engaging in any industrial, commercial or business activities.

23. To invest in, subscribe to or acquire any shares, stocks, debentures, debenture stocks, bonds, mortgage, obligations and other securities by subscription, tender, purchase, exchange or otherwise out of the funds of the Company, either conditionally or unconditionally and to guarantee the subscription thereof.

24. To undertake any takeover bids, mergers, amalgamations, acquisitions, rehabilitation or restructuring with or in respect of any business, company, body corporate or other person, whether incorporated or not by acquisition of its assets and liabilities, and whether as a going concern or as part of the concern, and to promote or procure incorporation, formation or setting up of concerns and undertakings for engaging in any industrial, commercial or business activities.

25. To negotiate, enter into and perform agreements and contracts of every kind and description with any company, firm or person whatsoever for any lawful purpose, without any limit as to amount, and to obtain from such company, firm or person any rights, privileges, contracts, concessions and dispose of them or turn to account the same.

26. To do all or any of the above things, either as principals, agents, contractors, or in conjunction with others, and either by or through agents, sub-contractors, trustees or otherwise, and either alone or in conjunction with others, and to do all such things as are incidental or conducive to the attainment of the objects as specified above.

It is hereby undertaken that the company shall not engage in banking business or business of any investment company or insurance or leasing or in any unlawful business and that nothing contained in the object clause shall be so construed to entitle it to engage in such business.

IV. The liability of the members is limited.

V. The Authorised Capital of the Company is Rs. 10,000,000 (Rupees Ten Million Only) divided into 1,000,000 Ordinary shares of Rs.10/-(Rupees Ten) each with power to increase or reduce the said Capital and divide the Ordinary Shares into various classes in accordance with provisions of the Companies Ordinance, 1984.

--*--*--*--*--*--*--*--*--*--*--

30/5/16

We, the several person whose names and addresses are subscribed are desirous of being formed into a Company in pursuance of this Memorandum of Association, and we respectively agree to take the Number of shares in the capital of the Company set opposite our respective names:

Name and Surname (Present and former) in full (Block Letter)	*Father's / Husband's Name in full*	*Nationality with any former Nationality*	*Occupations*	*Residential Address (in full)*	*Number of shares taken by each subscriber*	*Signature*
MR. IQBAL ALIMOHAMED CNIC No. 42201-2214140-7	*HAJI ALIMOHAMMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
MR. DANISH IQBAL CNIC No. 42201-4584613-1	*IQBAL ALIMOHAMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
MR. SAAD IQBAL CNIC No. 42201-9911226-5	*IQBAL ALIMOHAMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
MS. NATASHA IQBAL CNIC No. 42000-6370872-4	*IQBAL ALIMOHAMED*	*Pakistani*	*Industrialist*	*B-84/1-A, KDA SCHEME NO.1, KARACHI*	*125,000 (ONE HUNDRED TWENTY FIVE THOUSAND ONLY*	
Total Shares					500,000	

Dated the 30th day of July, 2015

Witness to the above signatures:

NIFT (Private) Limited, 5th Floor, AWT Plaza, I.I.Chundrigar Road, Karachi.

1. BACKGROUND TO GENERATION LICENSE APPLICATION

1.1 PROCESS OF ISSUANCE OF LETTER OF INTENT LEADING TO GENERATION LICENSE APPLICATION

1.1.1 Issuance of "Letter of Intent"

METRO WIND POWER LIMITED (a company duly organized and existing under the laws of Pakistan, with its office located at 7th Floor, Al-tijarah Centre, 32-1-A, Block 6, P.E.C.H.S, Main Sharae Faisal, Karachi) (the **Project Company**), was incorporated on 27 August 2015 to develop, own and operate an approximately 60 MW wind power project in Jhimpir, Thatta (**Project**) pursuant to a LETTER OF INTENT by the Energy Department Government of Sindh (EDGOS) on July 14th, 2015 vide its letter No. DAE/Wind/83/2015/25 (the **LOI**) to develop and establish an approximately 60 MW wind farm project to be located at Jhimpir, Thatta (**Project**). Further, the EDGOS has vide its letter No. DAE/Wind/83/2015/28 dated February 16, 2017 granted the Project Company an extension in the validity period of the LOI up to December 16, 2017.

1.1.2 Submission of the Feasibility Study

Pursuant to the relevant provisions of the Policy for Development of Renewable Energy for Power Generation 2006 (the **RE Policy 2006**) and the LOI, the Project Company completed the detailed technical feasibility study (the **Project Feasibility Study**) for the Project. The Project Company submitted the same to the Panel of Experts, EDGOS. The Project Feasibility Study was prepared by Renewable Resources (Private) Limited who are the technical consultants for the Project A copy of Project Feasibility Study is attached hereto as ANNEXURE A for NEPRA's perusal.

1.1.3 Submission of Initial Environmental Examination.

The technical consultants completed the initial environmental examination for the Project (the **Initial Environmental Examination**) and the Project Company submitted the same to the Sindh Environmental Protection Agency (the **SEPA**) on **10 February 2016**.

After careful review and analysis of the Initial Environmental Examination, the SEPA accorded its approval for the Project through its decision (Ref: **EPA/2016/02/12/IEE/05**) dated **08 April 2016** (the **IEE Approval Decision**). A copy of the IEE Approval Decision is attached hereto as ANNEXURE B for NEPRA's perusal.

1.1.4 Grid Interconnection Studies

Grid Interconnection Study was carried out by Power Planners International. The National Transmission and Despatch Company (**NTDC**) has vide letter no. GMPP/CEMP/TRP-380/1730-34 dated 04 April, 2017 accorded its approval of the Grid Study and issued the Power Evacuation Certificate to the Project Company vide letter no. GMPP/CEMP/TRP-380/1984 dated 19 April 2017. A copy of the Grid Interconnection Study, a copy of the approval of the Grid Study and a copy of the Power Evacuation Certificate is attached hereto as ANNEXURE M for NEPRA's perusal.

1.1.5 Location of Project & Lease of Land

The Project site is located in Jhimpir, District Thatta, Karachi; a city of the southern province Sindh. The aerial distance between the Project site and Karachi is about 45 km and the road distance of site from Port Qasim is 108km. The distance between Project site and the coastal line of Arabian Sea is approximately 60 km. The size of the whole wind farm is 410 acres. The north latitude of the site is 24° 59.548' N, and the east longitude is 67° 42.124' E. The altitude of the site is 114 m~187 m above sea level. The monsoon from the Indian Ocean, which is stable in its direction and high in quality brings rich wind energy resource to the site. The Project Company has already been allotted land required for the Project from the Government of Sindh (the **GoS**) for a period of thirty (30) years through Land Allotment Letter Reference: No.01-66-2015/SO-VI/07 dated 14 January 2016. A copy of the Land Allotment letter is attached hereto as ANNEXURE C for NEPRA's perusal.

1.1.6 Brief Technical Synopsis of the Project

The Project shall have an installed capacity of 60 MW with 30 wind turbine generators (WTG) of 2.0 MW each. There shall be a substation of 132 KV, which shall dispatch electricity to the CPPA-G through a grid station in Jhimpir. Please refer to **ANNEXURE M** for the Grid Interconnection Study carried out by Power Planners International.

1.1.7 Tariff

Metro Wind Power Limited had applied to the EDGOS for its recommendation to NEPRA for the award of upfront tariff to the Project and subsequently received the said letter on May 20, 2016. A copy of the Recommendation Letter from EDGOS to NEPRA for the award of upfront tariff to the Project is attached as ANNEXURE Q for NEPRA's perusal. Upon issuance of the Generation

License and award of the upfront tariff, the Project Company would execute the Energy Purchase Agreement with the power purchaser and aims to achieve financial close for the Project within 12 months of granting of the Tariff. The expected commercial operations date of the Project is to be within 18 months of Financial Close.

1.1.8 **Request for grant of a generation license**

Based on the matters provided in Sections 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6 and 1.1.7 above whereby the Project Company, on its part, has undertaken and completed all activities required for procurement of approvals of the relevant matters from various stakeholders, it is submitted that the requirements of the regulatory process for applying to NEPRA for grant of a generation license to the Project Company are complete.

1.2 SUBMISSION

1.2.1 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 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.

1.2.2 **PURSUANT TO** Sections 7(2)(a) and 15 of the NEPRA Act read with other enabling provisions of the NEPRA Act, the National Electric Power Regulatory Authority Licensing (Application & Modification Procedure) Regulations 1999, National Electric Power Regulatory Authority Licensing (Generation) Rules 2000, **AND** in accordance with the RE Policy 2006: **METRO WIND POWER LIMITED 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 60 MW power generation facility to be located at Jhimpir, District Thatta, Sindh, Pakistan.

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

1.2.4 This Generation License Application is submitted in triplicate.

1.2.5 The generation license fee, payable by the Project Company, in respect of this Generation License Application is also enclosed in the form of Pay order No. 00273090 for an amount of PKR 370,260/- (Pakistani Rupees Three Hundred

Seventy Thousand Two Hundred and Sixty Only) dated 26 April 2017 drawn in favor of NEPRA.

2. APPLICANT – METRO WIND POWER LIMITED

2.1 The Project Company, being the applicant under this Generation License Application, is a public limited company (unlisted) incorporated under the laws of Pakistan and has been specifically established to undertake power generation business and activities in Pakistan.

2.2 The Project Company (following grant of a generation license and approval of the Project Company's reference generation tariff by NEPRA) proposes to design, engineer, construct, insure, commission, operate and maintain the Project constituting of a 60 MW power generation facility (the **Facility**) to be located at Jhimpir, District Thatta, Province of Sindh, Pakistan (the **Site**).

2.3 For the purposes of designing, engineering, procuring, constructing, installing, testing, completing, commissioning, operation and maintenance of the Project, the Project Company has finalized the contract with HydroChina Corporation. The profile of HydroChina Corporation is attached herewith as ANNEXURE D.

2.4 The following supporting documents relating to the Project Company are attached herewith as follows:

DOCUMENTS	ANNEXURE
Shareholding Pattern	ANNEXURE E
Certified True Copy of SECP Certified Memorandum and Articles of Association	ANNEXURE F
Certified True Copy of SECP Certified Certificate of Incorporation	ANNEXURE G

3. FACILITY UTILIZATION

3.1 ELECTRICITY DEMAND & WIND CORRIDOR

3.1.1 Pakistan is a developing economy having a constant growth in industrialization coupled with a constantly rising demand for electricity. The non-availability of natural resources for expansion of the power sector has widened the gap between demand and supply, which has resulted in excessive and frequent load shedding. The shortfall in supply could be the major cause for stunned growth in the industrial sector in Pakistan. The total installed capacity of Pakistan as on June 30, 2014 was 24,375 MW; of which 16,366 MW (67.14%) was thermal, 7,116 MW (29.19%) was hydroelectric, 787 MW (3.23%) was nuclear and 106 MW (0.43%) was wind. At present, a total of 309 MW of wind power projects are in their operations phase.

3.1.2 The demand for electricity has continued to increase by out pacing the growth rate of the economy. The shortfall at times crosses 6,000MW and this is the time when urban areas have 8-12 hours of load shedding and small cities/rural areas have 18 hours of load shedding. The industry, having its self- generation on gas, has a suspended supply of gas for 2-3 days a week during winters. As mentioned above, Pakistan's major electricity sources at present are thermal and hydro generation, meeting approximately 96% of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil, high-speed diesel and gas. While the fuels are produced domestically, demand for them already outstrips supply by a considerable amount. Oil imports are already a significant burden on the national exchequer and the increasing import bill continues to exert further pressure on the foreign exchange reserves. Therefore, securing alternative fuels and the technical management should be strengthened to solve these problems and wind power can play a very important role in overcoming Pakistan's growing energy crisis.

3.1.3 The wind power program in Pakistan was initiated around ten (10) years ago by installation of wind measuring stations in the coastal areas of Sindh, Pakistan. The energy potential of 346,000 MW in the country is estimated by National Renewable Energy Laboratory, USA and only the Gharo – Keti Bander – Hyderabad wind corridor (the **Wind Corridor**) has a potential of 50,000 MW of wind power generation. If harnessed adequately, wind energy alone would eradicate energy shortages in the country. The Government of Pakistan is currently looking to build wind farms in the Wind Corridor, some of which are regions where electricity supply through the national grid has been a challenge.

3.1.4 The Government of Pakistan has clearly articulated its support for the development of renewable energies. Due to the fact that the use of wind energy is actually the most economical renewable energy production technique, the focus is on supporting the development of wind farms through wind based independent power producers (the **Wind IPPs**).

3.1.5 In light of compliance by the Project Company of all requirements under the RE Policy 2006 for eligibility of an application for a generation license and

following grant of a generation license and approval of Project Company's reference generation tariff, in each case, by NEPRA, the Project Company will finance, design, engineer, procure, construct, install, test, complete, commission, insure, operate and maintain the Project at Site.

3.1.6 The proposed Project has the advantage of being located in the Wind Corridor and thus will, following its completion, contribute towards relieving the shortage of electric power in the country.

3.1.7 Based on a thorough analysis of the national electricity generation structure and in light of technical parameters, it is anticipated that the Project shall operate as one of the most competitive independent power producers in Pakistan.

3.2 POWER OFF-TAKE

3.2.1 Following commercial operation date of the Project, the electricity generated will be sold to the Central Power Purchasing Agency (Guarantee) Limited (the **Power Purchaser**) pursuant to an energy purchase agreement (the **EPA**), which in turn will distribute and modulate the electricity generated by the Project Company.

3.2.2 The EPA will be finalized and executed by and between the Project Company and the Power Purchaser following NEPRA's approval of the Project Company's twenty five (25) years reference generation tariff, the grant of a generation license to the Project Company and the issuance by the AEDB of the Letter of Support.

4. THE SPONSOR

4.1 AN INTRODUCTION

Metro Group (the "Project Sponsor") is the Sponsor of the Project with 100% shareholding in the Project Company. The Project Company is the second wind power project being set up by the Project Sponsor, the first being a 50 MW wind power project i.e. Metro Power Company Limited (MPCL). Brief Profile of the Project Sponsor is given below:

Metro Group

Metro Group established business in 1948 and represents one of Pakistan's leading business groups with a diversified portfolio in power generation, trade and manufacturing, investments, real estate and information technology. The group has over 20 years of experience in building, owning and operating power generation facilities. It has shareholding and directorship in major power generation facilities i.e. (i) 1600 MW Kot Addu Power Company Limited, (ii) 1400 MW Hub Power Company, and (iii) 136 MW Gul Ahmed Energy Limited. Apart from these, Metro Group also owns and has developed Metro Power Company Limited (MPCL), a 50 MW wind power project which achieved COD in September 2016.

4.2 COMPANIES REPRESENTED BY METRO GROUP

i. Metro Power Company Limited

MPCL is a 50 MW wind power project set up by Metro Group in collaboration with InfraCo Asia. MPCL is currently in the operations phase and achieved COD in the 3rd Quarter of 2016.

ii. Hub Power Company

The Hub Power Company is one of the largest private power projects in Pakistan with an installed capacity of over 1,400MW. The station achieved COD on 31 March 1997. The Company also has 75% controlling interest in Laraib Energy Ltd, a subsidiary that is developing a 84 MW Hydel power plant in Azad Kashmir. Today, the Hub Power Company is listed on the Karachi, Lahore and Islamabad Stock Exchanges and its Global Depository Receipts are listed on the Luxembourg Stock Exchange. It has over thirteen thousand (13,000) Pakistani and International shareholders. Metro Group holds 0.9% shareholding in the company.

iii. Kot Addu Power Company Limited

Metro Group also holds 7.2% shareholding of Kot Addu Power Company Limited (KAPCO), which is a 1600MW multi fuel gas-turbine power plant. Pakistan Water and Power Development Authority (WAPDA) set up KAPCO in five phases between 1985 and 1996. Later WAPDA diversified its shareholding by initially 36% (1996) followed by another 18% (2005) to various strategic investors, local corporate entities and individuals.

5. RESOURCES

5.1 SENIOR MANAGEMENT & PERSONNEL

5.1.1 The Project Company has access to and has engaged the highly qualified personnel of its Sponsor, in addition to top ranking consultants, for the development of the Project. The Project Company is presently under the process of appointing various personnel and details of the same will be provided upon finalization of the terms and conditions of their appointment.

5.1.2 In addition, the curriculum vitae of the following individuals currently engaged by the Project Company are attached herewith at ANNEXURE H:

	NAME OF INDIVIDUALS	POSITION	ANNEXURE
1.	MR. YASIN HAJI KASSAM	Chairman	H
2.	MR. DANISH IQBAL	Chief Executive Officer/Director	H
4.	MR. SAAD IQBAL	Director	H

5.2 THE EPC CONTRACTOR

5.2.1 In addition to recruitment of its own management, staff and personnel for the purposes of the Project, the Project Company has selected HYDROCHINA CORPORATION as the EPC Contractor for the Project.

5.3 TECHNICAL ADVISORS AND OWNER'S ENGINEERS

5.3.1 The Project Company has appointed RENEWABLE RESOURCES (PRIVATE) LIMITED (PAKISTAN) as technical advisors and 'Owner's Engineers' in respect of the Project.

5.4 FINANCIAL ADVISORS

5.4.1 The Project Company has appointed BRIDGE FACTOR PRIVATE LIMITED as its financial advisor in respect of the Project. Bridge Factor has advised a number of power projects, including majority of the wind power projects in Pakistan

5.5 LEGAL ADVISOR

5.5.1 HaidermotaBNR has been selected by the Project Company to provide legal support on all legal aspects of the Project including Project documentation, regulation and financing matters.

6. CAPITAL BUDGET

6.1 The estimated total Project cost (the **Total Project Cost**), expressed in United States Dollars, has been calculated after thorough analysis, evaluation and understanding of the dynamics that affect the development and operation of a wind farm. The Total Project Cost comes to approximately US$ 110,000,000 (United States Dollars One hundred and ten Million).

6.2 The capital structure of the Project is proposed as follows:

	USD
DEBT	82,500,000
EQUITY	27,500,000
TOTAL PROJECT COST	110,000,000

7. FINANCIAL PLAN

The Total Project Cost of approximately US$ 110,000,000 (United States Dollars One hundred and ten Million) is to be financed in a debt to equity ratio of 75:25, which is in accordance with the RE Policy 2006.

7.1 DEBT

7.1.1 With regards to debt financing for the Project, the Project Company is currently undergoing discussions with a consortium of leading Foreign Development Finance Institutions (DFIs) and local banks including International Finance Corporation, Asian Development Bank, DEG and United Bank Limited (the **Mandated Lead Arrangers**). The Mandated Lead Arrangers have provided soft commitments for an amount of up to USD 98,259,994 for the Project at competitive terms - a matter that signifies the confidence and keen interest of the lenders in the Project. A copy of the Mandate Letters by the International Finance Corporation, Asian Development Bank, DEG and United Bank Limited are attached hereto as ANNEXURE I for NEPRA's perusal.

7.2 EQUITY

7.2.1 Based on the Debt to Equity ratio of 75:25, the equity required to be injected by the Sponsors (the **Equity**) amounts to USD 27,500,000. The Sponsors have already committed the equity in respect of the Project and such arrangements have been agreed with the Mandated Lead Arrangers.

7.2.2 The financial strength of the Shareholders and the Cash Balance certificate of the Project Company is also included in ANNEXURE J.

8. THE PROJECT & THE FACILITY

8.1 PROJECT BACKGROUND

8.1.1 Since the issuance of the LOI, the Project Company conducted various studies to assess the feasibility of the Project. These studies *inter alia* included the wind resource assessment, geo technical investigation, digital topographic map, initial environmental examination and grid interconnection study. The complete feasibility study was submitted by the Project Company to EDGOS.

8.1.2 In order to select EPC and O&M contractors for the Project, the Project Company carried out a bidding process by circulating RFPs to the EPC contractors for awarding the turnkey EPC contracts for the development of the Project and following submitted the bids:

- Descon Engineering Limited;
- Nordex Germany;
- Huadong Engineering Corporation Limited;
- Vestas Asia Pacific Wind Technology Pte Ltd;
- General Electric
- China Shipbuilding Industry Corporation
- HydroChina Corporation

8.1.3 After an extensive technical, financial and commercial evaluation process, the Project Company selected "**HydroChina Corporation**" as Engineering, Procurement & Construction (EPC) Contractor with **Gamesa G114-2.0** _ Wind Turbines.

8.2 PROJECT COMMENCEMENT AND COMPLETION SCHEDULE

Activities	Project Company
Submission of proposal, review and approval EDGOS	✓
Issuance of LOI	✓
Allocation of Land (Received Land Coordinates)	✓
Installation of Wind Masts	✓
All Technical Wind Related Studies	✓
Request for Proposal (RFP) to be sent to EPC contractors	✓
Selection of EPC & O&M Contractor	✓
Grid Interconnection Study by NTDC	✓

Mandate Letter by the Lead Arranger	✓
Indicative Term Sheet with Lead Advisor & Arranger	June 2017
Land Lease Execution	Submitted to Land Utilization Department for signing
Submission of Tariff Petition to NEPRA (Upfront Tariff)	June 2017 or when available
Signing of EPC & O&M Contract	Four months after tariff is made available
Submission of Performance Guarantee & Issuance of LOS	Six months after tariff is made available
Execution of Concession Documents	Five months after tariff is made available
Execution of Financing Documents	Five months after tariff is made available
Achievement of Financial Close	April 2018
Achievement of Commercial Operations Date	January 2020

8.3 PROJECT SITE

8.3.1 The site proposed for the implementation of the Project has been selected by considering:

- Location in the wind corridor;
- Wind conditions at the Site;
- Topographic conditions;
- Site accessibility; and
- Location of the grid with reference to the Site for interconnection. The Site is located within the wind corridor identified by EDGOS.

8.3.2 The Site is located in Jhimpir, District Thatta, Sindh, which is one of the most promising areas where wind power projects can be viably installed. The major track from Karachi to Nooriabad is via the Karachi-Hyderabad Motorway, and another access to the Project site is through Jhimpir. When travelling via the Karachi-Hyderabad Motorway, the access from Nooriabad to the site is a single track, which turns toward the site. However, the terrain is flat and long and heavy vehicles can easily navigate through this road.

There are number of neighboring wind farms in the surrounding area of Jhimpir. There is no requirement to establish roads or tracks for movement of traffic. The total distance from Karachi port to the site is approximately 108 km.

8.3.3 Land Description of the Project Site:

Total Land Area: 410 Acres		
	Geodetic Coordinates	
Point No.	Latitude (N)	Longitude (E)
Boundary 1	25° 1.248'N	67° 39.445'E
Boundary 2	25° 1.179'N	67° 39.396'E
Boundary 3	24° 57.849'N	67° 44.812'E
Boundary 4	24° 57.922'N	67° 44.852'E

8.3.4 The Project site is exposed to very strong south westerly winds; wind data analysis of the area suggests that, 80% wind blows from the south west direction. The terrain of the area is flat with small change in altitude. The proposed site lies under roughness class 1.5 as there is low vegetation. The site is easily accessible through metallic roads. The ground is hard and rocky; the subsurface soil also includes clay and silt.

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

8.3.6 The proposed site area lies in an arid zone with very little annual precipitation. The result is that there is hardly any natural vegetation in the area. Some hard tree species are visible scattered far and wide in the area. The area is rocky with some rock outcrops towards the Super Highway. There are small rock outcrops and hillocks left over by the wind and flash flood erosions in the middle of the project land. The terrain at the site and surrounding area is generally flat with elevations varying between 114m to 195m.

8.3.7 The proposed site is located about 108 km from Port Qasim Karachi. Karachi borders on the Arabian Sea and the weather belongs to tropical monsoon climate. Rainfall is scarce with about 200 mm for a whole year and most of this is concentrated in July and August. The temperature in winter from November to February is temperate, but it is hot with high temperature in summer from April to August as the highest temperature has reached 44.02 Celcius.

8.4 INFORMATION REGARDING INFRASTRUCTURE, ROADS, RAIL, STAFF COLONY, AMENITIES ETC.

8.4.1 The Project Company is located in Jhimpir Sindh within the same wind corridor as many other wind power projects. The Bin Qasim Port, which is the point of delivery of equipment for the Project, is located towards the Southwest of the Project.

8.4.2 In order to make transportation to the Site, a detailed Transportation and Site Access Study has been carried out by the technical consultants (refer to Annex 2 of Annexure A (Feasibility Study).

8.4.3 As per the study, access to Project Site has been planned from Port Qasim using National Highway and Super Highway, whereby two different routes leading to the Site have been studied with respect to the track quality, elevations, waterways, nearby surroundings, and overall suitability. Both routes are viable options and will serve as backup for each other during the construction period.

8.4.4 The study has elaborated few critical points that need to be addressed during the construction of the roads at the Site in order to make a suitable connection of the Site with the recommended routes and allow movement of heavy vehicles, hardware and execution of civil works.

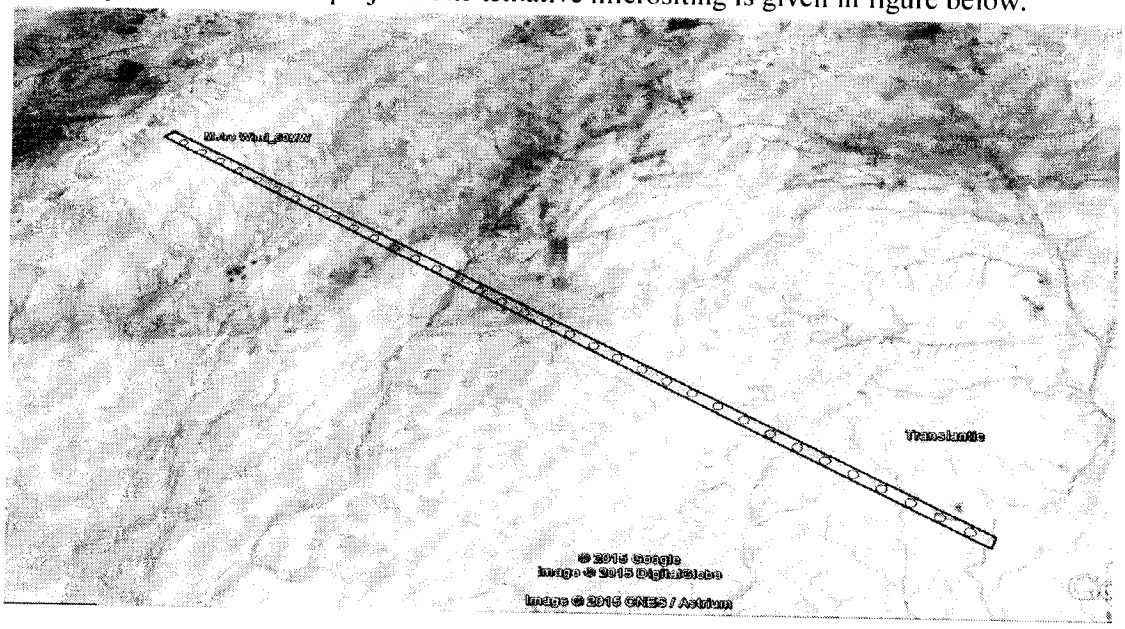
8.4.5 Under the turnkey EPC Contract, the EPC Contractor shall be responsible for the construction of roads at the Project Site and also for the access road. The EPC Contractor is also responsible for setting up clean, safe and secure staff colony within the Project Site, which will be used by the EPC and O&M Contractor's team during the construction and operation period of the Project. The Project team's staff will also be resident here.

8.4.6 Furthermore, the procurement of utilities for the staff colony and construction activities will be the responsibility of the Contractor under the EPC and O&M Contracts to be signed by the Project Company. During construction, electricity will be provided by generators and water will be transported via bowsers. Septic tanks will be constructed for all waste disposal. Disposal of waste shall be the responsibility of the EPC Contractor.

8.4.7 With regards to the telecommunication, the wire based land line network is currently available in nearby towns that can be requested for the Project Site (if required), whereas all major mobile operators already have coverage on the Site area. The Project Site will have a microwave antenna for dedicated high speed data and voice communications.

8.5 WIND FARMS LAYOUT AT PROJECT SITE

8.5.1 The wind farms site is in long and narrow in shape, the topography is relatively flat and the elevation above sea level is approximately 114-187m. There is little vegetation at the wind farm site. Wind Turbines will have a 93m hub height. See figure below for the sketch map for the WTG towers location setting parameters for the project. The tentative micrositing is given in figure below:



8.6 TOPOGRAPHICAL AND GEOLOGICAL CONDITIONS AT PROJECT SITE

8.6.1 Topographical conditions:

The Site is on a plain area at an elevation of 114-187m, which is generally flat, but a bit higher on the west and lower on the east. The landform at wind farm sites is mainly of pediment and the vegetation there is less developed.

8.6.2 Geological conditions:

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

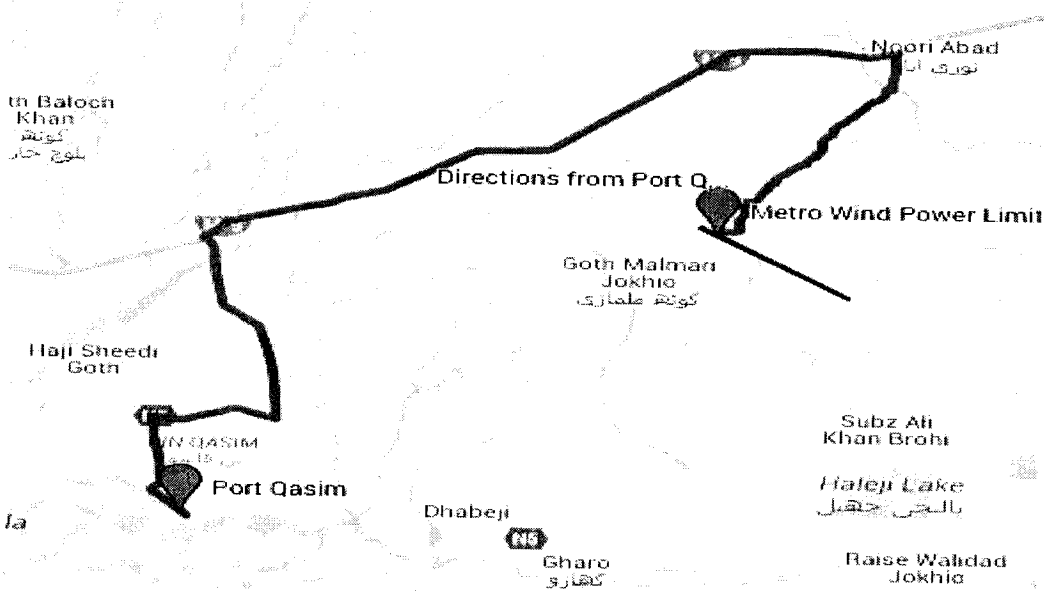
8.6.3 Hydrology:

According to the regional hydrological data available, the Project site is in a dry area, where the water table is deeply underground, and the surface water and

water in the shallow surface layers is weakly to slightly corrosive to the concrete and is corrosive to the rebars in the concrete which has been immerged in water for a long-time or alternatively in wet and dry conditions. Corrosion prevention measures will be adopted in the design and implementation of the wind farm.

8.7 SITE ACCESSIBILITY

8.7.1 The major track from Karachi to Nooriabad is via the Karachi-Hyderabad Motorway, and another access to the Project site is through Jhimpir. When travelling via the Karachi-Hyderabad Motorway, the access from Nooriabad to the site is a single track, which turns toward the site. However, the terrain is flat and long and heavy vehicles can easily navigate through this road. There are number of neighboring wind farms in the surrounding area of Jhimpir. There is no requirement to establish roads or tracks for movement of traffic. The total distance from Karachi to the site is approximately 130 km. The route is given in Figure below.



8.8 TELECOMMUNICATION AT PROJECT SITE

8.8.1 Close to the site, there is wire based telecommunication available in Jhimpir. Cellular phone suppliers, Warid Telecom Ltd, and Pakistan Telecommunication Mobile Ltd (Ufone) are offering services at the site. GPRS services are also available in the region.

8.8.2 For the SCADA system of the wind farm, a wire based telecommunication infrastructure has to be installed. Land line network will be arranged from Jhimpir once civil work starts at the site.

8.9 AVAILABILITY OF SEMI-SKILLED AND SKILLED LABOR

8.9.1 There is a dearth of wind project specific skilled labor in the area, however unskilled and semi-skilled labor is available in the area and the Project will be a source of employment for these individuals.

8.10 TRAINING AND DEVELOPMENT OF STAFF

8.10.1 The Operations & Management (O&M) of the Project shall be managed by the EPC Contractor for initial 2 years post-COD as Warranty Period O&M under the EPC Contract. The O&M for years 3 – 8 shall be carried out by the same contractor under the O&M Contract. The O & M Plan is attached herewith as ANNEXURE R for NEPRA's perusal. Throughout the O&M period, the Contractor shall be responsible for On Job Training (OJT) of the local team, which shall remain part of the O&M and gradually take over after completion of O&M tenure.

8.10.2 The EPC and O&M Contracts shall mention in detail the training requirements for the operation of the wind farm and the Project Company's personnel. As per the Contracts, the Contractors shall be required to provide details of how training will be carried out, including the number of days of training outside Pakistan, and the number of people who will be trained under their offer. The Contractor will ensure that the personnel working on the wind farm during the construction and the operation period are correctly trained and qualified for the roles that they are performing and that a record of their training is maintained.

8.10.3 The Contractors shall be required to provide special emphasis to the Health & Safety (H&S) aspects of the Project construction and operations, for which specific training will be provided by the Contractors to all of the operations and maintenance personnel, including the regulatory requirements for the use of any special safety equipment required for the undertaking of such functions. Such training will be in addition to any other training provided and will continue, for each individual, until each said individual can be certified by the Contractors as having attended the full H&S training, thus gaining sufficient appreciation of the H&S requirements to operate the Project.

8.10.4 Although the content of training modules will be finalized between the Contractors and the Project Company prior to COD, some specific training needs that will be covered include the following:

a) Procedures for operation and maintenance of the wind farm and its associated equipment.

b) Awareness and application of safe systems of work and responsibilities of all staff involved in operations and maintenance duties.
c) Fire control and prevention (including equipment maintenance and management and 'emergency plan').
d) First-aid provision (including 'emergency plan').
e) Working at heights (including 'emergency plan').
f) Working on, at or near rotating plant.
g) Working on, at or near high and low voltage AC and DC apparatus (HV & LV) and the differences between live, not live and dead circuits.
h) Working on, at or near energized systems (such as pressure vessels, accumulators, springs, gearing, torque arms, unearthed electrical systems and dampers).
i) Working on, at or near hazardous substances (oils, chemicals, insulators and gases).
j) Confined space works and requirements therein.

8.10.5 The Contractors shall provide or procure the provision of these training needs for all O&M personnel in order that the O&M services may be performed in accordance with the Project Agreements and Prudent Industry Practices.

8.11 PROJECT SITE SECURITY

8.11.1 The Project Company has plans to use the infrastructure at Jhimpir in the most efficient manner to provide seamless security at offices, accommodation and site.

8.12 SAFETY PLANS & EMERGENCY PLANS

8.12.1 The Project has carried out a comprehensive environmental study to assess the impact of the Project on the environment. The Study titled "Initial Environment Examination" (IEE) has already been approved by Sindh Environmental Protection Agency (SEPA) on 08 April 2016. As per the study, the Project has no significant hazardous impact on the environment. However, the study has addressed minor adjustments that shall be required during the construction phase in order to ensure the safety of the environment and Project personnel. The study also details an environment management plan, which will be enforced by the project team and the EPC contractor. The recommendations of the IEE have further been enforced upon by SEPA in its approval of the IEE. As per the EPC Contract to be signed by the Project Company, the EPC Contractor will be responsible for adhering to the recommendations of the IEE during the construction phase in order to comply with the SEPA approval. A copy of the IEE has shall be provided to the EPC Contractor as part of the EPC Contract.

8.12.2 In addition, the EPC Contractor shall be required under the EPC Contract to comply with all applicable safety regulations according to the laws of Pakistan and take care for safety of all personnel entitled to be on the Site. The EPC Contractor shall use reasonable efforts to keep the Site clear of unnecessary obstruction. Furthermore, the EPC Contractor shall be responsible for provision of, lighting, guarding and watching of the facility during construction of the Project. The EPC Contract shall also require the EPC Contractor to provide temporary roadways, footways, guards and fences during construction for the use and protection of the public and of owners and occupiers of adjacent land

8.12.3 Similarly the O&M Contractor shall be required under the O&M Contract to provide security in accordance with prudent industry practices. The O&M Contractor shall comply with reasonable health and safety requirements established from time to time by the legal and regulatory authorities. The O&M Contract shall also require the O&M Contractor to take all reasonable precautions to protect the Complex, Project Company and O&M Contractor's Personnel, sub- contractors, public and the environment

8.12.4 With regards to the health and safety of the personnel 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.

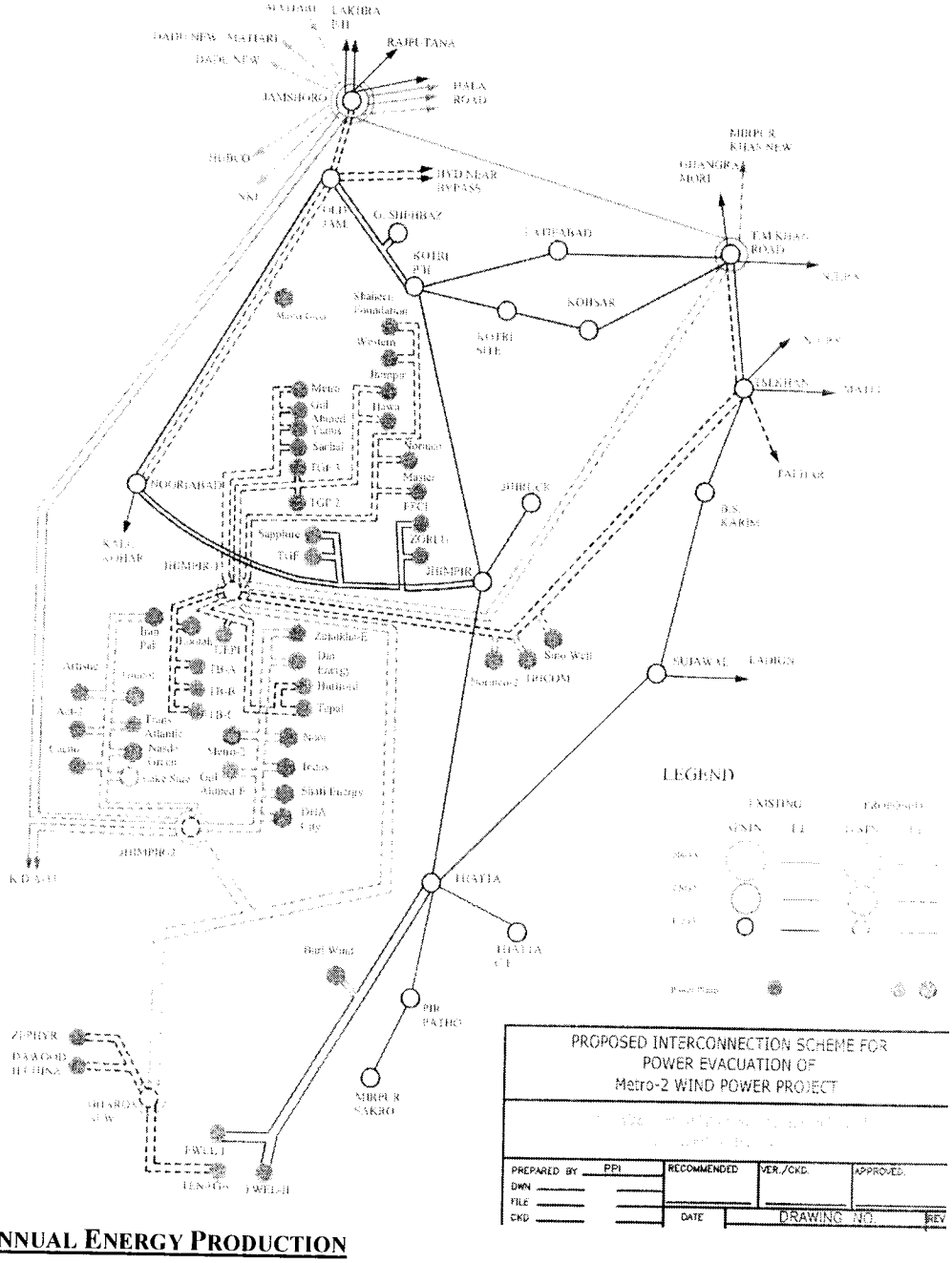
8.12.5 A safety and health supervision department will be established on the wind farm, which is to be in charge of the education, training and management of safety and health related issues after the project is put into operation. There will be safety personnel in the production section, and a part-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

8.12.6 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.

8.12.7 A comprehensive safety system will be established during the preparation phase, and carefully implemented during the construction and operation 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 seriously observed to preclude accidents such as fall, fire, or electric shock.

8.13 GRID CONNECTIVITY

8.13.1 The Project would be connected by a double circuit of 132kV looping in-out with a sub cluster also connecting nearby WPPs to Jhimpir-2 132/220 kV Grid. The proposed interconnection scheme for the evacuation of power from the project is shown below.



8.14 ANNUAL ENERGY PRODUCTION

8.14.1 The Annual Energy Production shall be 183.96 GWh. The tables below show key details relating to power generation from the Project.

Installed Gross ISO Capacity of Project	60 MW
Annual Energy Generation	183.96 GWh
Capacity Factor	35.0 %

8.15 WTG TECHNOLOGY & EPC BIDDING PROCESS

8.15.1 The Project Company, in order to get the right companies involved in the procurement and construction of the project conducted a bidding process. The Consultants of the Project Company developed prequalification criteria for this purpose, which included the following:

- Machines should be available in hot climate version.
- Should not be in litigation over completion liability issues in the region.
- Should have been viable financial entity for at least last three years.
- Should have successfully completed works of similar sizes in last three years.
- Suitable population of the proposed machine installed and working..

8.15.2 Based on the pre-qualification attributes set aside by the Project Company's Technical Management and its follow up with the EPC vendors, the RFPs were sent out to vendors fulfilling the criteria.

8.15.3 The Project Company received interest from various international WTG suppliers and EPC contractors. After considerable effort and receipt of proposals from many suppliers, the Project Company took this input as a starting point and started negotiations with the vendors for EPC proposals.

8.15.4 Based on its thorough due diligence and following an intense negotiations process with the various suppliers and contractors, the Project Company has shortlisted "**HydroChina Corporation**" and "**GAMESA WTG G114-2.0"** as the technology for its Project with a fixed price and fixed Commercial Operations Date.

8.16 GAMESA– THE WTG MANUFACTURER

8.16.1 Gamesa is an international, multi-faceted wind power company with 22 years' experience in the wind industry and more than 35,800 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.

8.16.2 The company has production centers 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.

8.16.3 Gamesa is also a world leader in the development, construction and sale of wind farms.

8.16.4 The annual equivalent of its 35,200 MW installed amounts to more than 7.6 million tons of petroleum (TEP) per year and prevents the emission into the atmosphere of close to 52.8 million tonnes of CO_2 per year.

8.16.5 The 2.0 MW platform, G114-2.0 WTG model selected for the project contributes more than 150 MW to total accumulated capacity.

8.16.6 The specifications of 2.0 MW G114 -2.0 turbine are as follows:

(i).	Wind Turbine Type, Make & Model	G114-2.0
(ii).	Installed Capacity of Wind Farm (MW)	60 MW
(iii).	Number of Wind Turbine Units/Size of each Unit (KW)	30 x 2.0 MW
(iv).	Number of blades	3
(v).	Rotor diameter	114 m
(vi).	Hub Height	93m
(vii).	Generator Voltage	690 V
(viii).	Cut-in wind speed	3 m/s
(ix).	Cut-out wind speed	25 m/s
(x).	Survival wind speed	59.5 m/s

8.16.7 The energy data of the wind farm is given below.

-1	Total Installed/Gross ISO Capacity (MW)	60 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)	207.87
-5	Array & Miscellaneous Losses (GWh)	14.72
-6	Availability Losses (GWh)	5.52
-7	Balance of Plant Losses (GWh)	3.68
-8	Annual Energy Generation (25 year equivalent Net AEP) GWh	183.96
-9	Net Capacity Factor	35.00%

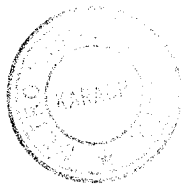
8.17 EPC CONTRACTOR

8.17.1 The details of the EPC Contractor selected for the Project are attached as ANNEXURE D.

CONCLUSION

In light of the submissions, the relevant financial analysis and information contained in this Generation License Application, along with the Annexures attached hereto, this Generation License Application is submitted for NEPRA's kind consideration and grant of the Generation License to the Project Company.

Respectfully submitted for and on behalf of:
METRO WIND POWER LIMITED



.....

MR. DANISH IQBAL
AUTHORIZED REPRESENTATIVE OF
METRO WIND POWER LIMITED

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 Licensee are described in this Schedule.

Actual drawings pertaining to Wind Farm Location Map, Wind Farm Lay Out, Wind Farm Micro-Sitting, Single Line Diagram (Electrical System of the Wind Farm),

Location of Generation Facility/ Wind Farm

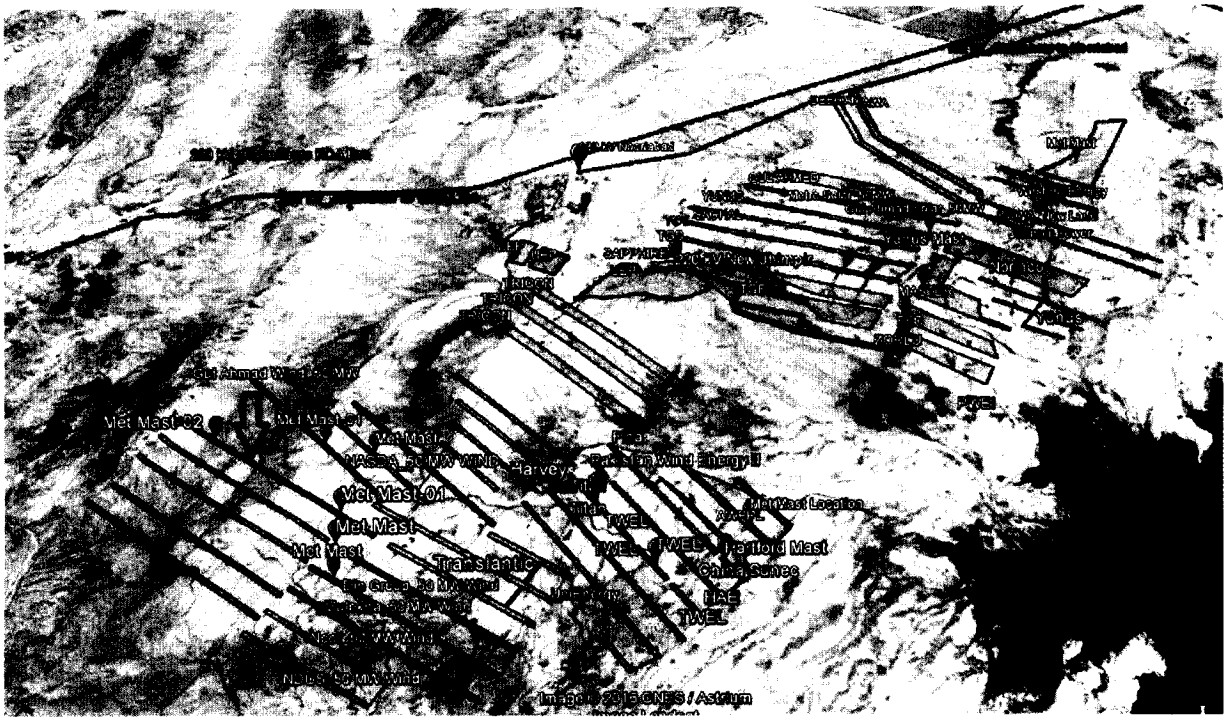
The wind farm Project is located in Jhimpir, which is located approximately 108 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 410 acres of land, which is leased by GoS. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site. The Jhimpir wind corridor is identified as potential area for the development of wind power projects. The overview of the project site is shown below:

Project Size

The Project shall have an installed capacity of approx. 60 MW rated power. The number of WTGs are 30 with capacity of 2.0 MW each.

Layout of Generation Facility/ Wind Farm

The general layout along with neighboring Wind Farms of 60 MW MWPL is shown in figure below.



Land Coordinates of Generation Facility/Wind Farm

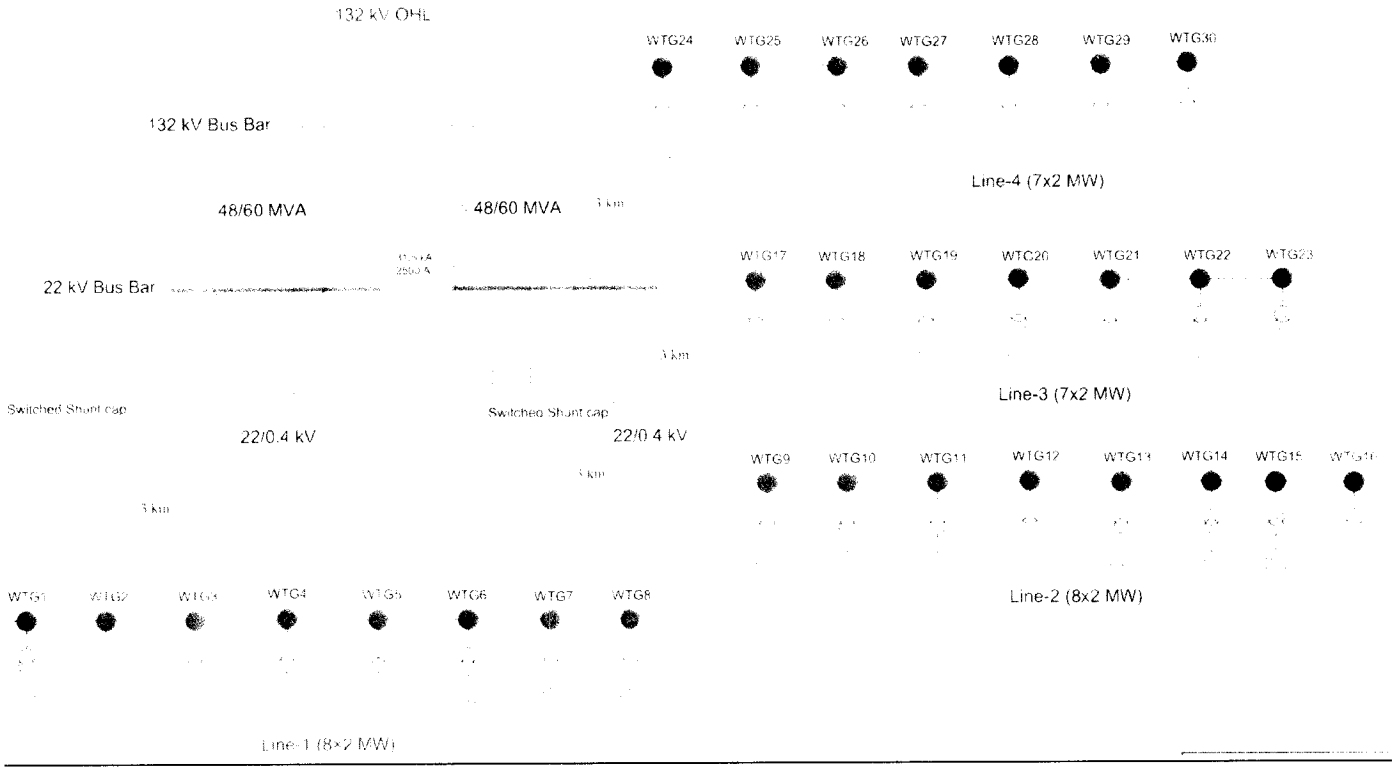
Location: Jhimpir – Sindh, Pakistan

The Site coordinates are given in Table below.

	Geodetic Coordinates	
Point No.	**Latitude (N)**	**Longitude (E)**
Boundary 1	25° 1.248'N	67° 39.445'E
Boundary 2	25° 1.179'N	67° 39.396'E
Boundary 3	24° 57.849'N	67° 44.812'E
Boundary 4	24° 57.922'N	67° 44.852'E

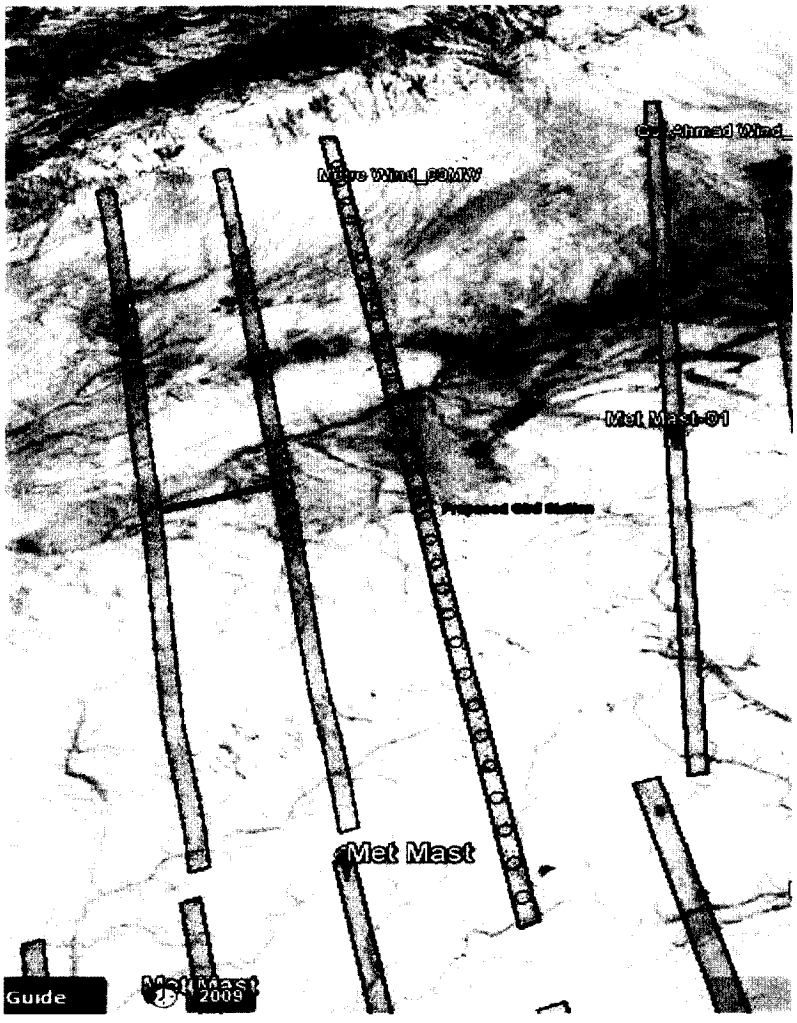
Electrical System Single Line Diagram of Generation Facility/Wind Farm

The project will install 30 WTGs (Gamesa G114-2.0). There shall be four (04) WTG collector groups, two of which will consist of 8 WTGs each and other two will group 7 WTGs each, as shown below:



Micro-Sitting of Generation Facility/Wind Farm

The micrositing of Wind Farm with 30 WTGs is given in figure below.



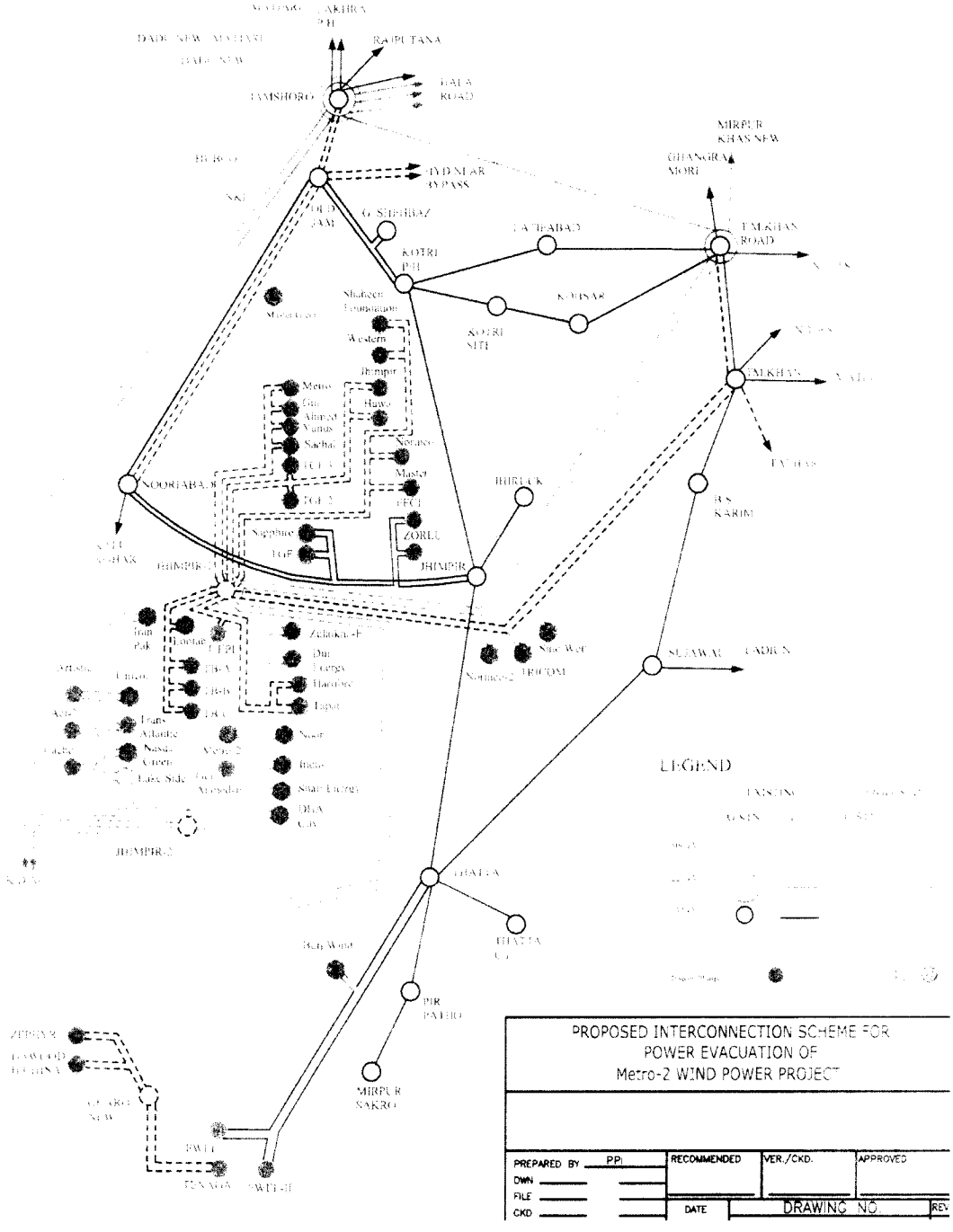
The coordinates (UTM z42 WGS84) of WTGs are given in table below

Turbine No.	Easting [m]	Northing [m]
Metro_G01	364871.49	2767600.17
Metro_G02	365153.12	2767406.14
Metro_G03	365434.75	2767212.1
Metro_G04	365716.37	2767018.07
Metro_G05	366279.63	2766630
Metro_G06	366561.26	2766435.96
Metro_G07	366842.89	2766241.92
Metro_G08	367124.51	2766047.89
Metro_G09	367406.14	2765853.85

Metro_G10	367687.77	2765659.82
Metro_G11	367969.4	2765465.78
Metro_G12	368251.02	2765271.75
Metro_G13	368532.65	2765077.71
Metro_G14	368814.28	2764883.68
Metro_G15	369095.91	2764689.64
Metro_G16	369377.53	2764495.6
Metro_G17	369659.16	2764301.57
Metro_G18	369940.79	2764107.53
Metro_G19	370222.42	2763913.5
Metro_G20	370504.05	2763719.46
Metro_G21	370785.67	2763525.43
Metro_G22	371067.3	2763331.39
Metro_G23	371348.93	2763137.35
Metro_G24	371630.56	2762943.32
Metro_G25	371912.18	2762749.28
Metro_G26	372193.81	2762555.25
Metro_G27	372475.44	2762361.21
Metro_G28	372757.07	2762167.18
Metro_G29	373038.69	2761973.14
Metro_G30	373320.32	2761779.1

Schematic Diagram for Interconnection Arrangement/Transmission Facilities for Dispersal of Power from MWPL

MWPL would be connected by a double circuit of 132kv looping in-out with a sub cluster connecting neighboring WPPs, to newly proposed 220/132kv Jhimpir-2 Grid station. The proposed grid interconnection scheme is shown below:



Detail of Generation Facility/Power Plant/ Wind Farm

(A). General Information

(i).	Name of Applicant/Company	Metro Wind Power limited (MWPL)
(ii)	Registered Office	36-F, Block 6, P.E.C.H.S, Karachi - 75400
(iii).	Business Office	Address: 7th floor, Al-Tijarah Centre, 32-1-A, Block 6, P.E.C.H.S., Main Shara-e-Faisal, Karachi. Ph: 92 21 34540270-73
(iv).	Plant Location	Jhimpir, District Thatta, Sindh
(v).	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)	60 MW
(iii).	Number of Wind Turbine Units/Size of each Unit (kW)	30 x 2000 kW

(C). Wind Turbine Details

(a). Rotor		
(i)	Rated Power	2.0 MW
(ii).	Number of Blades	3
(iii).	Rotor Speed	7-14.7rpm
(iv).	Rotor Diameter	114m
(v).	Swept Area	10207m^2
(vi).	Power Regulation	Reactive and active
(vii).	Rated Power at	2000kw
(viii).	Cut-in wind speed	3m/s

(ix).	Cut-out wind speed	25m/s
(x).	Survival wind speed	59.5m/s (Maximum 3 sec)
(xii).	Pitch regulation	Type: Hydraulic pitch Principle: independent pitch
(b). Blades		
(i).	Blade Length	56m
(ii).	Material	Glass fiber reinforced composited material
(iii).	Weight	13T
(c). Gearbox		
(i).	Type	One step planetary /two steps parallel
(ii).	Gear ratio	1:128.5
(iii).	Weight	12.5-16T
(iv).	Oil quantity	460L
(v).	Main shaft bearing	Manufacturer : Gamesa/supplier
(d). Generator		
(i).	Power	2040kw
(ii).	Voltage	690V
(iii).	Type	Double-fed asynchronous generator
(iv).	Speed	1680rpm
(v).	Enclosure class	F (insulated class)
(vi).	Coupling	Stator: Delta Rotor: Star
(vii).	Efficiency	98%
(viii).	Weight	≤7.1 T
(ix).	Power factor	Ind 0.95 – Cap 0.95
(e). Yaw System		
(i).	Yaw bearing	PETP
(ii).	Brake	Active yaw
(iii).	Yaw drive	Motor drive
(iv).	Speed	0.42°/s (controlling speed)
(f). Control System		
(i).	Type	PLC
(ii).	Grid connection	CCU (Converter Control Unit)
(iii).	Scope of monitoring	CMS (Condition Monitoring System) monitoring gearbox, generator and main shaft

(iv).	Recording	The SCADA system is integrated into the turbine, Normal operation, safety protection, fault inspection and handling, operation parameters setting and data recording, frequency is recorded: every 5 second
(g). Brake		
(i).	Design	Gamesa
(ii).	Operational brake	Aerodynamic brake
(iii).	Secondary brake	High speed shaft disc break
(h). Tower		
(i).	Type	Conic tube
(ii).	Hub heights	93m

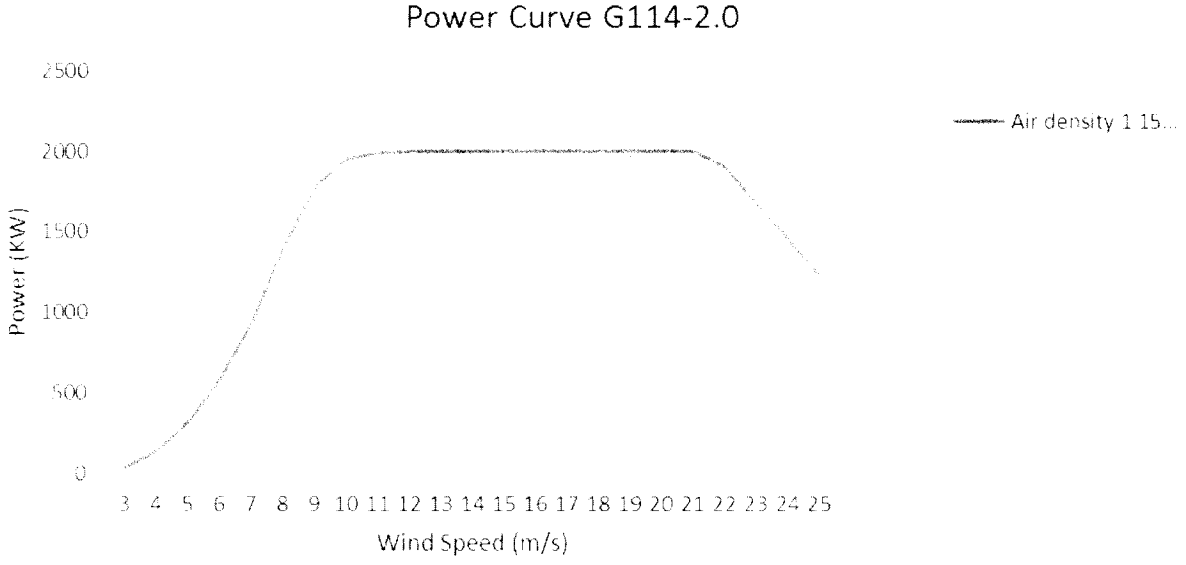
(D). Other Details

(i).	Project Commissioning Date (Anticipated)	January 2020
(ii).	Expected Life of the Project from Commercial Operation Date (COD)	25 Years

Power Curve of Gamesa G114-2.0 MW Wind Turbine Generator

The tabular and graphical values of Power curve at 1.15 Kg/m^3 air density are shown below:

Wind Speed at hub height (m/s)	Power (KW)
3	29
4	135
5	319
6	581
7	943
8	1408
9	1789
10	1951
11	1991
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 G114-2.0
2500
2000
1500
1000
500
0
Power (KW)
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Wind Speed (m/s)
Air density 1.15...

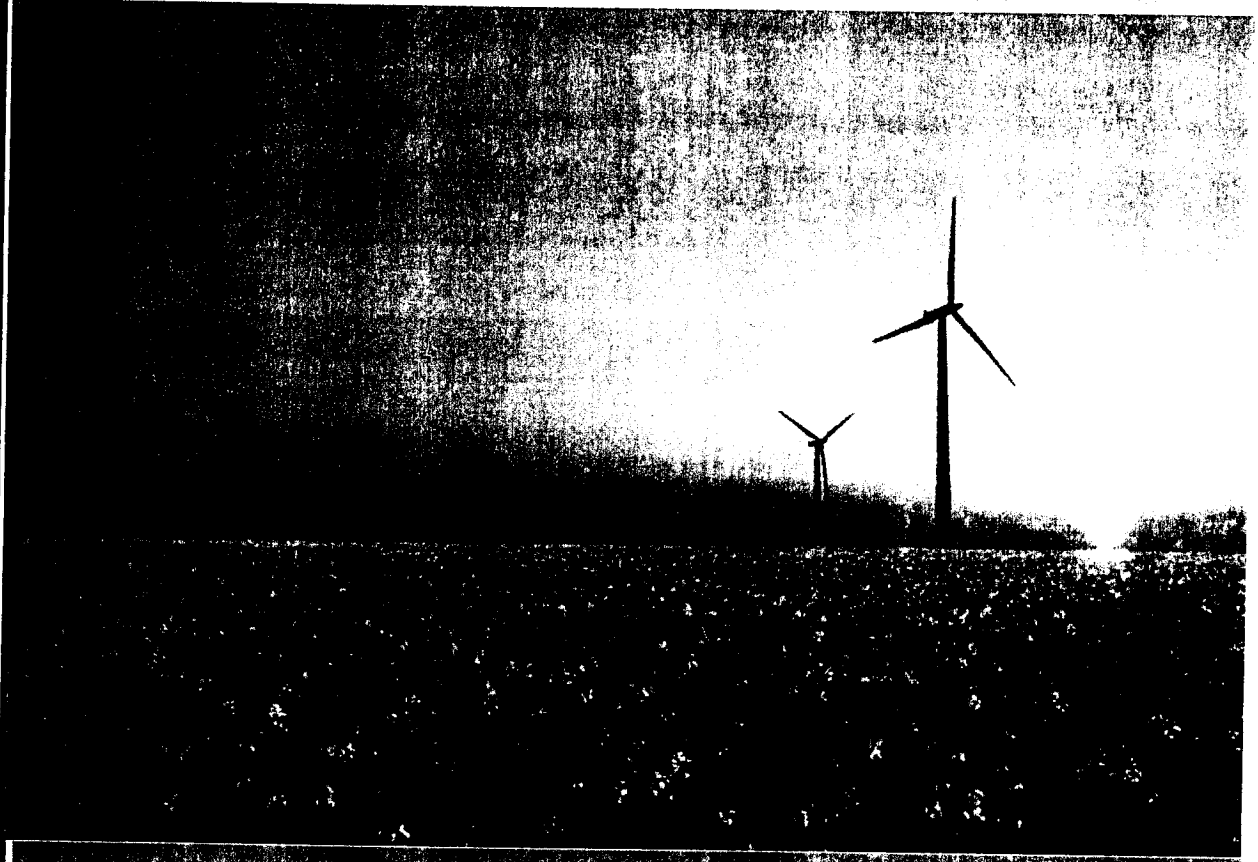
SCHEDULE-II

(1).	Total Installed Gross ISO Capacity of the Generation Facility /Wind Farm (MW/GWh)	60 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)	207.87 GWh
(5).	Array & Miscellaneous Losses GWh	14.72 GWh
(6).	Availability Losses GWh	5.52 GWh
(7).	Balance of Plant Losses GWh	3.68 GWh
(8).	Annual Energy Generation (25 year equivalent Net AEP) GWh	183.96 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.

FEASIBILITY STUDY REPORT FOR 60 MW WIND POWER PROJECT IN JHIMPIR, SINDH PAKISTAN



Feb, 2016

PROJECT COMPANY

Metro Wind Power Limited

PROJECT CONSULTANT

Renewable Resources (Pvt.) Ltd

Certified True Copy
Metro Wind Power Limited
Company Secretary

APPROVAL SHEET

TITLE : Feasibility Study Report for 60 MW Wind Power Project in Jhimpir-Sindh, Pakistan

DOCUMENT NUMBER : RE2-141-172-003 Issue: 03

CLASSIFICATION : **CONTROLLED**

SYNOPSIS

This document is a feasibility study report of 60MW Wind Power Project sponsored by Iqbal AliMohamed and Family. 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.

Metro Wind Power Limited
Company Secretary

DATE : Feburary, 16

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:

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danish.iqbal@gaenergy.com

Company Secretary

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Metro Wind Power Limited
Company Secretary

Company Secretary

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LIST OF ABBREVIATIONS

AC	Alternate Current
AEDB	Alternative Energy Development Board
C.R	Core Recovery
CDM	Clean Development Mechanism
CFCs	Chlorofluoro Carbons
CH_4	Methane
Cm	Centimeter
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
CoP	Conference of the Parties
CPPA	Central Power Purchasing Agency
DC	Direct Current
DISCOs	Distribution Companies
EE	Energy Efficiency
EMP	Environment Management Plan
EPA	Energy Purchase Agreement
EPC	Engineering Procurement Construction
EU	European Union
GENCOs	Generation Companies

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GHG	Green House Gas
GIS	Geographic Information System
GoP	Government of Pakistan
GoS	Government of Sindh
GPS	Global Positioning System
GW	Gold Wind
HESCO	Hyderabad Electric Supply Corporation
DAE	Department of Alternate Energy, Sindh
Hz	Hertz
IEE	Initial Environmental Examination
IPPs	Independent Power Producers
JI	Joint Implementation
Km	Kilometer
kV	Kilovolt
KW	Kilowatt
LOI	Letter of Intent
LOS	Letter of Support
m^2	Meter square
m^3/h	Meter cube per hour
MVA	Million Volt-Ampere
MW	Megawatt

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N_2O	Nitrous Oxide
NEPRA	National Electricity Power Regulatory Authority
NOCs	No Objection Certificates
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Dispatch Company
O & M	Operation & Maintenance
OECD	Organization for Economic Cooperation and Development
OHL	Overhead Lines
PCM	Pulse Code Modulation
QC	Quality Control
RE	Renewable Energy
RE2	Renewable Resources (Pvt.) Ltd
RQD	Rock Quality Designation
SF_6	Sulfur Hexafluoride
SPT	Standard Penetration Test
WAPDA	Water And Power Development Authority
WTG	Wind Turbine Generator

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 costal 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 uncertainty in 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.

MWPL is a company incorporated under the laws of Pakistan and is owned by Mr. Iqbal Alimohamed & Family (the "Sponsor"). Mr. Iqbal Alimohamed & Family has spearheaded the recent financial close of a 50 MW wind power project at Jhimpir, Taluka & District Thatta, Province of Sindh, Pakistan and this project is currently in its construction phase.

Metro Wind Power Ltd has land available having area of approximately 410 Acres. In order to identify the land for the wind farm within the same area, preliminary site assessment has been carried out. 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.

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1.1 PROJECT OVERVIEW AND SITE

The wind farm Project is located in Jhimpir, which is located approximately 130 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 410 acres of land, which is leased by GoS. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site. The Jhimpir wind corridor is identified as potential area for the development of wind power projects. The overview of the project site is shown in ***Figure 1***.

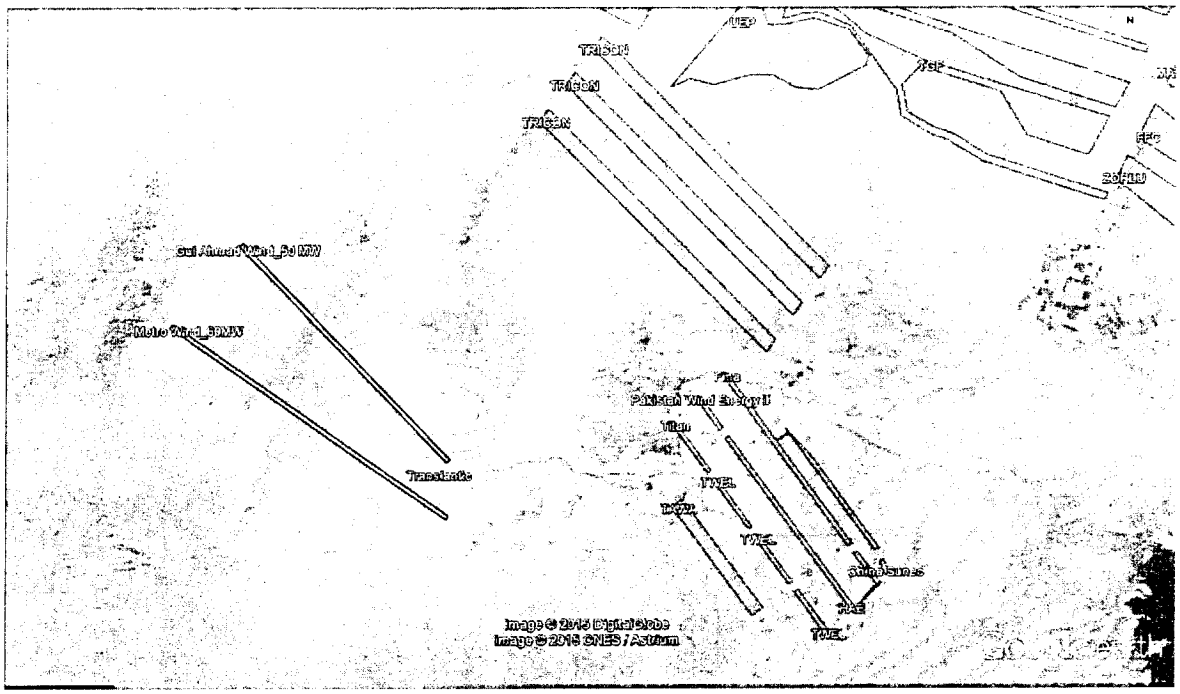

Figure 1: MWPL Site overview

The terrain is flat at the Project Site with little vegetation, savanna being the 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***.

Company Secretary

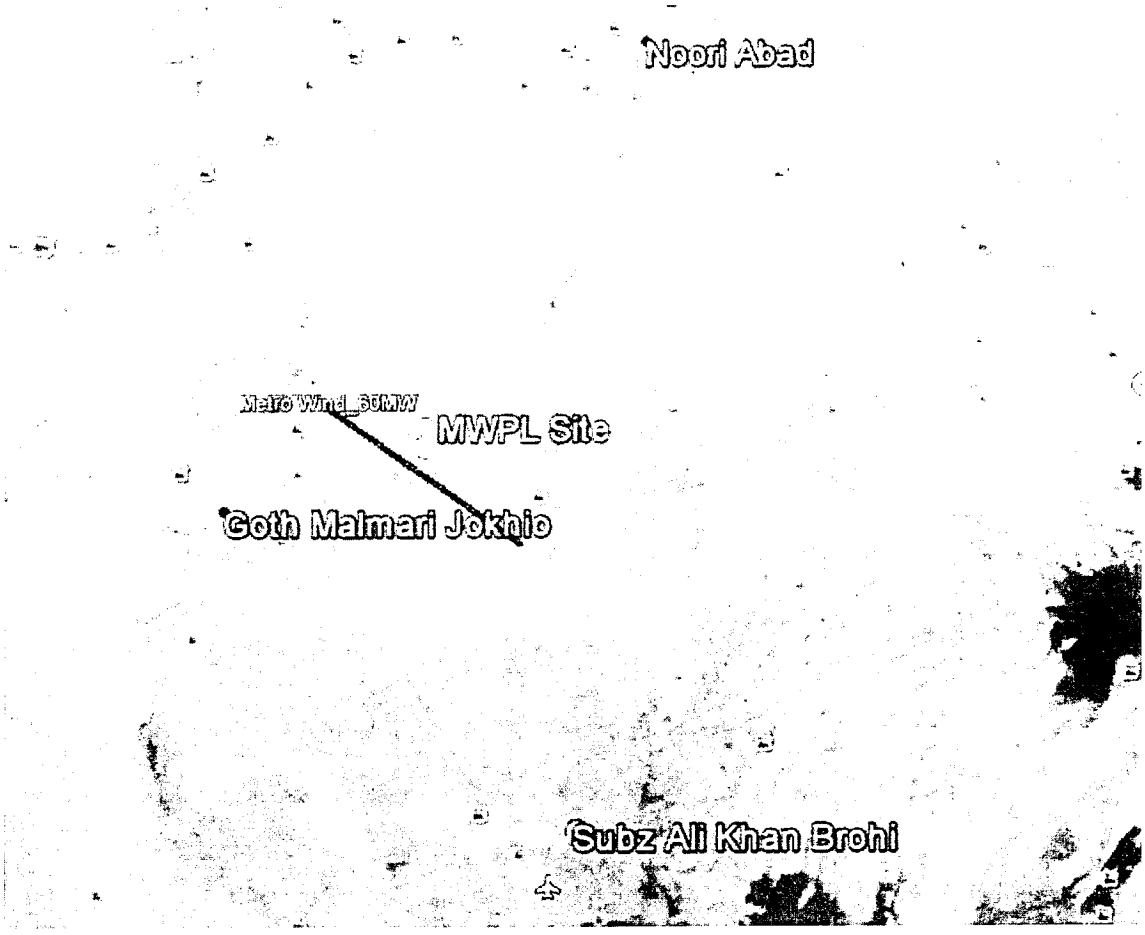

Figure 2: Satellite map of the MWPL Site

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

1.1.1 Project Size

The Project shall have an installed capacity of 60 MW, having area of 410 Acres. However, the actual land requirement shall be determined during the evaluation of the different generation equipment on offer, and may therefore differ from the already allocated 410 Acres.

Metro Wind Power Limited
Company Secretary

1.1.2 Project Status and Calendar

The project calendar is given below:

Table 1: Project Planned Milestones

Activity / Milestone	2015	2016				2017				2018	
	4th QTR	1stQRT	2ndQTR	3rdQTR	4thQTR	1stQTR	2ndQTR	3rdQTR	4thQTR	1stQTR	2ndQTR
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 14 months from the date of planning till the COD.

Table 2: Project Construction Scheduling

Activity / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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														

It is to be that noted that the Project construction schedule is based on 50 MW project size and is aimed by deploying parallel works. It has been assumed in this way due to NEPRA's persistence approach for having fix construction period regardless of the project capacity. Still, it is deemed appropriate to take longer construction period, which will be discussed with NEPRA at the tariff stage.

Company Secretary

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 20 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 – 3.0 m. 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.

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 60 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 power 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

Information related to the construction management is given in Section 14.

1.1.9 O & M Management

During the Warranty Period O&M (first 2 years), the responsibility of O&M shall be with the EPC Contractor. However, that responsibility shall be captured through a separate agreement. Therefore, three contracts: (1) the EPC Contract with the selected EPC contractor, (2) the 2 year O&M Contract with the EPC Contractor, (3) 8 year O&M Contract with the WTG supplier. In parallel, there shall be a mechanism to sign off a WTG supply Agreement with the WTG supplier and reset of the works as turnkey with the EPC Contractor. This shall be followed by having a Direct Agreement among WTG

supplier, EPC Contractor, Sponsor and Lenders. Again, the 2 year O&M shall be with the EPC Contractor and 8 year O&M Contract with the WTG supplier.

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

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

A separate environment study has been carried out. The Initial Environment Examination (IEE) report is attached as Annex VII.

There are no significant hazards. The minor adjustments required during construction phase have been addressed and mitigation plan provided. 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.

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.

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

Company Secretary

implemented. The Safety Regulation of the wind farm will also be carefully observed to avoid 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.

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.

Presently, the Project plans to opt for upcoming upfront tariff. Therefore Annex III and Annex IV, being not required for an upfront tariff, are not submitted for approval at present. If for any reason, the Project is not able to opt for the upfront tariff, then the cost plus option will be opted and the wind studies will be submitted to relevant departments.

Company Secretary

1.3 PROJECT TEAM

1.3.1 Metro Wind Power Ltd. (MWPL)

MWPL is a company incorporated under the laws of Pakistan and is owned by Mr. Iqbal Alimohamed & Family (the "Sponsor"). Mr. Iqbal Alimohamed & Family has spearheaded the recent financial close of a 50 MW wind power project at Jhimpir, Taluka & District Thatta, Province of Sindh, Pakistan and this project is currently in its construction phase.

Mr. Iqbal Alimohamed & Family intends to develop a 60 MW wind power project located at Jhimpir, District Thatta, Sindh. In relation hereto, Mr. Iqbal Alimohamed & Family wish to invite and receive bids for inter alia, the engineering, procurement and construction of the wind power projects.

Mr. Iqbal Alimohamed & Family are also involved in development of another 50MW Wind Power Project i.e. Gul Ahmed Electric Limited simultaneously. Sponsor has envisaged keeping the same set of Lenders for both the projects and are currently discussing financing options with various leading local and foreign banks.

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

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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.

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 Hydel 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.

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2 COUNTRY AND INDUSTRY OVERVIEW

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.

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 social life. The situation has further forced Government of Pakistan to again 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.

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 Agency Guarantee Ltd. (CPPA-GL)
- Department of Alternate Energy, Sindh (DAE-GoS)

3.1 MINISTRY OF WATER AND POWER

The federal Ministry of Water and Power is the GoPs 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 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 to be the same platform for federal as well as provincial projects.

3.3 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.

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.

3.4 CENTRAL POWER PURCHASE AGENCY GUARANTEE LIMITED (CPPA-GL)

CPPA-GL is an agency to purchase power from wind power plants on behalf of NTDC. CPPA-GL acts as a one window for all affairs related to NTDC for the Project including signing of the Energy Purchase Agreement (EPA), establishment of Operating Committee (OC), development of Operating Procedures (OP), appointment of Independent Engineer (IE) and testing of the Project leading to declaration of commercial operations. CPPA-GL also handles payments to the Project against sale of electricity and all sort of Non Project Missed Volume (NPMV) under the EPA.

3.5 Department of Alternate Energy Government of Sindh

Energy Department, 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. 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.

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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 Annex I (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.

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 as a whole, 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.

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

Emission trading 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 CO_2 emission against the emissions prevented when technology that cuts down on greenhouse gas emissions is deployed in poor countries.

Company Secretary

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.

4.2 ROLE OF CDM IN MWPL 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.

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 work in new markets like Pakistan. But now most of the suppliers are keen for the Pakistani market. One factor might be continuous maturity of Pakistani market. Presently, 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 GoS for various projects till date are in the range of 100.

5.1.2 Land Allocation by AEDB / GOS

AEDB along with GOS got approx. 31,000 acres of land from GOS and further allocated land to twenty six (26) wind IPPs.

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:

Table 3: Wind Projects with CODs achieved

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

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

Table 4: Wind Projects at Construction Stages

No.	Company	Capacity (MW)
1	Yunus Energy Ltd	50.0
2	Metro Power Company Ltd	50.0
3	Gul Ahmed Wind Power Ltd	50.0
4	UEP Wind (Pvt) Ltd	99.0
5	Master Wind Energy Ltd	52.8
6	Tapal Wind (Pvt) Ltd	30.0
7	HydroChina Dawood	49.5
8	Tenega Genarsi	49.5

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5.1.4 Projects at Advanced Development Stages

Following projects have reached the Generation License / Tariff stage:

Table 5: Wind Projects at Advanced Development Stages

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

5.1.5 Projects at Initial Development Stages

During 2015, various projects have got their LOIs and lands from GOS. The approvals of land have been done in most cases and final allotment letters are awaited for the consent of Chief Minister, Sindh. All these projects are currently at different stages of feasibility study and EPC bidding. These include:

Table 6: Wind Projects at Initial Development Stages

No.	Company	Capacity (MW)
1	Master Green Energy Ltd	100.0
2	Metro Wind Power Ltd	60.0
3	Gul Ahmed Electric Ltd	50.0
4	ACT2 Wind (Pvt) Ltd	50.0
5	Artistic Wind Power (Pvt) Ltd	50.0
6	Uni Energy Ltd	50.0
7	Din Group	50.0
8	Liberty Group	50.0
9	Naveena Group	50.0

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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 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 has 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.

The current upfront tariff allows full payment till an annual capacity factor of 35% is achieved. Afterwards, the tariff decreases to 75% from 35% till 36%. Then the tariff starts rising reaching 80% from 36% till 37%. Thereafter, the tariff regains its 100% value. This scheme is to intensify the high efficiency WTGs.

Most of the projects now prefer upfront tariff. MWPL intends to opt for the upfront tariff.

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 accomplished in July 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 has been allocated from Government of Sindh in terms of legal formalities.

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.

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6.6 LETTER OF SUPPORT (LOS)

Once the tariff is approved, the Project Company is required to move for arrangement of financing. DAE GoS will issue a 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.

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. However, the discussions with lenders have already been started.

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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 3.***

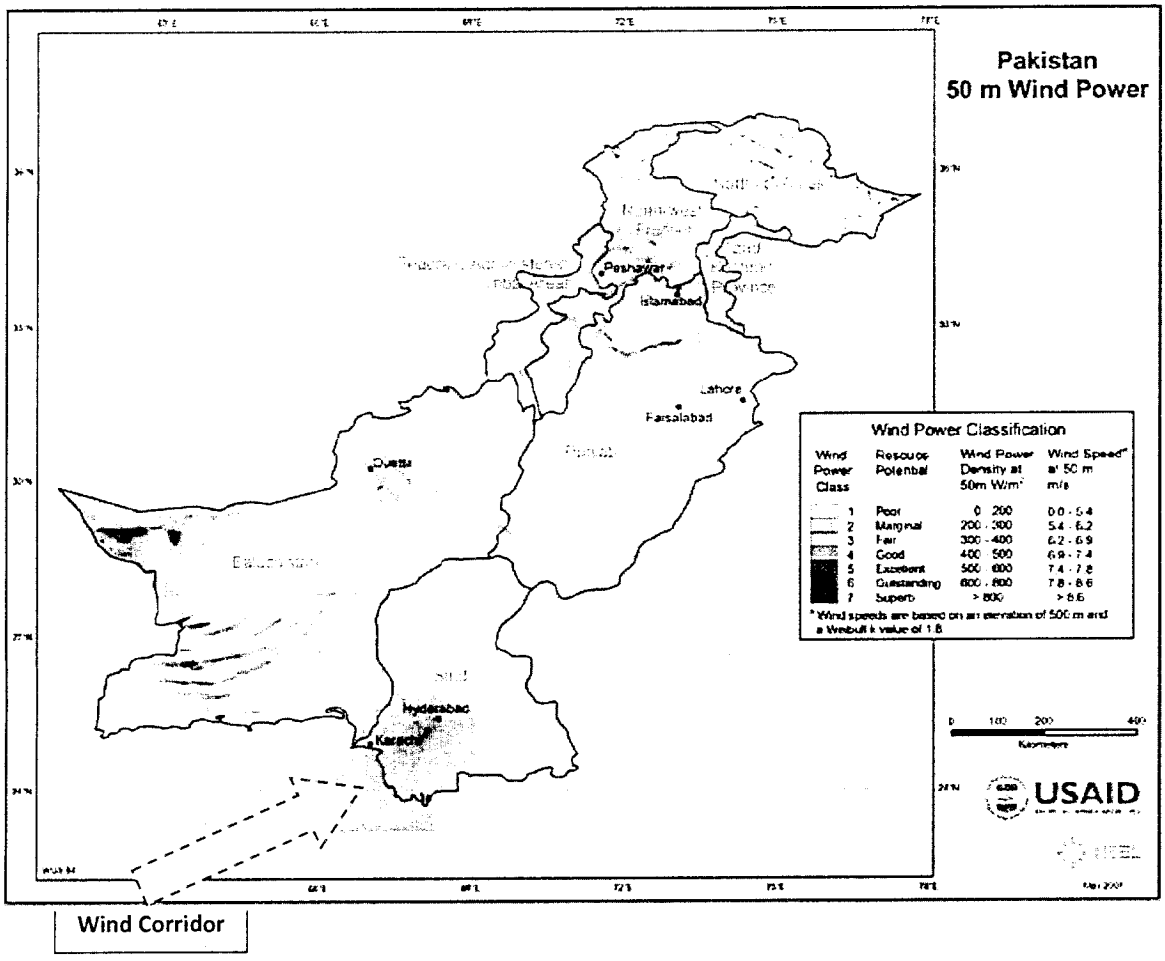

Figure 3: Wind Map of Pakistan by NREL

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. MWPL is acquiring land in the Jhimpir directly from GOS.

An overview of project sites allocated in Jhimpir region is shown in ***Figure 4***:

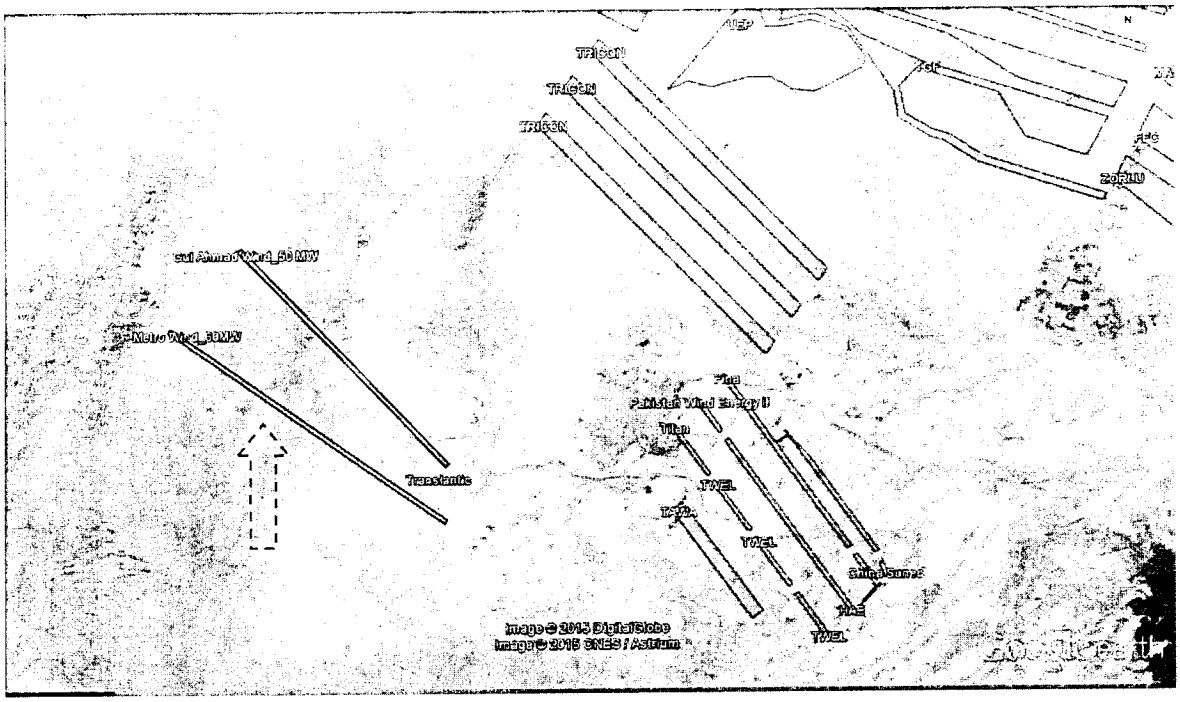

Figure 4: Overview of MWPL Site

7.2 SITE DETAILS

The site is located in Jhimpir Sindh which is towards the North East of Karachi. In the same region, where other wind farms are also there as shown in ***Figure 5.***

Company Secretary

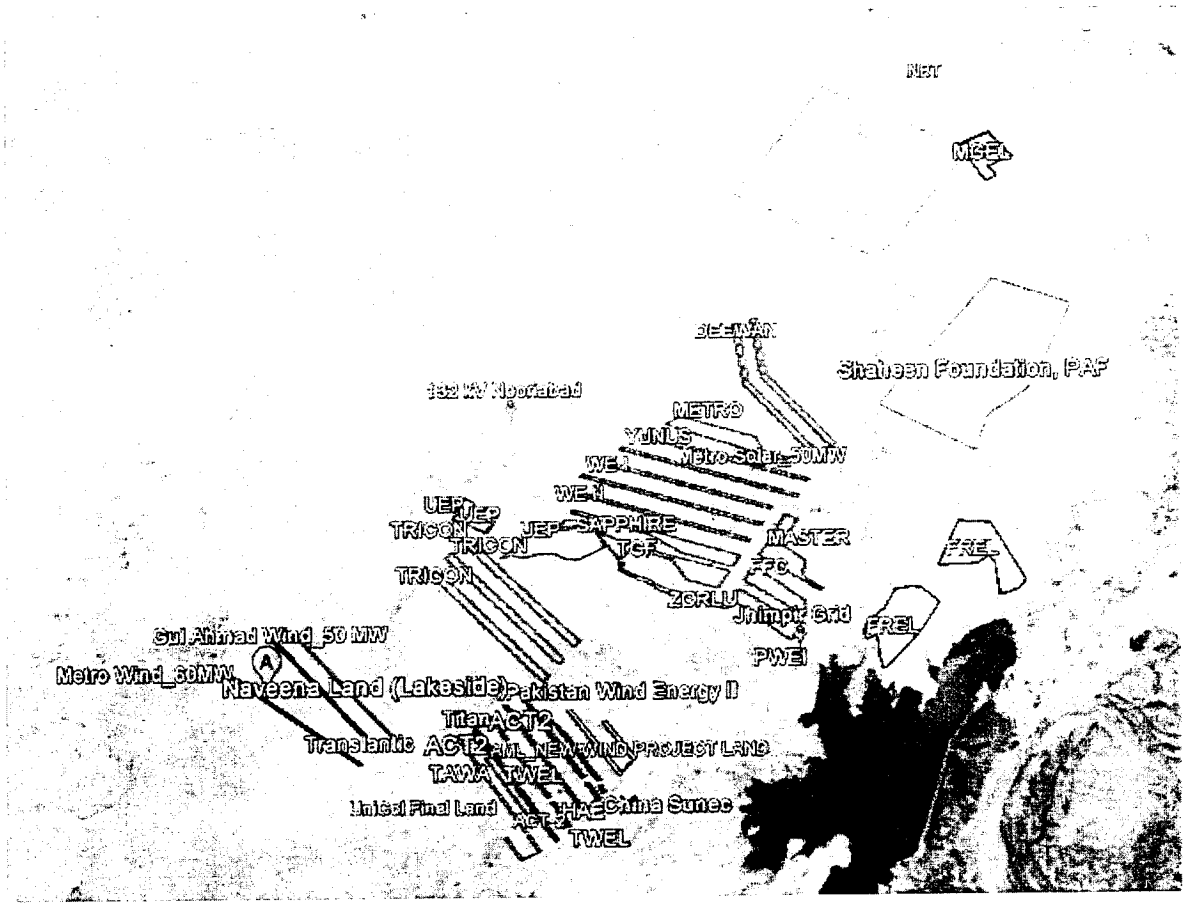

Figure 5: MWPL Site

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 Jhimpir. Nearest Grid is New Jhimpir Grid. The distance of the grid station from the Project site is approximately seventeen (17) kilometers.

A separate electrical and grid interconnection study will be conducted for the project including Power Quality, Load Flow, Short Circuit and Power Evacuation.

The site is nearly flat with surrounding having same characteristics. Real View of MWPL Site is given in ***Figure 6.***

Figure 6: View of Project Site

7.3 TRANSPORTATION AND ACCESS NETWORK

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

The major track from Karachi to Nooriabad is via the Karachi-Hyderabad Motorway, and another access to the Project site is through Jhimpir. When travelling via the Karachi-Hyderabad Motorway, the access from Nooriabad to the site is a single track, which turns toward the site. However, the terrain is flat and long and heavy vehicles can easily navigate through this road. There are number of neighboring wind farms in the surrounding area of Jhimpir. There is no requirement to establish roads or tracks for movement of traffic. The total distance from Karachi to the site is approximately 130 km.

The satellite overview of the track from Karachi to the Project site through Karachi-Hyderabad Motorway is shown in ***Figure-7***.

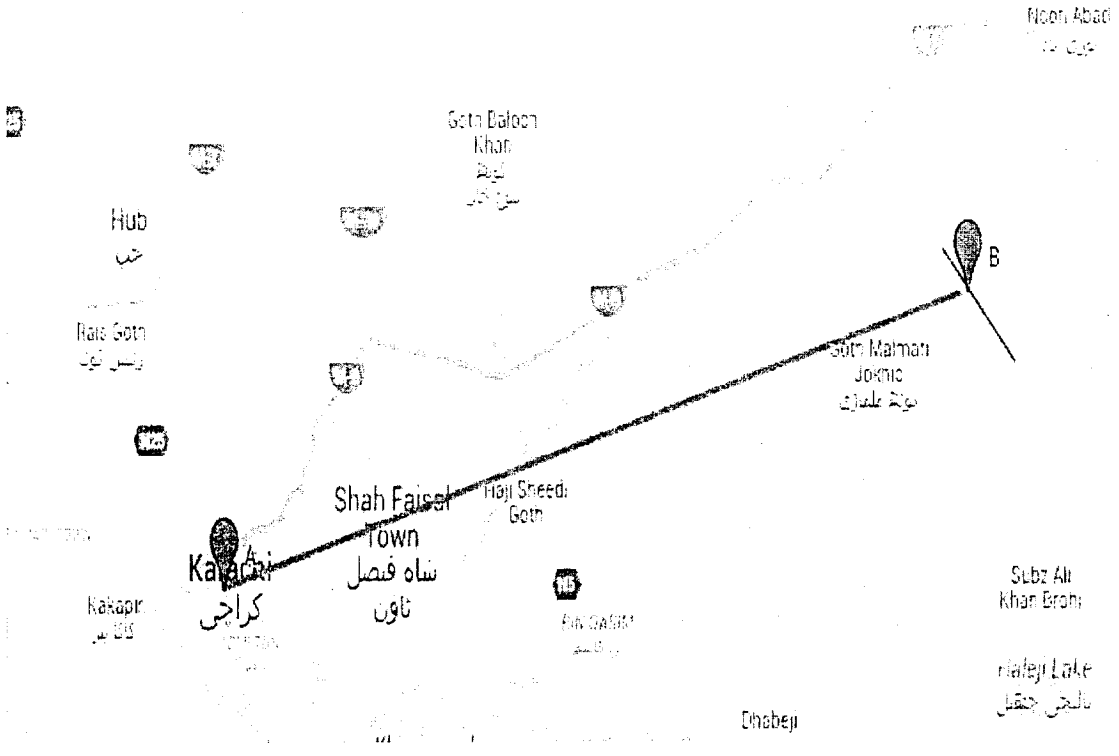

Figure 7: Access to the Site

The major track from Karachi to site is two-way road. 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-West of the site as shown in ***Figure-8***.

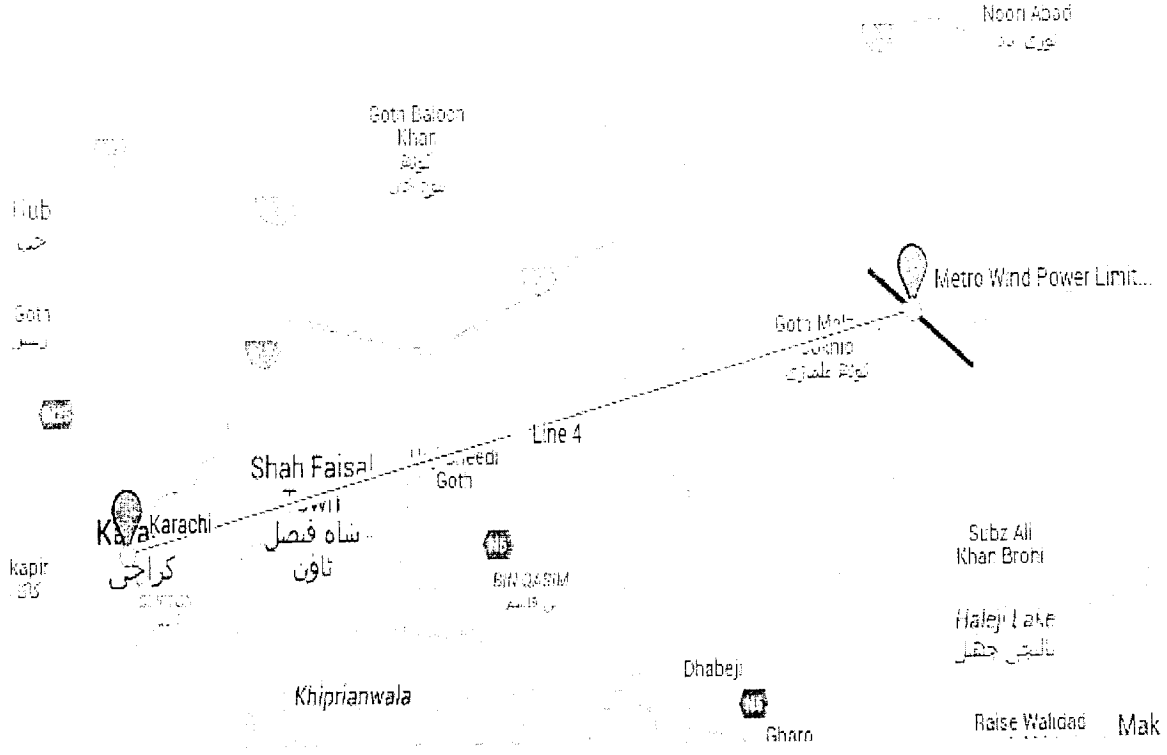

Figure 8: Detailed Access to the MWPL Site

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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: Maximum & Minimum temperatures in Jhimpir Region[1]

S. No.	Month	Mean	Median	Min	Max	Std. Dev.
		(°C)	(°C)	(°C)	(°C)	(°C)
1	Jan	20.6	20	10.3	34.5	5.7
2	Feb	22.9	22.3	12.9	33.3	4.8
3	Mar	26.7	25.9	14.7	42.6	5
4	Apr	29.8	28.9	20.4	41.9	4.8
5	May	31.6	30.2	25.2	42.8	4.3
6	Jun	31.1	30.3	25.9	38.2	2.8
7	Jul	29.4	28.7	25.7	35.8	2.2
8	Aug	28.5	27.8	24.7	34.6	2.1
9	Sep	28.6	27.8	23.6	38.5	3.5
10	Oct	28.9	28.4	21.6	38.5	4
11	Nov	25.8	25	17.9	35.9	4.4
12	Dec	21.8	21.6	9.9	34.8	5.7

Table 8: Average Precipitation and Rainfall Days in Jhimpir Region[2]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
14mm	6mm	7mm	6mm	5mm	12mm	21mm	50mm	13mm	3mm	0mm	16mm
1m	m	m	m	m	m	m	m	m	m	m	m
2	1	0	1	0	1	3	4	1	0	0	1

[1] Long term Temperature Data from nearby met mast

[2] Metrological Department of Pakistan

Company Secretary

7.5 TELECOMMUNICATION

The wire based land line telecommunication is not available at site. Some major mobile phone suppliers including Warid, Ufone and Zong have coverage on the site area.

7.6 EARTHQUAKES

According to the seismic zoning map of Pakistan, the Jhimpuir 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 Environmental Impact Assessment.

Company Secretary

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 GoS because the Project plans to opt for the upfront tariff determined by NEPRA.

Company Secretary

9 SELECTION OF WTG AND EPC CONTRACTOR

MWPL 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:

Table 9: EPC contractors

EPC Contractor	Turbines offered	Capacity of Turbine
DESCON	• General Electric GE 1.7-103	• 1.7 MW
	• Gold Wind GW 121-2.5	• 2.5 MW
Power China	• General Electric GE 1.7-103	• 1.7 MW
	• General Electric GE 2.75	• 2.75 MW
	• Gold Wind GW 121-2.5	• 2.5 MW
	• Gamesa G114-2.0	• 2.0 MW
	• Gamesa G114-2.5	• 2.5 MW
Nordex	• Nordex N131-3000	• 3.0 MW
Vestas	• Vestas V126-3.3	• 3.3 MW

Turnkey EPC proposals have been invited through a bidding process, which will be evaluated on merit and then initial meetings shall take place with all bidders. Following this, detailed negotiations will be done with the two better prospective options to make a final selection.

The main aspects to select the WTG and EPC Contractor are as follows:

a) The quality of WTG and Type Certification according to site suitability
b) The quality and certifications of EBOP equipment
c) The ultimate energy yield potential at P90 for the Project
d) The total EPC cost and resultant tariff / IRR
e) Technical guarantees, warrantees and obligations
f) Time for Completion
g) 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 WTG under consideration are attached as **Annex VIII.**

Company Secretary

10 GEOLOGICAL CONDITIONS

In order to collect detailed regional geological information, MWPL hired professional services of Geo Tech (Pvt.) Ltd: a Pakistani local prospecting agency to conduct field exploration drilling often (10) bore holes on the Site during December, 2015. The average drilling depth is 20 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, 20 m (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.

Company Secretary

10.2 GEOLOGY OF KARACHI REGION AND SURROUNDINGS

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/mélange 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 Jhimpir are shown in ***Figure 9 & Figure 10***:

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Figure 9: Tectonic Map of Pakistan

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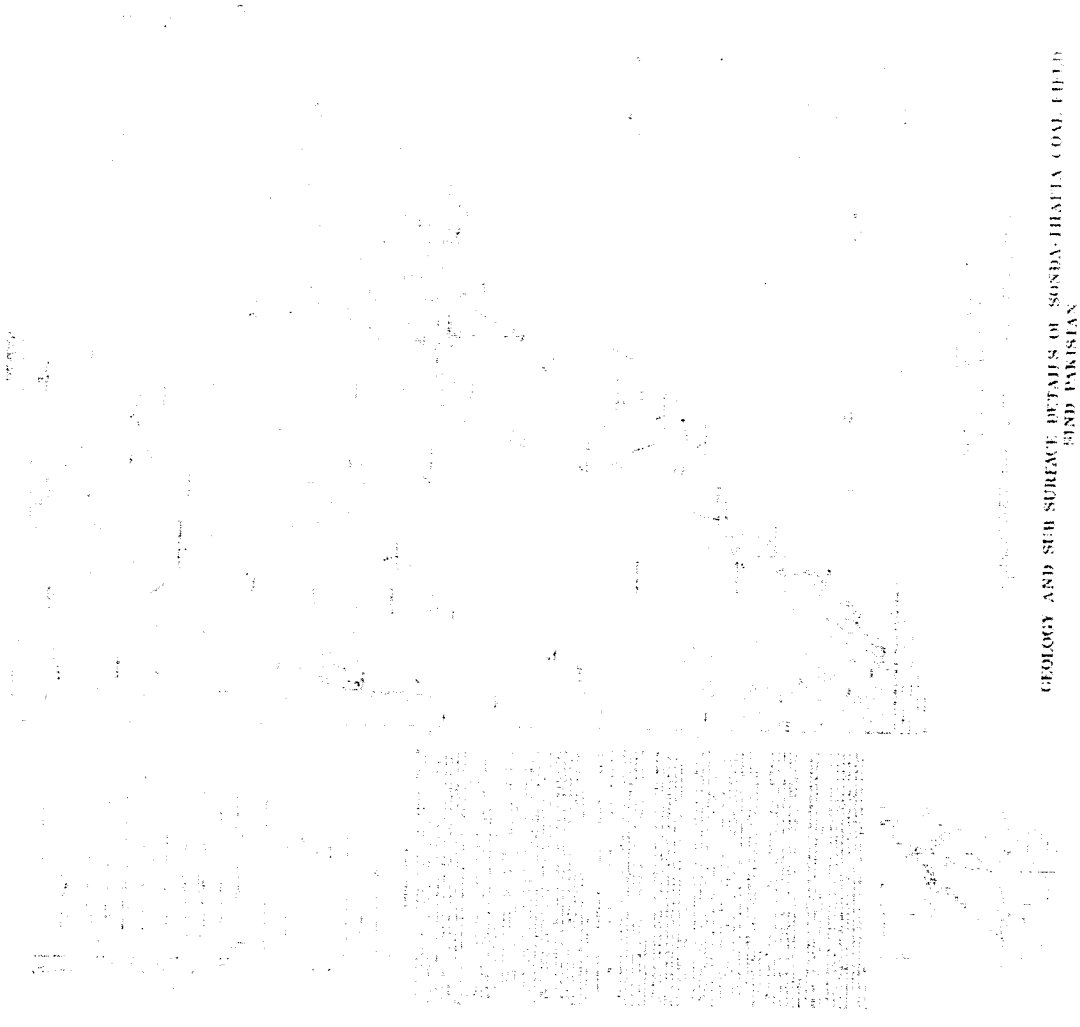

Figure 10: Geological and Sub Surface details of Jhimpir

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10.3 SEISMOLOGY OF KARACHI REGION

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

Table 10: 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	Jhimpir
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	Jhimpir
1972	25.35	66.71	33	4.50	V	Karachi
1973	25.00	68.00	——	5.00	VI	Jhimpir
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

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The seismic parameters of Karachi region are in table below along with map in ***Figure 11***:

Table 11: Seismic Parameters of Karachi

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

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.

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.

10.4.3 Location of Boreholes

Table 12: Location of Boreholes during Geo Technical Investigations (UTM zone 42R)

S. No.	Latitude	Longitude
B1	25° 1'10.89"	67°39'28.94"
B2	25° 0'51.39"	67°40'1.16"
B3	25° 0'34.15"	67°40'27.40"
B4	24°59'54.52"	67°41'31.30"
B5	24°59'32.47"	67°42'7.83"
B6	24°59'9.41"	67°42'45.43"
B7	24°58'47.39"	67°43'21.78"
B8	24°58'31.88"	67°43'46.04"
B9	24°58'14.33"	67°44'14.43"
B10	24°58'1.93"	67°44'34.67"

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

A Geotechnical Investigation for MWPL 60MW Wind Power Project Jhimpir, Sindh was carried out in Dec, 2015. The Scope of work included drilling of eight (10) boreholes up to 20 meters depth. Soil and rock samples were also collected during the field investigation. Laboratory testing of soil and rock samples has been carried out in Geo Tech lab and includes natural moisture content, specific gravity, water absorption, density, unconfined compressive strength etc. Chemical characteristics of soil and rock samples have also been assessed through determination of total dissolved solids, sulphate content, chloride content and pH.

Keeping in view, the results from field, and laboratory tests and the expected loads being transferred to the founding stratum, allowable bearing pressures for shallow foundations at certain depth. Exposure to chloride and sulphate salts is *'negligible'* for soil; therefore, *Ordinary Portland Cement (OPC)* should be used for underground concreting.

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.
- Construction of building for Protection and Control, Telecommunication and DC Power Supply.

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.

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 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 either 22 kV or 33 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, each having approx. five (05) WTGs. Every WTG shall be equipped with own step-up transformer and shall be connected with the successive 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 Switch gear 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 two (02) in number (60 MVA each). The instrumentation transformers (CTs, VTs, CVTs) for all purposes shall be sized according to requirement.

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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 confirming to the requirements to be spelled in detail in the EPC Contract and in the EPA. Further, the detailed electrical design will be subject to approval of both MWPL and NTDC as per the requirements of EPC Contract and EPA respectively.

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.

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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 MWPL shall become to supervise and monitor everything.

MWPL personnel will supervise construction activities right from the beginning. The team of MWPL 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.

MWPL requires careful management of construction. To achieve this, MWPL 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.

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The project construction shall take 14 months from the date of planning till the COD. The activity structure and timelines are given in table below:

Table 13: Project Construction Schedule

Activity / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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														

14 Initial Environment Examination (IEE)

The Initial Environment Examination (IEE) has been carried out as per Pakistan Environmental Protection Act, 1997 according to 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.

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.

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- ❖ 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, 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 MWPL 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 MWPL 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 MWPL, 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

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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.

Stakeholder from Government sector and Non-Government sector has also appreciated the project activities, raised concerns related to social and environment area which shall be addressed through effective planning and management.

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The 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 60 MW wind power project of Metro Wind Power Ltd will have no adverse environmental impact and the project can be regarded as Environmental Friendly Green Project.

Company Secretary

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), 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.

All WTGs considered in the study are equally good for the Project. The negotiations of EPC contract and the price shall play a vital role in final selection.

The Project Site is conveniently located close to the Grid of HESCO and NTDC. However, the remaining 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 2nd quarter of year 2018. It is anticipated that the Project of MWPL would be a valuable addition to the National Grid for generating electricity and contribute to overcome the current energy crises of the Pakistan.

NATIONAL TRANSMISSION & DESPATCH CO. LTD (NTDC)

General Manager Planning Power, NTDC

No. GMPP/CEMP/TRP-380/1730-34 Dated: 04-04-2017

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

Sub: Approval of Grid Interconnection Study Report of 60 MW Metro Wind Power Project by M/s Metro Wind Power Limited at Jhimpir, District Thatta Sindh

Ref: CPPA-G letter No. CPPA(G)L/CTO/DGMT-II/MT-V/MPCL/18426-27 dated 22-03-2017.

This office has received the final grid interconnection study report of the subject Metro WPP vide above referred letter. After review of the report, it was found that most of our comments communicated previously vide our letter No. GMPP/CEMP/TRP-380/5313-18 dated 08-12-2016 had been incorporated in the subject report. Therefore, the grid interconnection study report of Metro WPP is approved at NTDC end as per assumptions and study results presented in the report.

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

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

(Maqsood Ahmad Qureshi) 4/4/17
General Manager Planning Power

cc:
- Chief Executive Officer, HESCO
- General Manager (Services Division) NTDC
- Chief Executive, Metro Wind Power Limited, 7th Floor, Al-Tijarah Center, 32-1-A, Block 6, P.E.C.H.S. Main Shahra-e-Faisal Road, Karachi-75400
- M/s PPI, 64-F/1 Wapda Town, Lahore.
- *Master File (MP)*

Certified True Copy
Metro Wind Power Limited
Company Secretary

NATIONAL TRANSMISSION & DESPATCH COMPANY LTD.

General Manager Planning Power, NTDC

No. GMPP/CEMP/TRP-380/1984

Dated: 19-04-2017

CERTIFICATE

Subject: Approval of System Studies of 60 MW Wind Power Project by M/s Metro Wind Power Limited at Jhimpir, Sindh

NTDC hereby accords its approval in respect of System Studies submitted by M/s Metro Wind Power Limited in respect of 60 MW Wind Power Project (WPP) at Jhimpir, Sindh. NTDC further certifies that the power to be generated by 60 MW WPP of M/s Metro Wind Power Limited will be evacuated in accordance with the study assumptions and results given in the approved grid interconnection study report of the subject project. Also, the power injected through the above mentioned project will not have any adverse effect on the National Grid as required under the prevailing Grid Code.

Signature: 19/4/17

Name: Maqsood Ahmad Qureshi

Designation: General Manager Planning Power, NTDC

Certified True Copy
[redacted] Limited
[redacted] Secretary

ANNEXURE – M
GRID INTERCONNECTION STUDY, APPROVAL OF GRID STUDY & POWER EVACUATION CERTIFICATE

Report No. PPI-211.2-Final-Metro-2/17

ELECTRICAL GRID STUDIES

For

60 MW Wind Power Plant by Metro Wind Power 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 Metro Wind Power Limited has been validated.
- The wind project by Metro Wind Power Limited, referred to as Metro-2 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-380/2838-41 dated 04-07-2016.
- Recently a study of 10 WPPs was carried out by NTDCL planning department to fill the power capacity vacated by NBT Wind Power Pakistan II & III. A new 220kV grid station with the name of Jhimpir-2 was proposed which was connected by loop in-loop out configuration of Jamshoro – KDA 220kV single circuit and Jhimpir-1 – Gharo 220kV single circuit. This study is carried out for 15 new WPPs in integration with the already planned WPPs and other upcoming WPPs in its vicinity.
- Out of these 15 WPPs, 9 plants which lie in the southern part of Jhimpir namely Metro-2, Lakeside, DHA City, Noor, Indus, 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, Metro-2 WPP which is the plant under study, has been placed in the second loop at newly proposed 220/132kV Jhimpir-2 grid station. Metro-2 Wind Power Plant would be connected by a double circuit of 132 kV looping in-out with a sub cluster connecting neighboring Wind Power Plants of Gul Ahmed WPP 50 MW, Zulaikha Energy 50 MW and other 5 WPPs in the second loop with Jhimpir-2 220/132 kV collector substation. 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 Metro-2 WPP with neighboring wind power plants may change, depending upon the COD of the project.
- The scheme of interconnection of Metro-2 WPP 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 scheme the interconnection of Metro-2 WPP (which is placed in second loop) includes 132 kV D/C transmission line approx. 0.1 km long, on twin bundled Greeley conductor for looping in/out on the 132kV single circuit from Gul Ahmed WPP to Zulaikha Energy WPP grid station.

➢ The existing grid system of HESCO and NTDC in the vicinity of Metro-2 WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Metro-2 WPP and no bottlenecks or constraints have been found in the grid system.

➢ Wind Farm of Metro-2 has been modeled considering Type-3 WTGs. They are Doubly Fed Asynchoronous 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 to connect to the Jhimpir-2 220/132 kV grid station of NTDC.

➢ The design of scheme of 132/22 kV substation of Metro-2 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 Metro-2 WPP and a future scenario of 2022, for the dispersal of power from Metro-2 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 Metro-2 WPP is curtailed to 9MW 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 Metro-2 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 Metro-2 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 Metro-2 132 kV are 8.96 kA and 8.09 kA for 3-phase and single phase faults respectively for 2022. This is much less than

the switchgear rating of 40 kA recommended for Metro-2 Farm Substation as per NTDC requirements for 132 kV. The fault levels for Metro-2 22 kV are 21.91 kA and 23.85 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 Metro-2 WPP power to the grid.

The switchgear ratings for Metro-2 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 Metro-2 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 Metro-2 WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Metro-2 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 60 MW of Metro-2 Wind Power Plant at the proposed site and scheduled time of commissioning, in any respect of steady state (load flow) or short circuit or dynamic performance (stability) or power quality issues related to this plant.

Report Contents

1. Introduction

1.1 Background

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

Study of 10 WPPs was recently carried out by NTDCL Planning Department after cancellation of LOIs of NBT-II and NBT-III. New Jhimpir-2 220/132 kV substation was proposed to evacuate power from these WPPs. For further evacuation of power from Jhimpir area, an integrated study was required depicting optimal utilization of resources. Hence a study of 15 new WPPs was carried out in integration with the already planned / existing WPPs. Metro Wind Power 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 60 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 Metro-2 Wind Power Plant on the System
2. Impact of the System on Metro-2 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 Metro-2 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 Metro-2 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 Metro-2 Wind Farm and the NTDC/HESCO substations of 132 kV connecting with the Metro-2 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 Metro-2 WPP in response to Grid disturbances and vice versa the dynamic impact of disturbances in Metro-2 WPP on the Grid.
9. To check the ability of the wind turbine generators of Metro-2 WPP to remain connected following major disturbances and grid disruptions i.e. the Low Voltage Ride Through (LVRT) capability to satisfy the Grid Code requirement of LVRT for 180 ms.
10. Analysis of power quality issues such as flicker, voltage-unbalance, harmonics and resonance of the system.

1.3 Planning Criteria

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

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

Short Circuit:

132 kV Substation Equipment Rating 40kA

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

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

1. Total normal fault clearing time from the instant of initiation of fault current to the complete interruption of current, including the relay time and breaker

interruption time to isolate the faulted element, is equal to 100 ms (5 cycles) for the systems of 132 kV and above.

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

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

Reactive Power and Power factor:

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

Power Quality Requirements:

As per IEC61400-21standards

1.4 Operating Criteria

The operating requirements to be fulfilled by the proposed Metro-2 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-380/2838-41 dated 04-07-2016. 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 Metro-2 Wind Farm has been provided by the client who has indicated to use 2 MW Gamesa-G114 Type-3WTG. 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 Metro-2 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. Metro Wind Power Limited is considering using 2 MW Gamesa G-114 Type-3 WTGs which are doubly fed asynchronous generators.

2.2 Approach to the problem

We will apply the following approaches to the problem:

- According to the COD of Metro-2 WPP as provided by the Client Metro Wind Power Limited, we have decided to perform our analysis for the scenario of August/September 2019 to judge the maximum impact of the plant after the COD of the plant when the 220/132 kV Substation of Jhimpir-2 is commissioned.
- 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 Metro-2 Wind PP.

3. Analysis of Network Prior to Metro-2 WPP Interconnection

3.1 Description of the Network

The electrical grid, which is relevant for interconnection of Metro-2 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:

- Metro-2 (60 MW)
- Gul Ahmed (50 MW)
- Indus (50 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:

- 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
- Master Green (50 MW) connected via loop In-out of the proposed Nooriabad – Jamshoro Old 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" Metro-2 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 Metro-2 WPP's commissioning.

3.1.1 Load Forecast

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

3.1.2 Generation and Transmission Expansion Plan

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

3.2 Load Flow Analysis

Load flow analysis has been carried out for the NTDC / HESCO network including all the existing and planned wind power plants at Jhimpir and Gharo clusters but without including Metro-2 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. The month has been selected so that the Jhimpir-2 220/132 kV substation is 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	Zulaikha-E to Gul Ahmed-E 132 kV Single Circuit Out
Exhibit 3.2	Gul Ahmed-E to Jhimpir-2 132 kV Single Circuit Out
Exhibit 3.3	Lake Side to Jhimpir-2 132 kV Single Circuit Out
Exhibit 3.4	DHA-City to Jhimpir-2 132 kV Single Circuit Out
Exhibit 3.5	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 3.6	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 3.7	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit 3.8	Kotri GTPS to Jamshoro Old 132 kV Single Circuit Out
Exhibit 3.9	Jhimpir-1 to TM.KH.RD 220 kV Single Circuit Out
Exhibit 3.10	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.11	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 3.12	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 3.13	Jamshoro 500/220 kV Single Transformer Out
Exhibit 3.14	Matiari to Dadu 500 kV Single Circuit Out

Exhibit 3.14a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 3.15	Jamshoro to Dadu 500 kV Single Circuit Out
Exhibit 3.15a	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 Metro-2 WPP shown plotted in Exhibits 3.1 to 3.13 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 3.14 and 3.15, 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 Metro-2 WPP in the same vicinity in Jhimpir cluster including the Jhimpir-2 220/132 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 Metro-2 WPP. We will check the adequacy of network after adding Metro-2 WPP in Chapter 6.

4. Development of Interconnection Scheme

4.1 Interconnection of Metro-2 60 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 Metro-2 WPP, the nearest substation is the collector substation of Jhimpir-2 220/132 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 Metro-2 WPP 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 scheme the interconnection of Metro-2 WPP (which is placed in second loop) includes 132 kV D/C transmission line approx. 0.1 km long, on twin bundled Greeley conductor for looping in/out on the 132kV single circuit from Gul Ahmed WPP to Zulaikha Energy WPP grid station.

The connection scheme of Metro-2 WPP for the scenario of August/September 2019 as shown in Appendix - 4 is by interconnecting Metro-2 in the second loop proposed at Jhimpir-2 220/132 kV substation. Metro-2 Wind Power Plant would be connected by a double circuit of 132 kV looping in-out with a sub cluster connecting neighboring Wind Power Plants of Gul Ahmed-E 50 MW, Zulaikha Energy 50 MW and other 5 WPPs in the second loop with Jhimpir-2 220/132 kV collector substation. 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 Metro-2 WPP with neighboring wind power plants may change, depending upon the COD of the project.

5. Modeling of Metro-2 Wind Farm

5.1 Electrical Layout of Wind Farm

5.1.1 Metro-2 WPP Energy Selection

Metro-2 has selected Type-3 Gamesa WTGs which they are considering to install on their Wind Farm at Jhimpir. It is a doubly fed asynchronous 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 1-8	(8 x 2 = 16 MW)
Line – 2	WTGs 9-16	(8 x 2 = 16 MW)
Line – 3	WTGs 17-23	(7 x 2 = 14 MW)
Line – 4	WTGs 24-30	(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 four 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-9 to Farm Substation
Collector Line-3	from WTG-17 to Farm Substation
Collector Line-4	from WTG-24 to Farm Substation

Since two collector groups would carry a max of approximately 16MW and the other two 14MW at normal rating, the 22 kV collector circuits loading capacity should be in the range of 18 MVA and 16 MVA respectively, 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 Metro-2 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, 38/48/60 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 Metro-2 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 Metro-2 medium voltage bus named Metro-2-MV 22 kV and Metro-2 132 kV, with two inter-bus transformers of 38/48/60 MVA each. These transformers have an overload capacity of 60 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. 60 MVA.

6.2 Reactive Power Requirements

Metro-2 is considering using 2 MW Gamesa Type-3 WTGs, which are doubly fed asynchronous 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 60 MW generating capacity is required to pump 19.7 MVAR to the grid at full output of 60 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. 18.9 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 Metro-2 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 Metro-2 WPP and after the commissioning of the newly proposed 220/132 kV substation in the southern part of Jhimpir. 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 Metro-2 WPP, 57.5 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 20.13 MVAR at (22.07 kV) voltage and, after VAR loss across 132/22 kV transformers, supplying about 18.90 MVAR (nearly 0.95 PF) at 132 kV bus i.e. fulfilling the Grid Code criteria at the point of interconnection. The voltage profile on all the bus bars of 132 kV of HESCO grid are well within the normal operating criteria of ± 5 % off the nominal.

6.3.2 Contingency cases and evolving of reliable scheme

The N-1 contingency cases have been run and the results have been shown plotted as under:

Exhibit 6.1.1	Metro-2 132/22 kV Single Transformer Out
Exhibit 6.1.2	Metro-2 to Gul Ahmed-E 132 kV Single Circuit Out
Exhibit 6.1.3	Zulaikha-E to Metro-2 132kV Single Circuit Out
Exhibit 6.1.4	Lake Side to Jhimpir-2 132 kV Single Circuit Out
Exhibit 6.1.5	DHA-City to Jhimpir-2 132 kV Single Circuit Out
Exhibit 6.1.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.1.7	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 6.1.8	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit 6.1.9	Kotri GTPS to Jamshoro Old 132 kV Single Circuit Out
Exhibit 6.1.10	Jhimpir-1 to TM.KH.RD 220 kV Single Circuit Out
Exhibit 6.1.11	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.1.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.1.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.1.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.1.15	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.1.15a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 6.1.16	Jamshoro to Dadu 500 kV Single Circuit Out
Exhibit 6.1.16a	Jamshoro to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW

The load flow results of the network in the close vicinity of Metro-2 WPP shown plotted in Exhibits 6.1.1 to 6.1.14 indicate that all the power flows on the lines are within the rated limits of this network.

For some critical outages of 500kV circuits shown in Exhibit 6.1.15 and 6.1.16, capacity constraint was observed in 500kV network emanating from Jamshoro and upwards. Due to this capacity constraint, partial curtailment in the output of all WPPs under study was proposed to bring the loading on the 500kV network within limit. Hence output of Metro-2 WPP is curtailed to 9MW in case of these contingency events. Results are shown in Exhibit 6.1.15(a) and 6.1.16(a). The details of the curtailment of WPPs are provided below:

Plant Name	Gross output	Curtailed Output
Lake Side	50 MW	7 MW
Nasda	50 MW	7 MW
Uni-Energy	50 MW	7 MW
Indus	50 MW	7 MW
Noor	50 MW	7 MW
Sino Well	50 MW	7 MW
Lootah	50 MW	7 MW
Shafi Energy	50 MW	7 MW
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 this 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	Metro-2 132/22 kV Single Transformer Out
Exhibit 6.2.2	Metro-2 to Gul Ahmed-E 132 kV Single Circuit Out
Exhibit 6.2.3	Zulaikha-E to Metro-2 132kV Single Circuit Out
Exhibit 6.2.4	Lake Side to Jhimpir-2 132 kV Single Circuit Out
Exhibit 6.2.5	DHA-City to Jhimpir-2 132 kV Single Circuit Out
Exhibit 6.2.6	Jhimpir-2 220/132 kV Single Transformer Out

Exhibit 6.2.7	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 6.2.8	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit 6.2.9	Kotri GTPS to Jamshoro Old 132 kV Single Circuit Out
Exhibit 6.2.10	Jhimpir-1 to TM.KH.RD 220 kV Single Circuit Out
Exhibit 6.2.11	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.2.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.2.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.2.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.2.15	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.2.15a	Matiari to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW
Exhibit 6.2.16	Jamshoro to Dadu 500 kV Single Circuit Out
Exhibit 6.2.16a	Jamshoro to Dadu 500 kV Single Circuit Out - Curtailment of Wind Generation by 600 MW

The load flow results of the network in the close vicinity of Metro-2 WPP shown plotted in Exhibits 6.2.1 to 6.2.14 indicate that all the power flows on the lines are within the rated limits of this network.

For some critical outages of 500kV circuits shown in Exhibit 6.2.15 and 6.2.16, capacity constraint was observed in 500kV network similar to the peak scenario discussed above. Hence curtailment of WPPs as discussed above was carried out in this off-peak scenario as well. Results after curtailment are shown in Exhibit 6.2.15(a) and 6.2.16(a).

6.5 Load Flow Analysis for Future Scenario of 2022

Load flow analysis has been carried out for the peak conditions for future scenario of 2022 for the NTDC / HESCO network. All the future reinforcements that were proposed till 2022 are modeled in the case.

Load flow simulations have been run for normal and contingency conditions. The results are shown plotted in Appendix-6.

Exhibit 6.3.0 shows the normal case under the peak system conditions of future year 2022. All these loadings are within the rated limits of these circuits. The bus voltages on all the substations in Southern HESCO grid are within the normal limits of operation.

The N-1 contingency cases have been run and the results have been shown plotted as under:

Exhibit 6.3.1	Metro-2 132/22 kV Single Transformer Out
Exhibit 6.3.2	Metro-2 to Gul Ahmed-E 132 kV Single Circuit Out
Exhibit 6.3.3	Zulaikha-E to Metro-2 132kV Single Circuit Out
Exhibit 6.3.4	Lake Side to Jhimpir-2 132 kV Single Circuit Out
Exhibit 6.3.5	DHA-City to Jhimpir-2 132 kV Single Circuit Out
Exhibit 6.3.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.3.7	Jhimpir-1 to T.M.Khan 132 kV Single Circuit Out
Exhibit 6.3.8	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit 6.3.9	Kotri GTPS to Jamshoro Old 132 kV Single Circuit Out
Exhibit 6.3.10	Jhimpir-1 to TM.KH.RD 220 kV Single Circuit Out
Exhibit 6.3.11	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.3.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.3.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.3.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.3.15	Matiari to Dadu 500 kV Single Circuit Out
Exhibit 6.3.16	Jamshoro to Dadu 500 kV Single Circuit Out

The results show that power flows on intact 132 kV circuits remain within their rated limits. For this future scenario of 2022, the issue of capacity constraint that was observed in the base case of 2019 is resolved due to the following major reinforcements in the system:

- 660kV HVDC from Matiari to Lahore
- 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 Metro-2 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 Metro-2 WPP under normal as well as the contingency conditions for all the scenarios studied.

Metro-2 Wind Power Plant would be connected by a double circuit of 132 kV looping in-out with a sub cluster connecting neighboring Wind Power Plants of Gul Ahmed-E 50 MW, Zulaikha Energy 50 MW and 5 other WPPs in the same loop to Jhimpir-2 220/132 kV collector substation. Twin bundled Greeley conductor with the capacity of 368 MVA per circuit is assumed to have a thermal limit of 404 MVA taking into account the increase in MVA capacity of the conductors at high wind speed during high wind season.

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 Metro-2 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 Metro-2 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 Metro-2 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. 14 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 40 kA, 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 Metro-2 132 kV are 8.96 kA and 8.09 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Metro-2 Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Metro-2 22 kV are 21.91 kA and 23.85 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 Metro-2 WPP – 2022

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Metro-2 132 kV	8.96	8.09
Metro-2 MV 22 kV	21.91	23.85
Nooriabad 132 kV	11.92	13.16
Thatta 132 kV	6.62	6.50
Jamshoro Old 132 kV	23.84	22.86
Jamshoro New 132 kV	25.25	24.90
Kotri GTPS 132 kV	19.73	19.01
Hala Road 132 kV	22.36	21.44
T.M.KHAN 132 kV	14.80	14.24
Jhimpir 132 kV	11.45	10.49
Jhimpir-1 132 kV	30.36	26.69

Jhimpir-2 132 kV	24.21	22.22
Gharo-New 132 kV	10.37	9.81
Gharo-New 220 kV	10.17	8.00
Jhimpir-1 220 kV	23.18	18.06
Jhmipir-2 220 kV	29.86	21.96
Jamshoro 220 kV	45.00	45.78
Hala Road 220 kV	29.68	22.90
TM.KH.RD 220 kV	22.56	18.46
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 Metro-2 WPP 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Metro-2 132 kV	6.39	5.77
Metro-2 MV 22 kV	16.28	16.21
Nooriabad 132 kV	7.88	8.41

Thatta 132 kV	4.74	4.71
Jamshoro Old 132 kV	15.93	15.61
Jamshoro New 132 kV	16.89	16.90
Kotri GTPS 132 kV	13.25	12.28
Hala Road 132 kV	15.58	15.20
T.M.KHAN 132 kV	10.92	10.64
Jhimpir 132 kV	7.31	6.89
Jhimpir-1 132 kV	18.25	18.98
Jhimpir-2 132 kV	16.98	16.54
Gharo-New 132 kV	7.44	7.53
Gharo-New 220 kV	7.42	6.31
Jhimpir-1 220 kV	14.88	13.42
Jhmipir-2 220 kV	19.00	15.85
Jamshoro 220 kV	23.86	23.62
Hala Road 220 kV	18.13	14.89
TM.KH.RD 220 kV	14.89	12.93
Jamshoro 500 kV	13.12	11.18
Matiari 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 Metro-2 132 kV are 8.96 kA and 8.09 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Metro-2 Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Metro-2 22 kV are 21.91 kA and 23.85 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 Metro-2 Wind Power Plant on the System
2. Dynamic impact of the System on Metro-2 Wind Power Plant

8.1 Assumptions & Methodology

8.1.1 Type-3 WTG Dynamic Model

Metro-2 is considering using Doubly Fed Asynchronous 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: Metro-2 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Metro-2 to Gul Ahmed-E 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Metro-2 132 kV 2. Metro-2 MV 22 kV 3. Gul Ahmed-E 132 kV 4. Jhimpir-2 132 kV 5. Zulaikha-E 132 kV 6. Din-E 132 kV	The voltages of all the bus bars recover after fault clearance	1.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	1.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	1.3

• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	1.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	1.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	1.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	1.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	1.8
• **MW Line Flow** • **MVAR Line Flow**	Metro-2 to Zulaikha-E 132 kV intact single circuit	Recovers after damping down oscillations	1.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	1.10
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	1.11

8.2.2

Fault Type: 1-Phase			
Fault Location: Metro-2 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Metro-2 to Gul Ahmed-E 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Metro-2 132 kV 2. Metro-2 MV 22 kV 3. Gul Ahmed-E 132 kV 4. Jhimpir-2 132 kV 5. Zulaikha-E 132 kV 6. Din-E 132 kV	The voltages of all the bus bars recover after fault clearance	2.1

Frequency	Metro-2 132 kV	Recovers after fault clearance	2.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	2.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	2.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	2.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	2.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	2.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	2.8
• **MW Line Flow** • **MVAR Line Flow**	Metro-2 to Zulaikha-E 132 kV intact single circuit	Recovers after damping down oscillations	2.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	2.10
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	2.11

8.2.3

Fault Type: 3-Phase			
Fault Location: Metro-2 MV 22 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Metro-2 132/22 kV Single Transformer			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Metro-2 MV 22 kV 2. Metro-2 132 kV	The voltages of all the bus bars	3.1

	3. Gul Ahmed-E 132 kV 4. Jhimpir-2 132 kV 5. Zulaikha-E 132 kV 6. Din-E 132 kV	recover after fault clearance	
Frequency	Metro-2 132 kV	Recovers after fault clearance	3.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	3.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	3.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	3.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	3.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	3.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	3.8
• **MW Line Flow** • **MVAR Line Flow**	Metro-2 132/22 kV Single Transformer	Recovers after damping down oscillations	3.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	3.10
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	3.11

8.2.4

Fault Type: 3-Phase
Fault Location: Metro-2 MV 22 kV bus bar
Fault Duration: 9 cycles (180 ms)
Line Tripping: Metro-2 one collector group of 14 MW

Variable	Bus/Line	Response	Figure No.
Voltage	1. Metro-2 MV 22 kV 2. Metro-2 132 kV 3. Gul Ahmed-E 132 kV 4. Jhimpir-2 132 kV 5. Zulaikha-E 132 kV 6. Din-E 132 kV	The voltages of all the bus bars recover after fault clearance	4.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	4.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	4.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	4.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	4.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	4.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	4.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	4.8
• **MW Line Flow** • **MVAR Line Flow**	Metro-2 132/22 kV Single Transformer	Recovers after damping down oscillations	4.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	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	4.11

8.2.5

Fault Type: 3-Phase			
Fault Location: Gul Ahmed-E 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Gul Ahmad-E to Jhmipir-2 132 kV			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Gul Ahmed-E 132 kV 2. Gul Ahmed-E MV 22 kV 3. Metro-2 132 kV 4. Jhmipir-2 132 kV 5. Jhimpir-2 220 kV 6. Zulaikha-E 132 kV	The voltages of all the bus bars recover after fault clearance	5.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	5.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	5.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	5.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	5.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	5.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	5.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	5.8
• **MW Line Flow** • **MVAR Line Flow**	Gul Ahmed-E to Metro-2 132 kV intact single circuit	Recovers after damping down oscillations	5.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	5.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV	Damps down quickly and attain a steady state value	5.11

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

8.2.6

Fault Type: 1-Phase			
Fault Location: Gul Ahmed-E 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Gul Ahmad-E to Jhmipir-2 132 kV			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Gul Ahmed-E 132 kV 2. Gul Ahmed-E MV 22 kV 3. Metro-2 132 kV 4. Jhmipir-2 132 kV 5. Jhimpir-2 220 kV 6. Zulaikha-E 132 kV	The voltages of all the bus bars recover after fault clearance	6.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	6.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	6.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	6.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	6.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	6.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	6.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	6.8
• **MW Line Flow** • **MVAR Line Flow**	Gul Ahmed-E to Metro-2 132 kV intact single circuit	Recovers after damping down oscillations	6.9

• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	6.10
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	6.11

8.2.7

Fault Type: 3-Phase			
Fault Location: Jhimpir-2 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-2 to Gul Ahmed-E 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-2 132 kV 2. Jhimpir-2 220 kV 3. DHA-City 132 kV 4. Gul Ahmed-E 132 kV 5. Metro-2 132 kV 6. Zulaikha-E 132 kV	The voltages of all the bus bars recover after fault clearance	7.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	7.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	7.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	7.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	7.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	7.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	7.7

• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	7.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to DHA-City 132 kV intact single circuit	Recovers after damping down oscillations	7.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	7.10
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	7.11

8.2.8

Fault Type: 1-Phase			
Fault Location: Jhimpir-2 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-2 to Gul Ahmed-E 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-2 132 kV 2. Jhimpir-2 220 kV 3. DHA-City 132 kV 4. Gul Ahmed-E 132 kV 5. Metro-2 132 kV 6. Zulaikha-E 132 kV	The voltages of all the bus bars recover after fault clearance	8.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	8.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.5

• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	8.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	8.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to DHA-City 132 kV intact single circuit	Recovers after damping down oscillations	8.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	8.10
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	8.11

8.2.9

Fault Type: 3-Phase			
Fault Location: Jhimpir-2 220 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-2 to KDA-33 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-2 220 kV 2. KDA-33 220 kV 3. Jamshoro 220 kV 4. Jhimpir-1 220 kV 5. Gharo-New 220 kV 6. Metro-2 132 kV	The voltages of all the bus bars recover after fault clearance	9.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	9.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	9.3

• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	9.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	9.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	9.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	9.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	9.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to Jamshoro 220 kV intact single circuit	Recovers after damping down oscillations	9.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	9.10
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	9.11

8.2.10

Fault Type: 1-Phase			
Fault Location: Jhimpir-2 220 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-2 to KDA-33 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-2 220 kV 2. KDA-33 220 kV 3. Jamshoro 220 kV 4. Jhimpir-1 220 kV 5. Gharo-New 220 kV 6. Metro-2 132 kV	The voltages of all the bus bars recover after fault clearance	10.1

Frequency	Metro-2 132 kV	Recovers after fault clearance	10.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	10.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	10.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	10.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	10.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	10.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	10.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to Jamshoro 220 kV intact single circuit	Recovers after damping down oscillations	10.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	10.10
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	10.11

8.2.11

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 220 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 220 kV 2. Jhimpir-2 220 kV 3. KDA-33 220 kV	The voltages of all the bus bars recover after	11.1

	4. T.M.Khan Road 220 kV 5. Metro-2 132 kV 6. Gharo-New 220 kV	fault clearance	
Frequency	Metro-2 132 kV	Recovers after fault clearance	11.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	11.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	11.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	11.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	11.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	11.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers	11.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to Jhimpir-1 220 kV intact single circuit	Recovers after damping down oscillations	11.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	11.10
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	11.11

8.2.12

Fault Type: 1-Phase			
Fault Location: Jhimpir-1 220 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**

Voltage	1. Jhimpir-1 220 kV 2. Jhimpir-2 220 kV 3. KDA-33 220 kV 4. T.M.Khan Road 220 kV 5. Metro-2 132 kV 6. Gharo-New 220 kV	The voltages of all the bus bars recover after fault clearance	12.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	12.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	12.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	12.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	12.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	12.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	12.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers	12.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-2 to Jhimpir-1 220 kV intact single circuit	Recovers after damping down oscillations	12.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	12.10
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	12.11

8.2.13

Fault Type: 3-Phase			
Fault Location: Gul-Ahmed-E 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Gul-Ahmed-E to Metro-2 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Gul Ahmed-E 132 kV 2. Gul Ahmed-E-MV 33 kV 3. Metro-2 132 kV 4. Metro-2 MV 22 kV 5. Zulaikha-E 132 kV 6. Jhimpir-2 132 kV	The voltages of all the bus bars recover after fault clearance	13.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	13.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	13.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	13.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	13.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	13.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	13.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers	13.8
• **MW Line Flow** • **MVAR Line Flow**	Gul-Ahmed-E to Jhimpir-2 132 kV intact single circuit	Recovers after damping down oscillations	13.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	13.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV	Damps down quickly and attain a steady state value	13.11

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

8.2.14

Fault Type: 1-Phase			
Fault Location: Gul-Ahmed-E 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Gul-Ahmed-E to Metro-2 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Gul Ahmed-E 132 kV 2. Gul Ahmed-E-MV 33 kV 3. Metro-2 132 kV 4. Metro-2 MV 22 kV 5. Zulaikha-E 132 kV 6. Jhimpir-2 132 kV	The voltages of all the bus bars recover after fault clearance	14.1
Frequency	Metro-2 132 kV	Recovers after fault clearance	14.2
• **Plant MW Output** • **Plant MVAR Output**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	14.3
• **Speed** • **Pmechanical**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	14.4
• **Torque** • **Pitch Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	14.5
• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	14.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	14.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers	14.8
• **MW Line Flow** • **MVAR Line Flow**	Gul-Ahmed-E to Jhimpir-2 132 kV intact single circuit	Recovers after damping down oscillations	14.9

• **Paero** • **Shaft Twist Angle**	Metro-2 Collector Group-1 0.7 kV	Recovers after damping down oscillations	16.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Metro-2 Collector Group-1 0.7 kV	Recovers	16.7
• **Pitch control** • **Pitch compensation**	Metro-2 Collector Group-1 0.7 kV	Recovers	16.8
• **MW Line Flow** • **MVAR Line Flow**	Zulaikha-E to Din-E 132 kV intact single circuit	Recovers after damping down oscillations	16.9
• **MW Output** • **MVAR Output**	Gul Ahmed-E Collector Group-1 0.7 kV	Attains steady state value after damping of oscillations	16.10
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	16.11

8.5 Conclusion of Stability Study

The transient stability analysis performed as discussed above indicates that the NTDC system connecting to Metro-2 WPP through the proposed scheme of interconnection is strong enough to absorb the worst disturbances on either side i.e. on Metro-2 WPP side or the Grid side.

There are no constraints of connecting Metro-2 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 Metro-2 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 Metro-2 Wind farm reduced as

low as 25 % of its rated capacity. Therefore taking one collector group as one equivalent generator of 7x2 = 14 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 = 620 MVA

The value of c (ψ_k) at 10 minute average speed (v_a) is supplied by the manufacturer after filed measurements of $P_{St,\ fic}$ for different operating conditions using the following formula.

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

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 (ψ_k) may not be greater than 1, therefore for the present analysis we may assume it as 1 for the worst case.

Putting this data in the above Equation, we find

$P_{St\Sigma}$ =$P_{lt\Sigma}$= 0.009473497= 0.9473497 %

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 Metro-2 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 $k_{f,i}$ (ψk) is also provided by the manufacturer after the field and factory measurements; but for the present analysis we assume it to be equal to 1.

Substituting the numbers in the above equations, we find for switching conditions of (a) and (b) as follows;

$P_{St\Sigma} = 0.214015$

$P_{lt\Sigma} = 0.205498$

For switching conditions of (c) these values would be less as the frequency of occurrence assumed i.e. N_{10} and N_{120} are 10 times less.

Engineering Recommendation P28 (Electricity Association, 1989) specifies an absolute maximum of P_{St} on a network from all sources to be 1.0 with a 2 hour P_{St} value of 0.6. However, extreme caution is advised if these limits are approached as the risk of complaints increases when the limits are reached, therefore, an assessment method proposed in the same document is based on P_{St} not exceeding 0.5. British Standard (1995) is less stringent specifying that over a one week period P_{lt} must be less than 1 for 95 % of the time. Gardner (1996) describes P_{St} limits from a number of utilities in the range of 0.25 to 0.5 [2].

The values evaluated above are less than the values recommended in the references of above standards.

9.2 Voltage Unbalance

9.2.1 Voltage Step-Change

The voltage step change would occur when a WTG will be energized, assuming just one WTG in the collector for the minimum No. of units in the collector being energized.

The limit on the voltage change is based on the impedance of the circuit between the point of connection and the MV transformer bus bar together with the apparent power of the wind turbine generators. The following equation needs to be satisfied [2];

$$\Delta V = \sum S_{WKA} [(1/S_{KE}) - (1/S_{KSS})] \leq 1/33 \text{ or } 3\ \%$$

Where

S_{WKA} = MVA rating of the WTG

S_{KE} = Short circuit MVA at connection point

S_{KSS} = Short circuit MVA at MV bus of the wind farm substation

For the minimum short circuit case, we have calculated minimum fault levels in MVA as shown in Exhibit 7.1.2

S_{WKA} = 2.22 MVA for the equivalent WTG of a collector group for the minimum case

S_{KE1} for one WTG in collector group = 340 MVA (Exhibit 7.1.2)

S_{KSS} = 610 MVA (Exhibit 7.1.2)

Substituting these values we get

$$\Delta V = 0.00289007 = 0.2890\ \%$$

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 = 0.0058824 = 0.588 %

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

10- Conclusions & Recommendations

- Interconnection Study has been carried out for 60 MW Metro-2 WPP which is proposed to be placed in the second loop at newly planned Jhimpir-2 220/132 kV collector substation. The scheme of interconnection of Metro-2 WPP 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 scheme the interconnection of Metro-2 WPP (which is placed in second loop) includes 132 kV D/C transmission line approx. 0.1 km long, on twin bundled Greeley conductor for looping in/out on the 132kV single circuit from Gul Ahmed-E WPP to Zulaikha Energy WPP grid station.
- The existing grid system of HESCO and NTDC in the vicinity of Metro-2 WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Metro-2 WPP and no bottlenecks or constraints have been found in the grid system.
- Wind Farm of Metro-2 has been modeled considering Type-3 WTGs. They are Doubly Fed Asynchronous 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 to connect to the Jhimpir-2 220/132 kV grid station of NTDC.

- The design of scheme of 132/22 kV substation of Metro-2 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 Metro-2 WPP and a future scenario of 2022, for the dispersal of power from Metro-2 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 Metro-2 WPP is curtailed to 9MW 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 Metro-2 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 Metro-2 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 Metro-2 132 kV are 8.96 kA and 8.09 kA for 3-phase and single phase faults respectively for 2022. This is much less than the switchgear rating of 40 kA recommended for Metro-2 Farm Substation as per NTDC requirements for 132 kV. The fault levels for Metro-2 22 kV are 21.91 kA and 23.85 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 Metro-2 WPP power to the grid.

  The switchgear ratings for Metro-2 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 Metro-2 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 Metro-2 WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Metro-2 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 60 MW of Metro-2 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.

SECTION 3

DESCRIPTION OF PROJECT

3 DESCRIPTION OF PROJECT

3.1 PROJECT LOCATION

The wind farm Project is located in Jhimpir, which is located approximately 116 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 410 acres of land, which has been leased by the acquired by the project company. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site. The Jhimpir wind corridor is identified as potential area for the development of wind power projects. The layout of the project site is shown in Figure 3.1.

The Project site has very sparse vegetation consisting of small shrubby bushes and flat terrain area Location of the Project is shown in Figure 3.2.

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Figure 3.1: MWPL Project Site Layout

Document Title: Initial Environmental Examination (IEE) Metro Wind Power Limited of 60 MW Wind Power Project in Jhimpir, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2/131/172/001	Date of Approval February,2016
	Project Sponsor: Iqbal Allmohamed and Family	Document Issue 01	

Table 3-1: Land Coordinates

S. No.	Latitude	Longitude
1.	25° 1.178'N	67° 39.398'E
2.	24° 57.851'N	67° 44.814'E
3.	24° 57.917'N	67° 44.850'E
4.	25° 1.248'N	67° 39.448'E

The Project area is open and can be seen from images below in Figure 3.3;

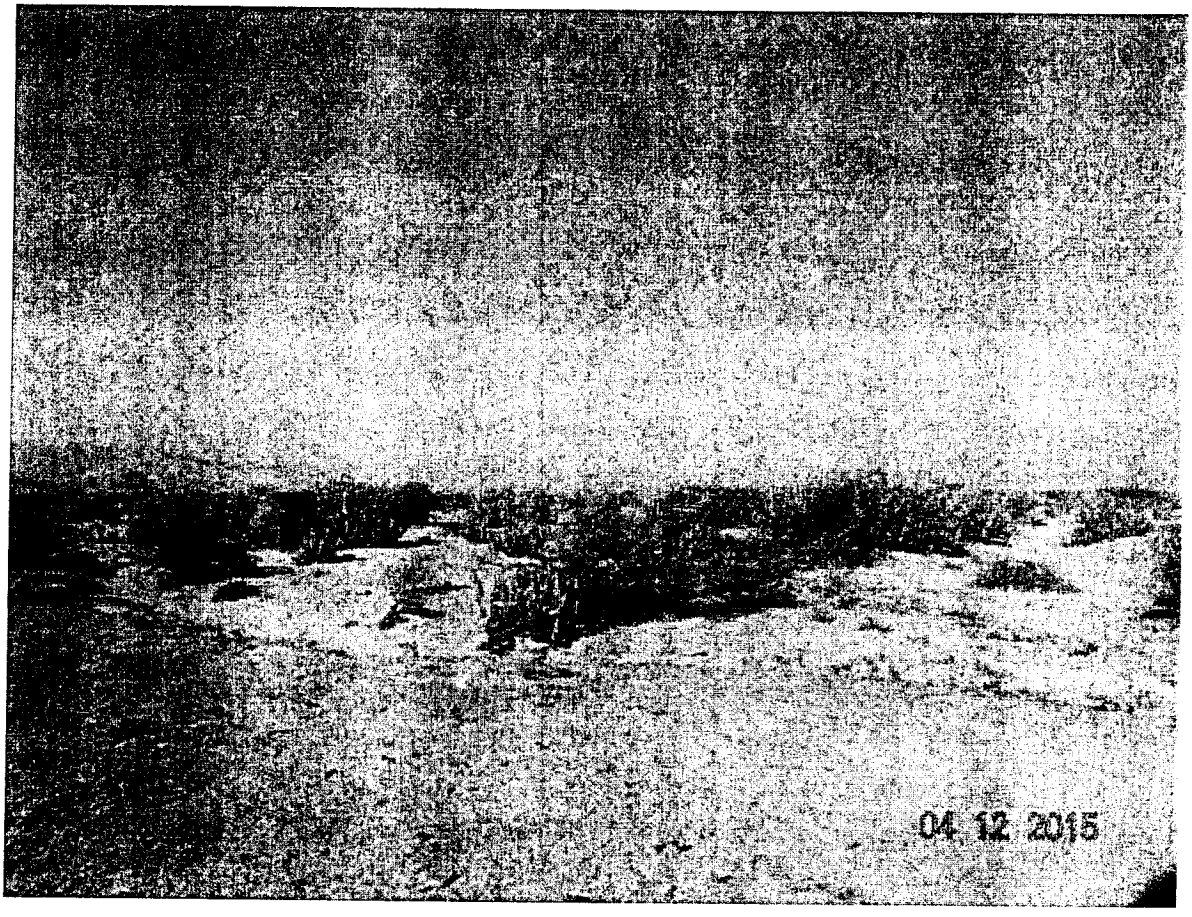

Figure 3.2: A View of Project Site

3.2 ROAD ACCESS

The Project site is easily accessible throughout the year.

The major track from Karachi to Nooriabad is via the Karachi-Hyderabad Motorway, and another access to the Project site is through Jhimpir. When travelling via the Karachi-Hyderabad Motorway, the access from Nooriabad to the site is a single track, which turns toward the site. However, the terrain is flat and long and heavy vehicles can easily navigate through this road. There are number of neighboring wind farms in the surrounding area of Jhimpir. There is no requirement to establish roads or tracks for movement of traffic. The total distance from Karachi to the site is approximately 116 km.

The satellite overview of the track from Karachi to the Project site through Karachi-Hyderabad Motorway is shown in Figure 3.3.

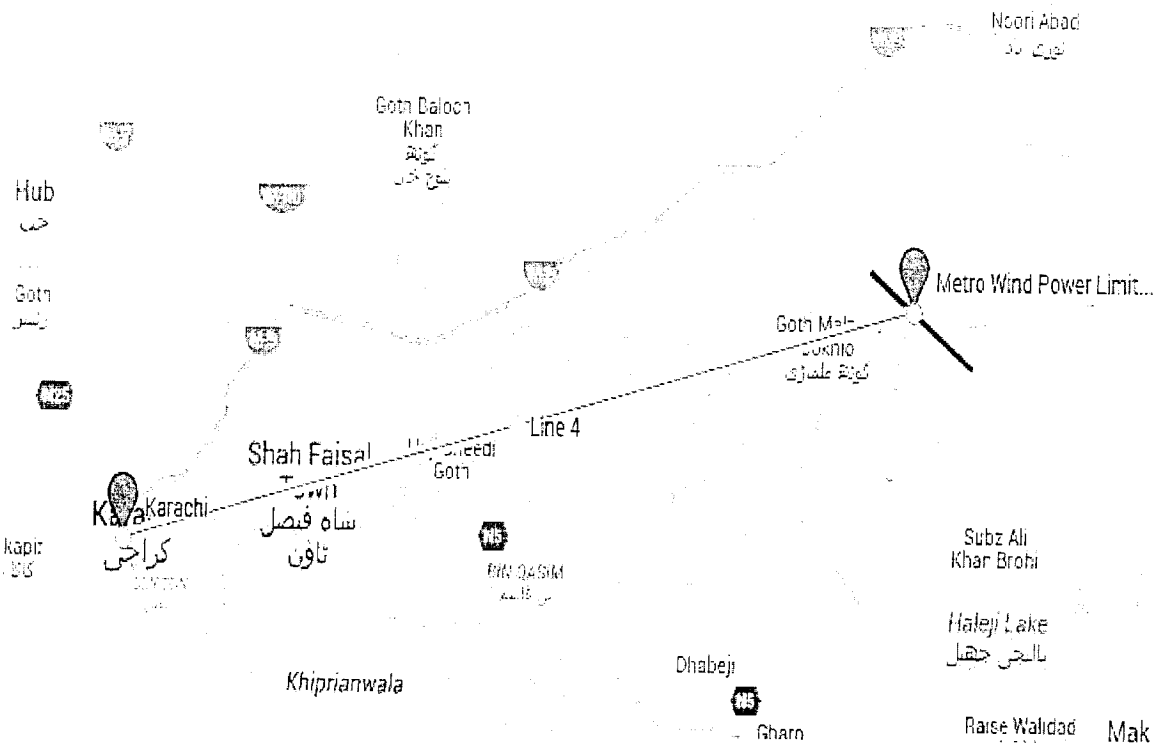

Figure 3.3: Ariel View of Complete Track (Through Karachi-Hyderabad Motorway)

The major track from Karachi to site is two-way road. 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 east of the site as shown in Figure 3.4.

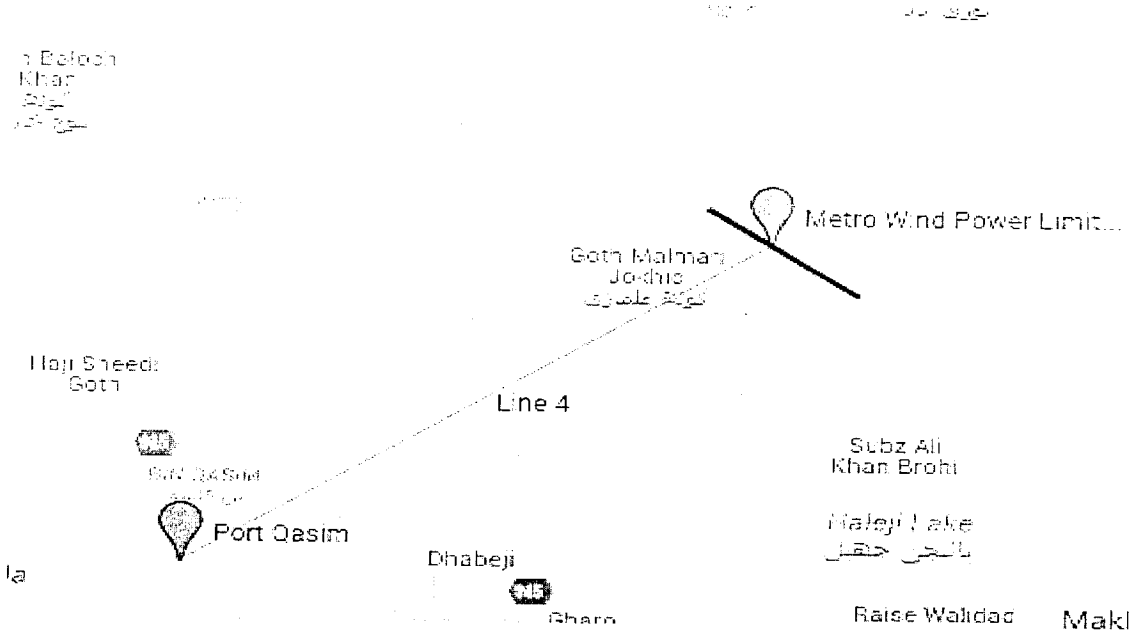

Figure 3.4: Orientation of Site from Port Qasim (Aerial View)

Aerial distance between the Port from the site is 38.7 km. Total track length between Port Qasim Karachi and site is approximately 108 km. Detail access to site is shown in figure 3.5.

The track from Port to the Nooriabad Super Highway is good but site access Road that turns to the site needs minor development.

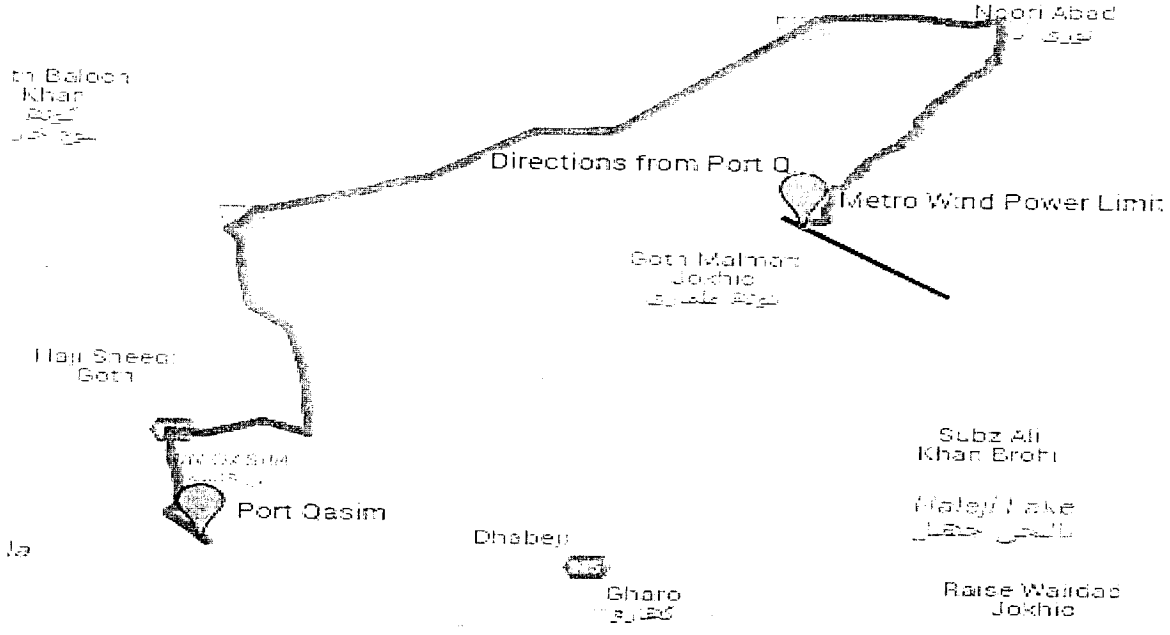

Figure 3.5: Detailed Access to the Site

There is a number of neighboring wind farms under various stages of development in the Jhimpir region of various capacities ranging from 05 MW to 250 MW. The view of different tracks of land allocated to the wind farm project developers in Jhimpir is shown in Figure 3.6.

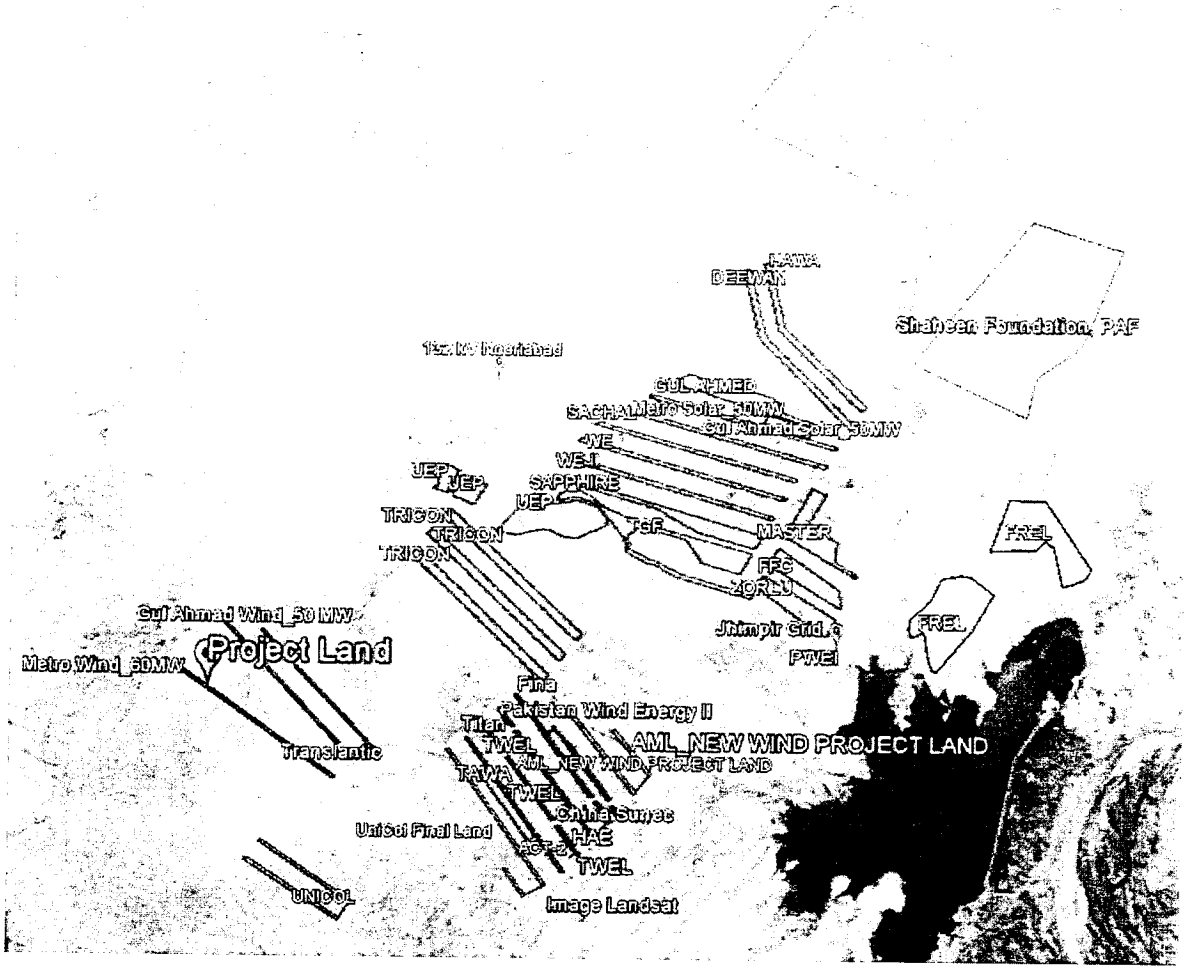

Figure 3.6: MWPL Site with Respect to Neighbouring Wind Farms in Jhimpir

3.3 PROJECT SIZE AND COMPONENTS

The Project is of 60 MW capacities. Following WTGs will be installed:

- G.E 1.7 MW – Total 35 WTG
- Gamesa G114 - 2.0 MW – Total 30 WTGs
- G.W 121 – 2.5 MW – Total 24 WTGs
- Vestas V126 -3.3 MW – Total 18 WTG
- Nordex N117 3.0 MW – Total 20 WTG

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

- 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 20 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.

3.4 PROJECT SCHEDULE

The Project is presently preparing its feasibility study, which is expected to be completed within the 1st Quarter of 2016. 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 January, 2016.

No	Milestone	Anticipated Date
1	Submission of Feasibility Study	1st QTR of 2016
2	Tariff Application	1st QTR of 2016
3	EPC Contract Signing	1st QTR of 2016
4	Tariff Approval	1st QTR of 2016
5	EPA/IA	2nd QTR of 2016
6	Financial Close	4th QTR of 2016
7	Project COD	1st QTR of 2018

3.5 LOCATION OF GRID

The Project is planned to be built in the Jhimpir region. 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 Nooriabad. The distance of the grid station from the Project site is approximately ten (18) Kilometers.

Figure 3.7: Nearest HESCO grid station

Another Grid Station of 220kV is under construction and will be available by end of 2016 as per the plans of NTDC.

3.6 WIND TURBINE DETAILS

Brief technical specification of wind turbine model is given in Table 3.2.

Table 3-2: Technical Specification s of Wind Turbine

Make	G.E
Rated Power	1.7
Hub Height	80 meters
No of Turbines	35

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 60 MW wind farm is calculated and presented in Table 3.1.

Table 3-3: Annual Energy Production Estimates

Number of WTG	35
Approximate Net Energy Production [MWh/a] of G.E	531,209MWh/a
Capacity Factor [%] of G.E	35.0%

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 33ºC to 37ºC. The temperature in summer seasons may reach up to 45ºC. The winters are pleasant with average temperature in the range of 15ºC to 25ºC. 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 Jhimpir is shown in Table 4.1.

The climatic conditions of 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 Meteonorm 7.1. The annual average of maximum and minimum temperatures of Jhimpir is given in Table 4.1 and presented in Figure 4.1.

Table 4-1: Average Maximum and Minimum Temperatures in Jhimpir 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

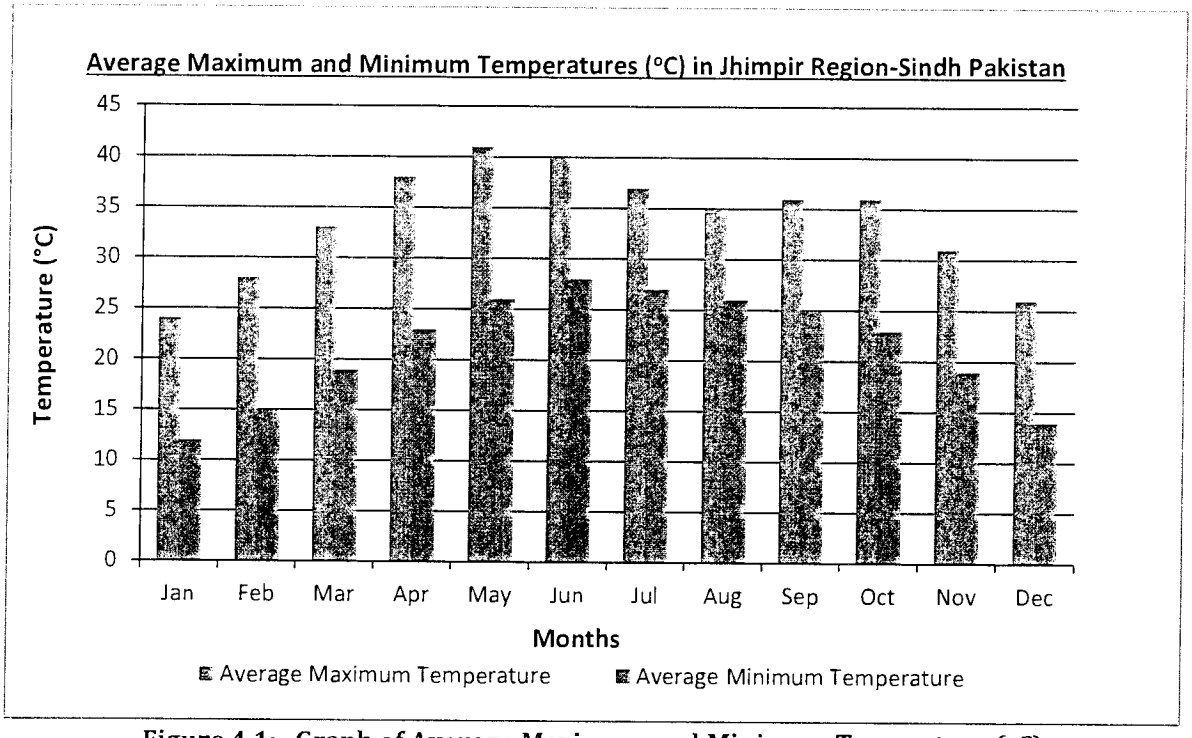

Figure 4.1: Graph of Average Maximum and Minimum Temerature (°C)

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.

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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 25 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.

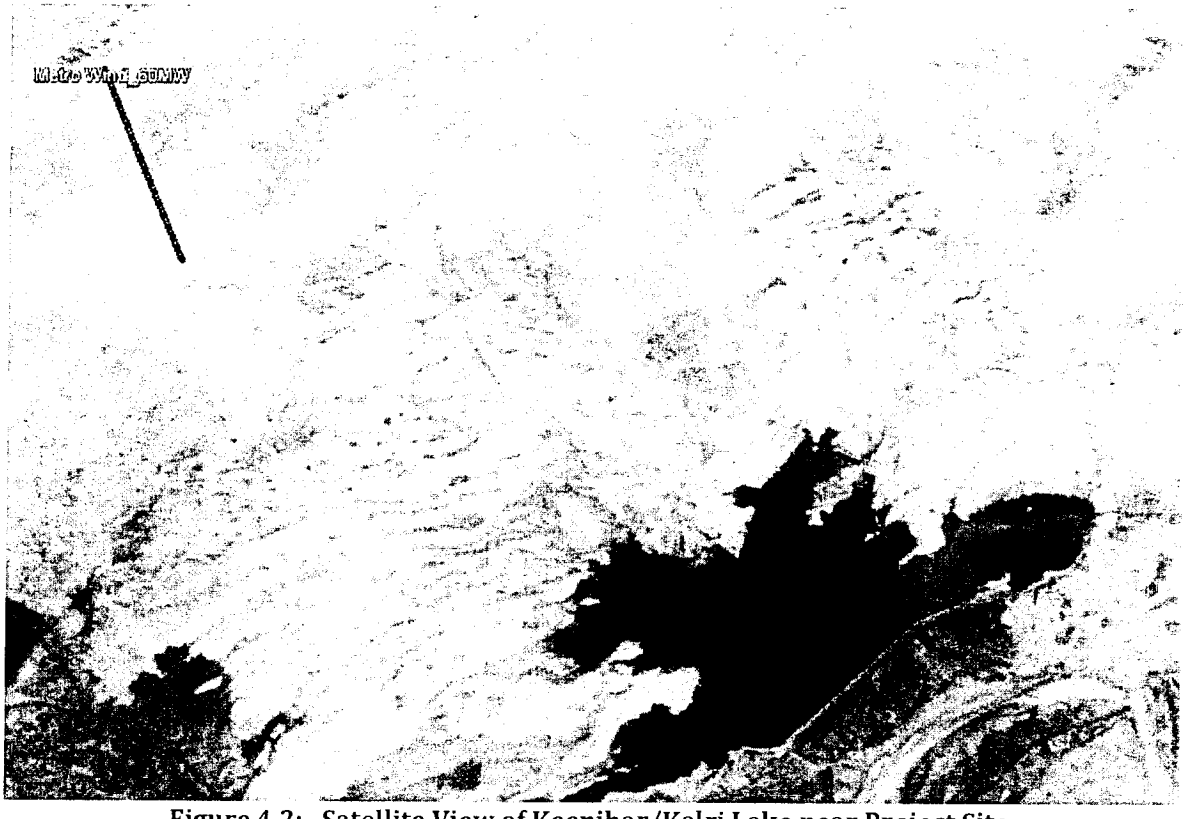

Figure 4.2: Satellite View of Keenjhar/Kalri Lake near Project Site

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 20km away from the Jhimpir wind farm sites 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. BaranNai, which is the principal source of flood drops into the River Indus downstream of Kotri barrage.

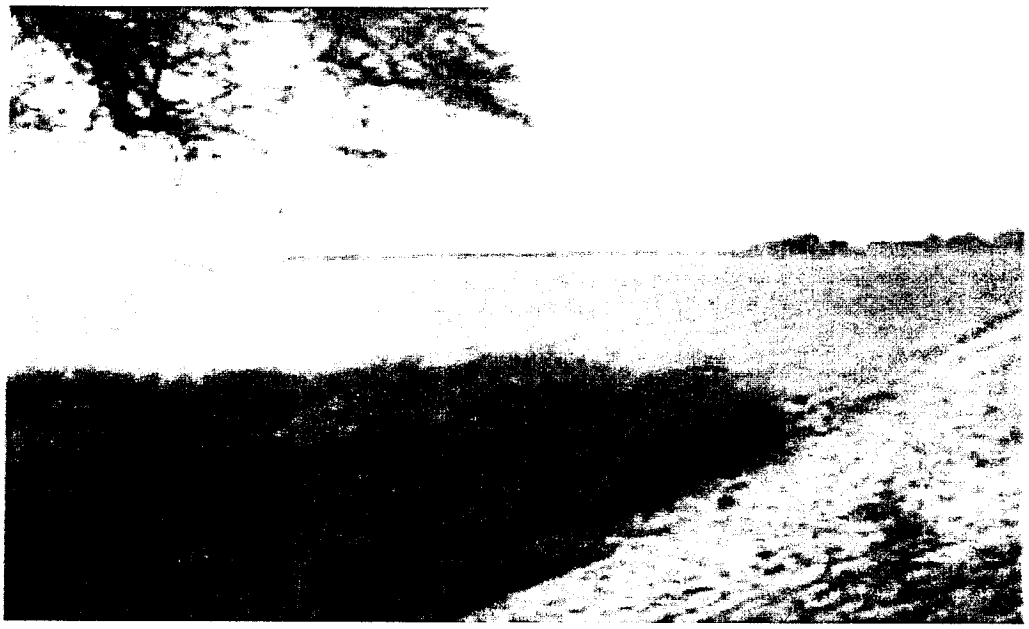

Figure 4.3: View of Kinjhar/Kalri Lake near Project Site

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.

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 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 results are also attached in **annexures VII**.

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.

The project activities will not disturb the water bodies located nearby. As there is no water discharges from the Wind turbines during operations and during construction wastewaters will not be disposed in any water body. However, water from domestic activities like Labor camps will be treated through septic tank / soaking pits.

The area is very poor in terms of the indicator in respect to piped water, which is available to only about 14% of the housing units. About 13% of rural households have hand pumps inside the housing units, while 16% use outside ponds for fetching water, and 6% of housing units use dug wells. The ground water level of the site is 115 meters.

The drainage system in the area is not developed. The booster pumping station for the water supply pipeline is established to supply water from Keenjhar Lake to Nooriabad Industrial State. Nooriabad Industrial state is located at a distance of approximately 26 km from Keenjhar Lake.

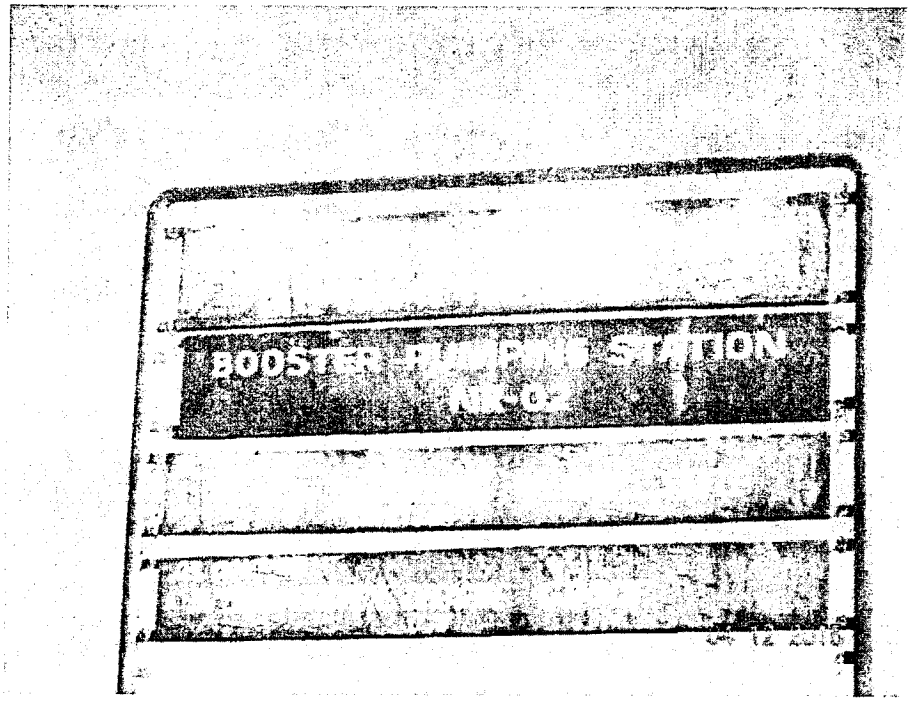

Figure 4.4: Booster Pumping Station from Kinjhar Lake to Nooriabad IndustriaL Estate

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 (PM). Ambient air quality recorded by the (SGS) EPA Certified Laboratory during this study. It may be seen that the average level of each parameter in ambient air is on lower side in comparison with National Environmental Quality Standards (NEQS). The results are attached in **annexure VII**.

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 37.5 dB (A) and 45 dB (A) with the average at 44.0 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 Jhimpir region falls in **ZONE II-B** with moderate to severe 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.

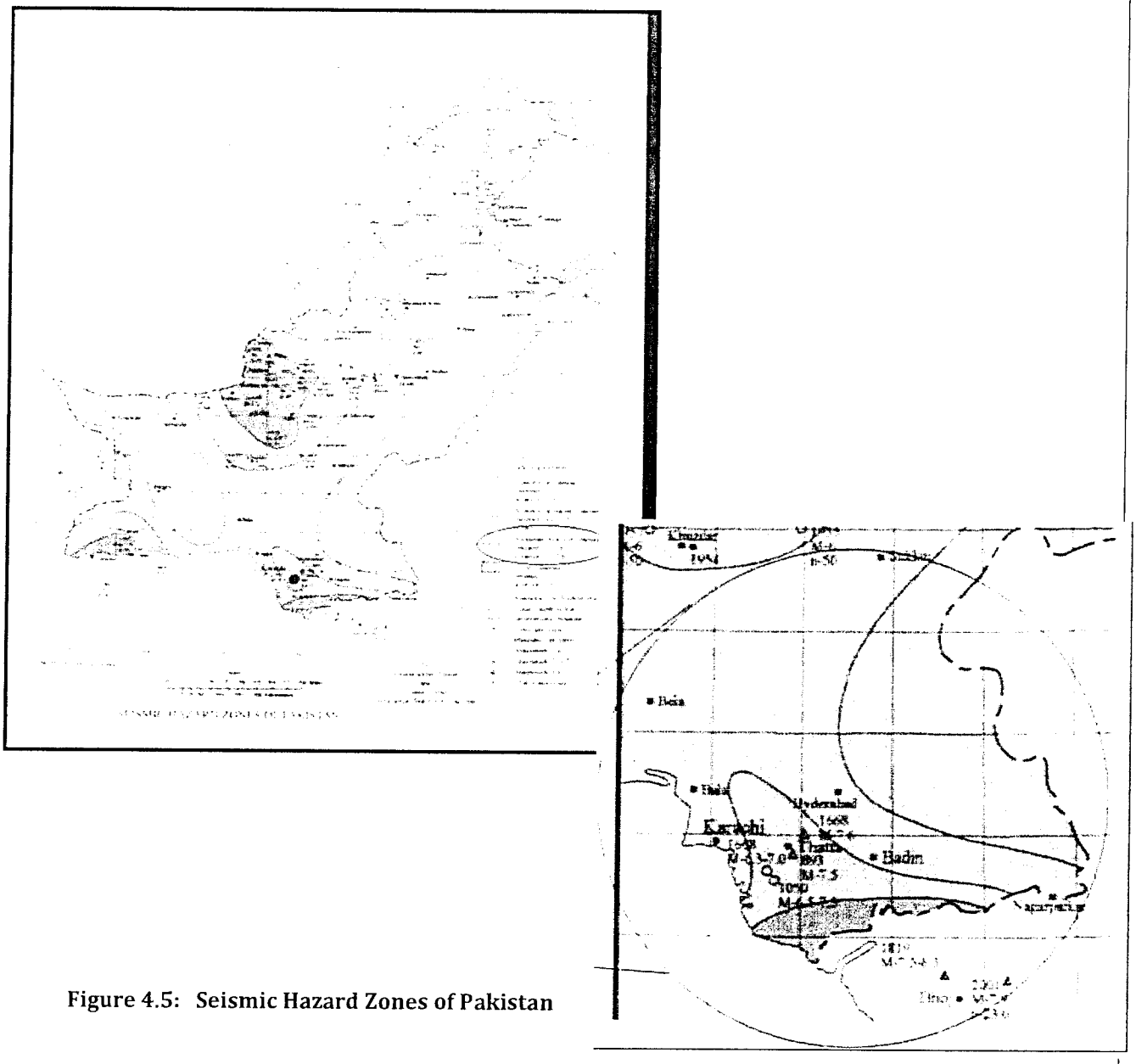

Figure 4.5: Seismic Hazard Zones of Pakistan

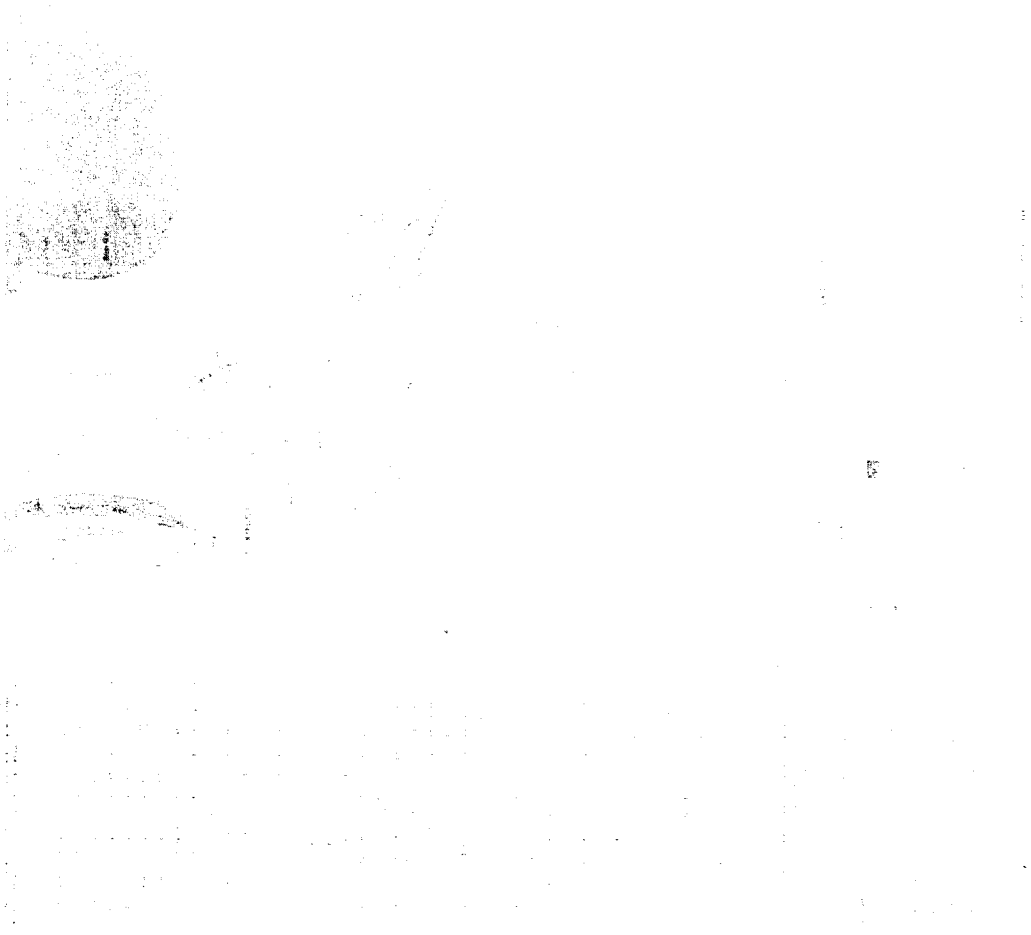

Figure 4.6: Seismic Map of Pakistan

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.

In 2011, torrential floods devastated more than 11,000 villages in Kacha and the surrounding areas of Sindh, displacing more than 213,000 households from their villages along with 1,065,000 numbers of livestock. District Thatta was the worst affected in Sindh because it was the last district on the Indus River where the flood remained for around two months. Official data reveals that approximately one million people were directly hit in this district of the province.

According to the flood map of Pakistan, Sindh province falls under a moderate to heavy flooding zone.

Figure 4.7: Flood Map of Pakistan

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 an MWPL 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 cretatious with the exceptions of some volcanic beds associated with these cretatious strata, all the rocks formation of western Sindh are the sedimentary origin. All of the more important hills messes consist of limestone. A vast majority of this limestone deposit is from the nummultic period and is largely built up of the accumulated shells of foraminifera; principally those belonging to the genus nummulties.

Table 4-3: Geologocal 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

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 in land 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 Jhimpir is classified as mainly loamy saline and part gravely. The soil is similar in nature to the soil of Gharo 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 6.6to 7.3), and moderately calcareous (with $CaCO_3$ content in the range of 3% to15%). 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%).

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).

Table 4-4: Land Use Capability Class in Jhimpir

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

Jhimpir, being in the administrative control of District Thatta, is unique in terms of population sensibility and characteristic. The total area of Thatta is 17,355 sq/km, the total population consists of 1,113,194 persons scattered in several *goths/paras*. Gender distribution shows a figure of 589,341 males and 523,853 females. The population density of Thatta is 64.1 per sq/ km, and the percentage of the total population residing in an urban area is 11.2 %. The average household size is approximately 5 persons. The average growth rate of the population has remained at 2.26% from 1981-98.

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.	Yaqoob Pollari Goth	24° 53.152'N 67° 50.790'E	12.9km	300-400	Permanent
2.	Rawal Pollari Goth	25° 6.684'N 67° 44.728'E	10km	400-500	Permanent
3.	Bilal Pollari Goth	25° 3.511'N 67°42.114'E	3km	150-200	Permanent

Average household size is 5; houses built in nearby villages are single room houses, made of mud and bushes; there are four settlements found in the proximity of the proposed project area nearest settlement are found at the distance of 3.0 kilometer. Kalo Khan Goth. Rawal Pollari Goth and Bilal Pollari Goth are the only permanent settlements and there are no seasonal /temporary settlements near the project site. The population of the settlements varies from 150 – 400+ inhabitants and houses from 50 – 60. 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.

4.10.2 Health and Education Facilities

The health infrastructure in District Thatta is scant. Three out of the six coastal Talukas do not have 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 Thatta, 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 center is present in the area with minimum facilities and staff.

Figure 4.8 A Basic Health Unit in Jhimpir

The literacy rate in District Thatta was reported to be 22% in 1998. The male literacy rate was three times higher at 32% compared to the female literacy rate of only 11%.The literacy rate in urban areas was much higher at 46% compared to only about 19% in rural areas. A single primary school is located in the area.

Government primary school has been observed in the vicinity, which is not functional. The peoples of these goths are demanding the teachers as well as the middle schools. Private school is observed which is far and located at Bachal Jhakro Goth. There is no any school present in these Goths. There is dire need of high school and to make primary school functional.

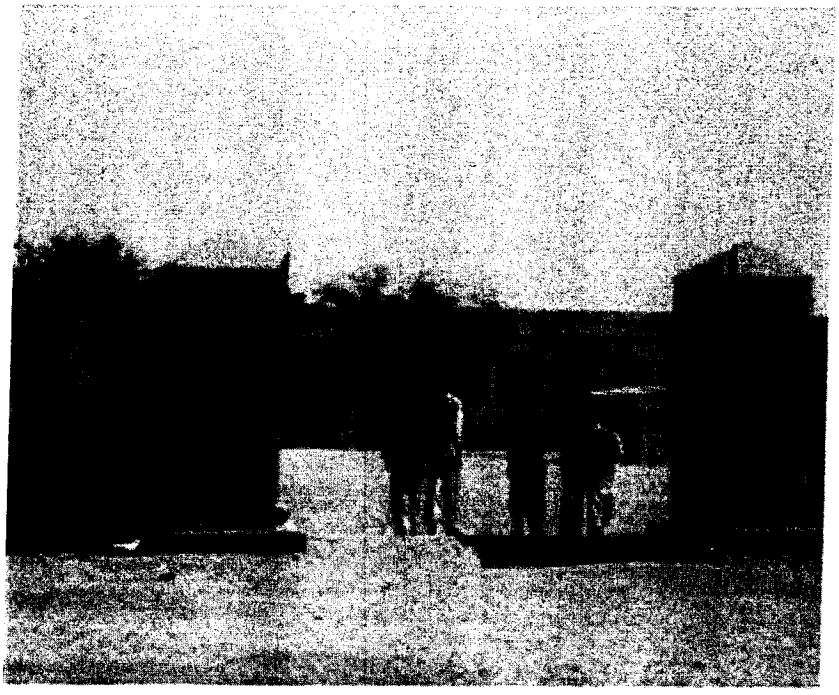

Figure 4.9: A View of School nearby Project Area

4.10.3 NGOs Working in the Area

Different national and international NGOs are working in District Thatta with the help of their local partners. Their scope of work ranges from relief operations in the coastal areas of Thatta 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, WWF, and Pakistan Fisher Folk Forum.

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, Hyderabad or Karachi. Skilled labor from this area mainly comprise of vehicle drivers, agriculture activities, Shepherd, welders, plumbers, and electricians. Government service is relatively rare; few locals are working in the Pakistan Steel Mill Dolomite Project and the Pakistan Railway Station in Jhimpir. 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 Metro Wind Power 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 Thatta for a length of approximately 200 km.

The main railway line from Karachi to Peshawar also connects the district. The nearest railway station is Jhimpir.

Electricity is only available in 21% for the rural housing units, while kerosene oil is still used in 77% of the rural dwellings. Firewood is used as the main cooking fuel in about 91% of rural households and 77% of urban households.

The district is also equipped with digital and non-digital telecommunication systems, besides postal service and telegraph service.

From an industrial point of view, The Thatta district has progressed considerably. There are about 30 industrial units established in the district.

Nearest industrial hub is Nooriabad at the distance of approximately 20 kilometers, Nooriabad has different type and size of industries; which includes Textile, Power, Cement, etc.

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.

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.

Survey Methods

There are two main survey types involved in such studies.

Distribution and status surveys: These are meant to record the occurrence, distribution and population / seasonal status of the various species using the site as breeding, wintering or staging site.

Vantage Point Surveys: These surveys comprise a series of observations from a certain fixed chosen location to quantity the flight activities of the birds at a proposed development site, which provides data to estimate the collision risk of the birds (particularly the migratory ones) against the blades of the turbine.

The survey area must adequately cover the entire development area. This includes access tracks; borrow pits, nearby villages, forested area, water points, farmland, vegetative area and wastelands.

Habitat loss and displacement may affect animals out with the project site. Therefore, surveys are also made in the area extending at least 500m beyond the project area boundary on either side.

Snap shots of Biological Environment survey are attached as Annexure IX.

B. Principal Habitats

The Project Area is mostly a wasteland comprising of the following main habitats.

- Sandy Plain Area
- Rocky Plain Area
- Rocky Area
- Scrubland

- Small patches of barani agriculture land
- Coal pits/mines

4.11.1 Flora

Flora survey conducted by Project team experts revealed that, during the fieldwork in the Project Area, 24 plant species belonging to 15 families were identified. Out of these, 17 species are perennial, 05 are annual and 02 are herbs. The quantitative analysis of the floral composition was made and four distinct plant communities were identified based on life forms of the identified species. The dominant vegetation comprises of Zizyphus nummularia, Copparis decidua and Grewia tenax.

Project area has 20 plant species belonging to 14 families were identified sampled in the main locations within the project Area. Out of these, 13 species were perennial, 5 were annual and 02 were herbs the. The quantitative analysis of the floral composition was made and four distinct plant communities were identified based on life forms of the identified species. Summary of Floral composition found in project area is shown in table 4-6;

Table 4-6 Floral Composition found in Project Area

Life Forms	Numbers
Trees	06 species
Shrubs	11 species
Herbs	06 species
Grasses	02 species

No endemic or rare plant species (expect commiphora wightii) was recorded during the survey.

The following Table provides the list of floral species observed in the three main habitats viz. Flat Plains, Streambeds and hillocks/ foothills in quadrates measuring 20 x 20 m and 2 x2 m.

4.11.2 Fauna

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. Faunal attributes recorded during the study period is given below in table 4-7

Table 4-7 Faunal Attributes in the Project Area

Attributes	Numbers
Mammals	10 species
Birds	38 species
Reptiles	08 species
Plants	22 species

A. Mammals

During the present survey, 15 species were recorded. The area has very thin population of mammals. Only solitary individuals of big mammals such as Indian Jackal and Red Fox could be sighted. One den of Indian Crested Porcupine was located. The small mammals such as Five Striped Palm Squirrel, Indian and Desert Gerbils, House mouse were scarce. Desert Hedgehog, Desert Hare, Ratel and Indian Pangolin have been reported from the area.

B. Birds

22 species were recorded from the area (Table 4-7). The area supports Grey Partridges, Chestnut bellied and Lichtenstein Sand grouses, Pigeons, Doves, Bee-eaters, Mynahs Shrikes, Bulbuls, Indian Robin, Purple Sunbird, Black Drongo, Black Kite, House Sparrow, and House Crow. Indian Silverbill and Sind Jungle Sparrows area quite common near the villages or near the water points.

C. Reptiles

As regards the Reptiles, 13 species were recorded during the present survey. Snakes such as Saw-scaled Viper, Indian Cobra, Indian Krait, Indian Sand Boa, Plain Racer have been reported from the area. Indian Desert Monitor was found to be scarce, while Indian Garden Lizard and Indian Spiny tailed Lizard were common in the area.

List of Flora and Fauna found in the Project area is attached as Annexure VIII

D. Protected Areas

There is no Wildlife Protected Area in the close vicinity of the site. Keenjhar Wildlife Sanctuary is more than 16 miles away from the site. No Protected / Reserve Forest or any Rangeland lies in the vicinity of the Project Area. Two Ramsar Sites are located within this wind corridor viz. Haleji Lake, and Keenjhar Lake.

4.12 NATURAL MINERAL RESOURCES

The area near the Project site area is very rich in natural resources. Coal reserves of approximately 28 million tones covering an area of 350 sq.miles are present in the area of Jhimpir.

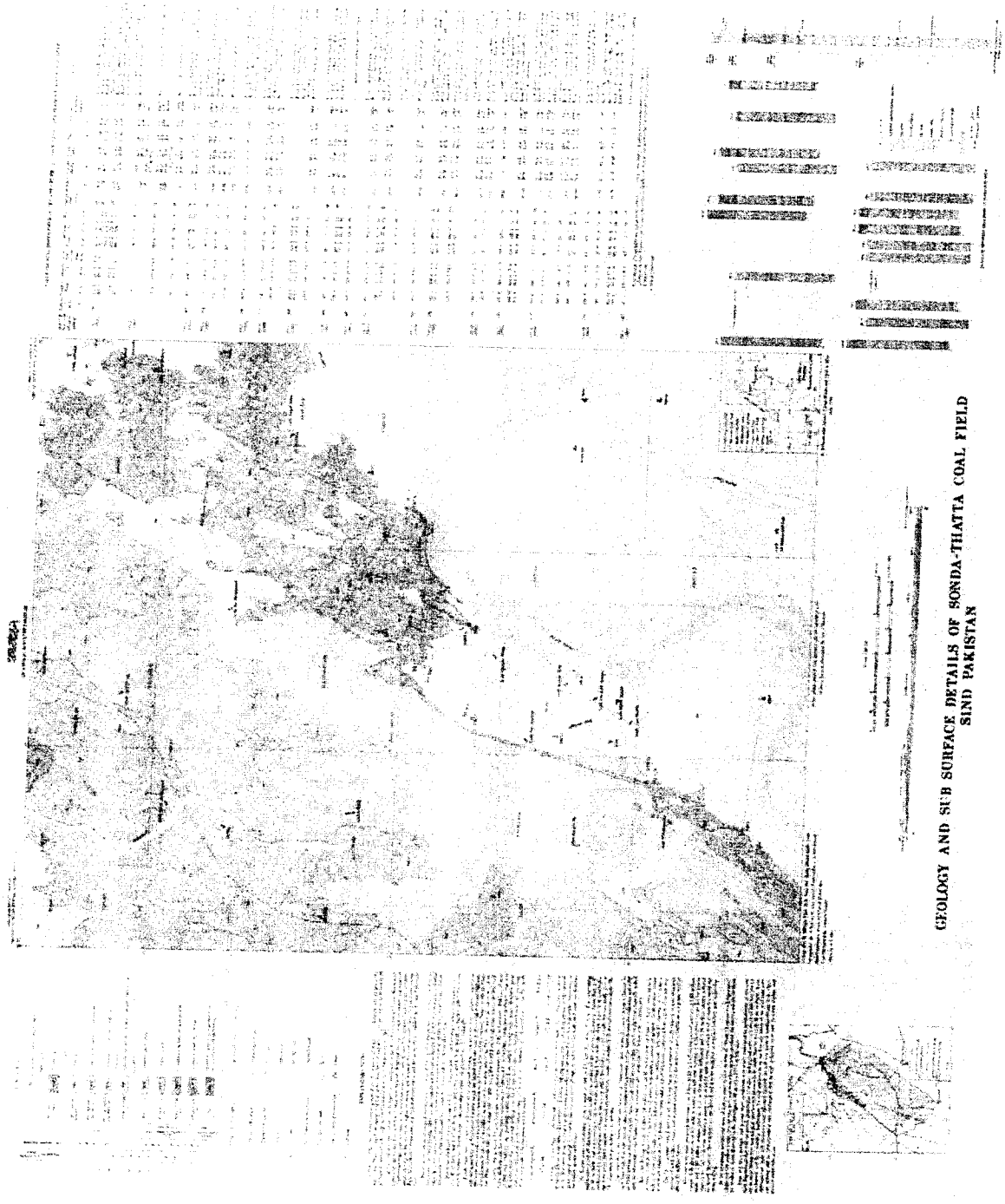

Figure 4.9: Geological and Sub Surface Details of Jhimpir

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.

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 Jhimpir. The location of the project is selected on the base of suitable terrain and wind speed availability in the area.

Jhimpir 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 this 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 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.

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.

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Company Secretary

SECTION 6
POTENTIAL ENVIRONMENTALIMPACTS AND MITIGATION MEASURES

6 POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 LAND USE

The total land allocated for the Project is 410 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 three settlements/Goths near the project area, which are located 03 to 13 kilometers away from the project site and will not be affected due to construction and operation activities of the project.

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

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-metaled 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 03 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.

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

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.

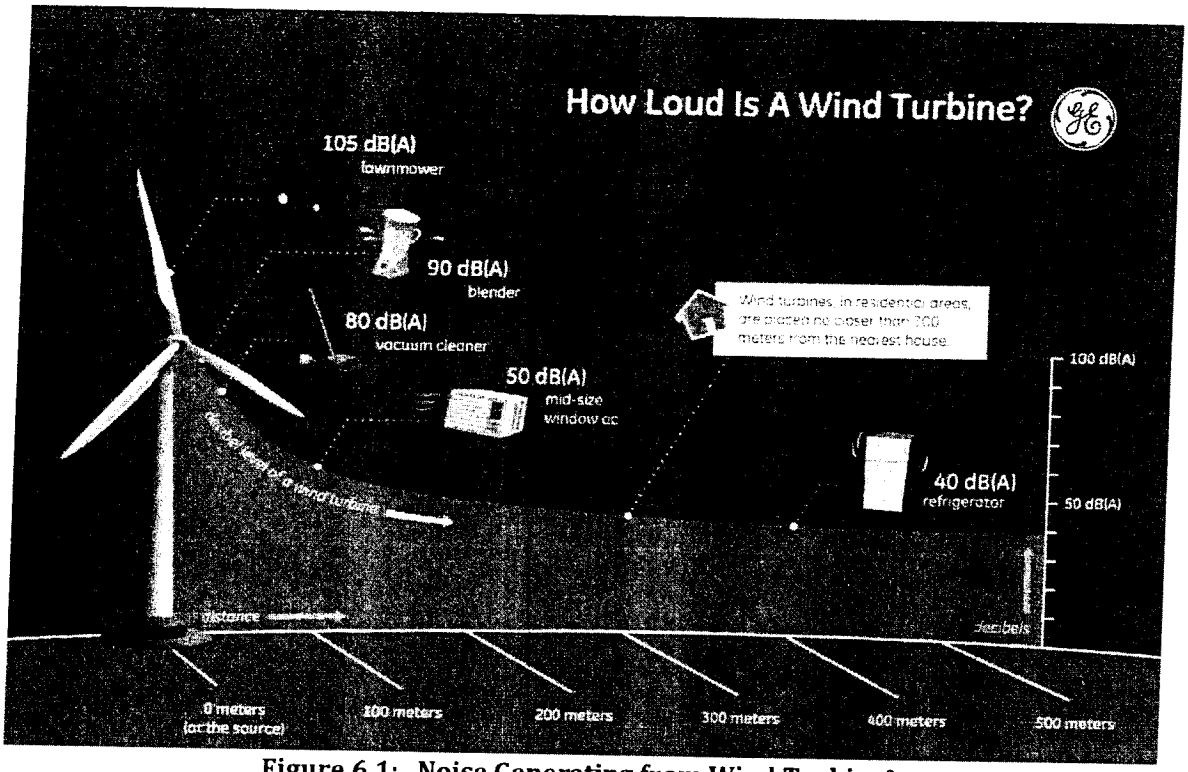

Figure 6.1: Noise Generating from Wind Turbine[2]

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 3-6 kilometers.

[2] GE Global Research; National Institute of Deafness and other Communication Disorders (NIDCD part of NIH)

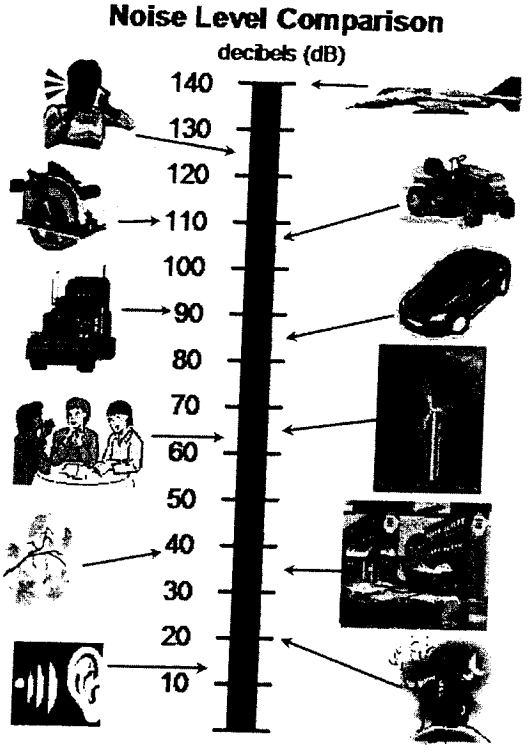

Figure 6.2: Noise Generating from Wind Turbine[3]

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)

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.

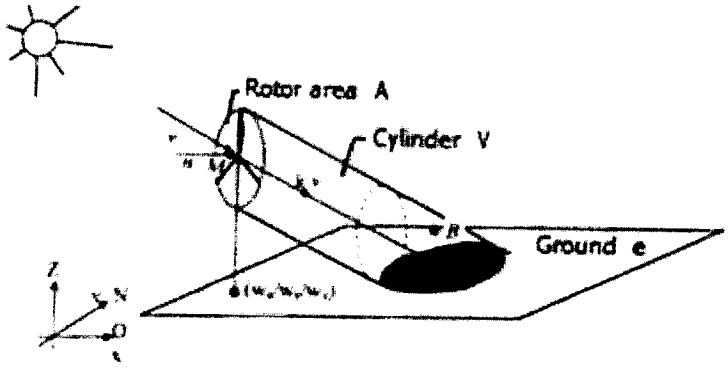

Figure 6.3: Shadow Flicker of Wind Turbine

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

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 2000 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 and drinking use of Project staff at the site.

Water Use & Quality	◇ = Low

◇◇◇ =High

◇◇ =Medium

◇ =Low

○ =No Impact

☆ =Locally Favorable

☆☆ =Regionally Favorable

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. The waste disposal contractor will be hired to collect and dispose solid waste as per NEQS requirement. The contractor must be approved by local municipality Thatta.

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.

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. 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

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.

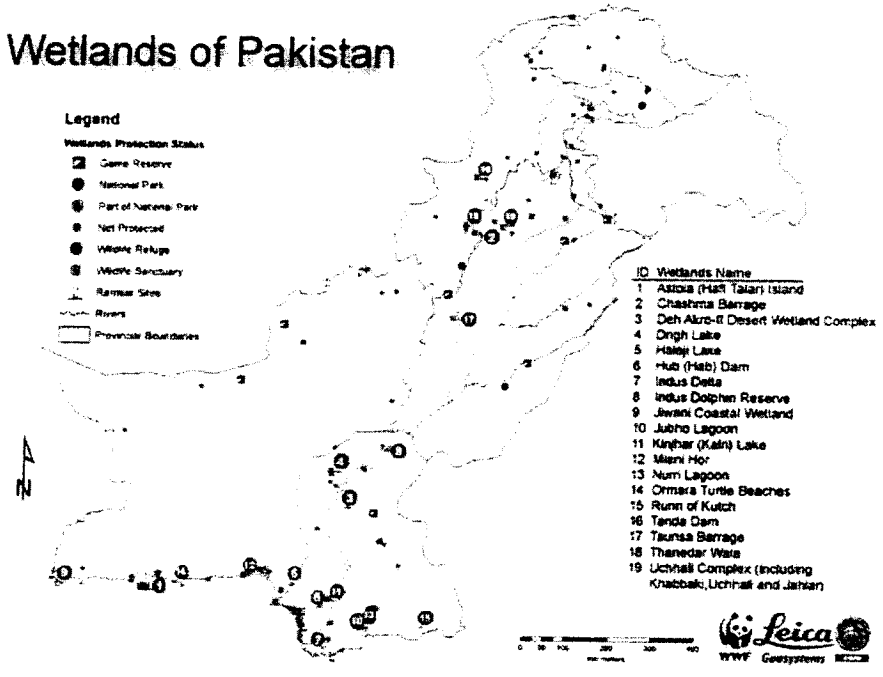

Figure 6.4: Wetlands of Pakistan[5]

[5] www.pakistanwetland.org

Out of 19 Ramsar sites, 10 sites are located in the province of Sindh, which are shown in Figure 6.5.

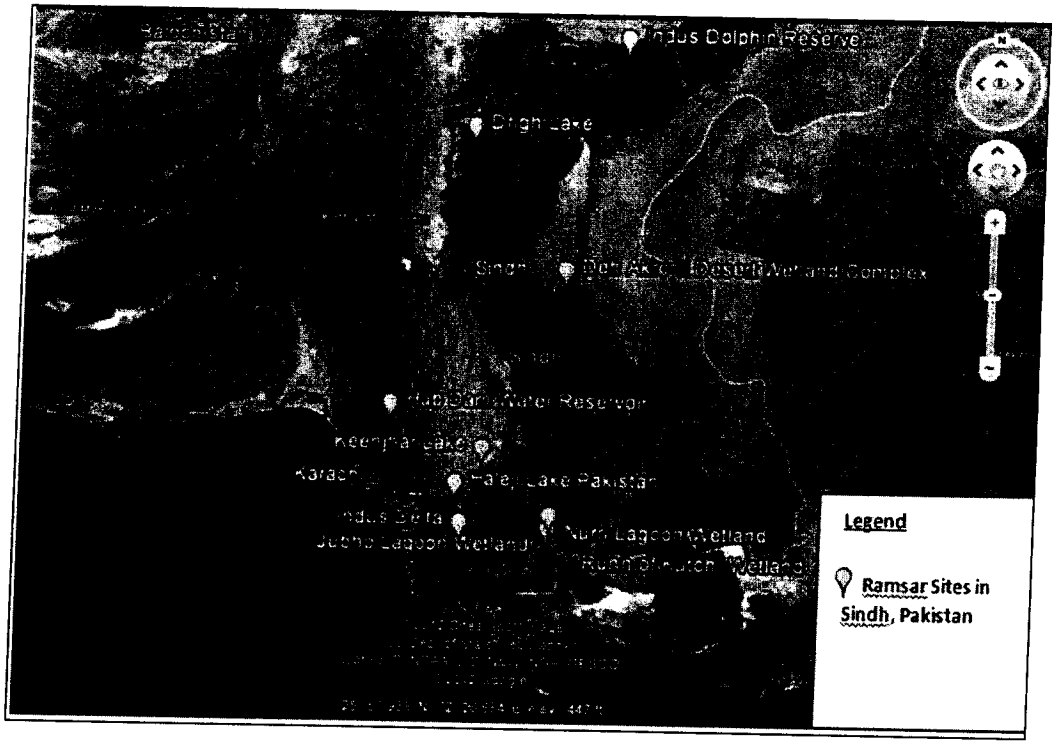

Figure 6.5: Wetland located in Sindh

Keenjhar Lake is the declared wildlife sanctuary, and the Ramsar site is located at a distance of 16 miles approximately 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. The 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.

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

Table 6-1: Migratory and Local Birds of Keenjhar Lake[7]

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	Herons 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

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 of 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.

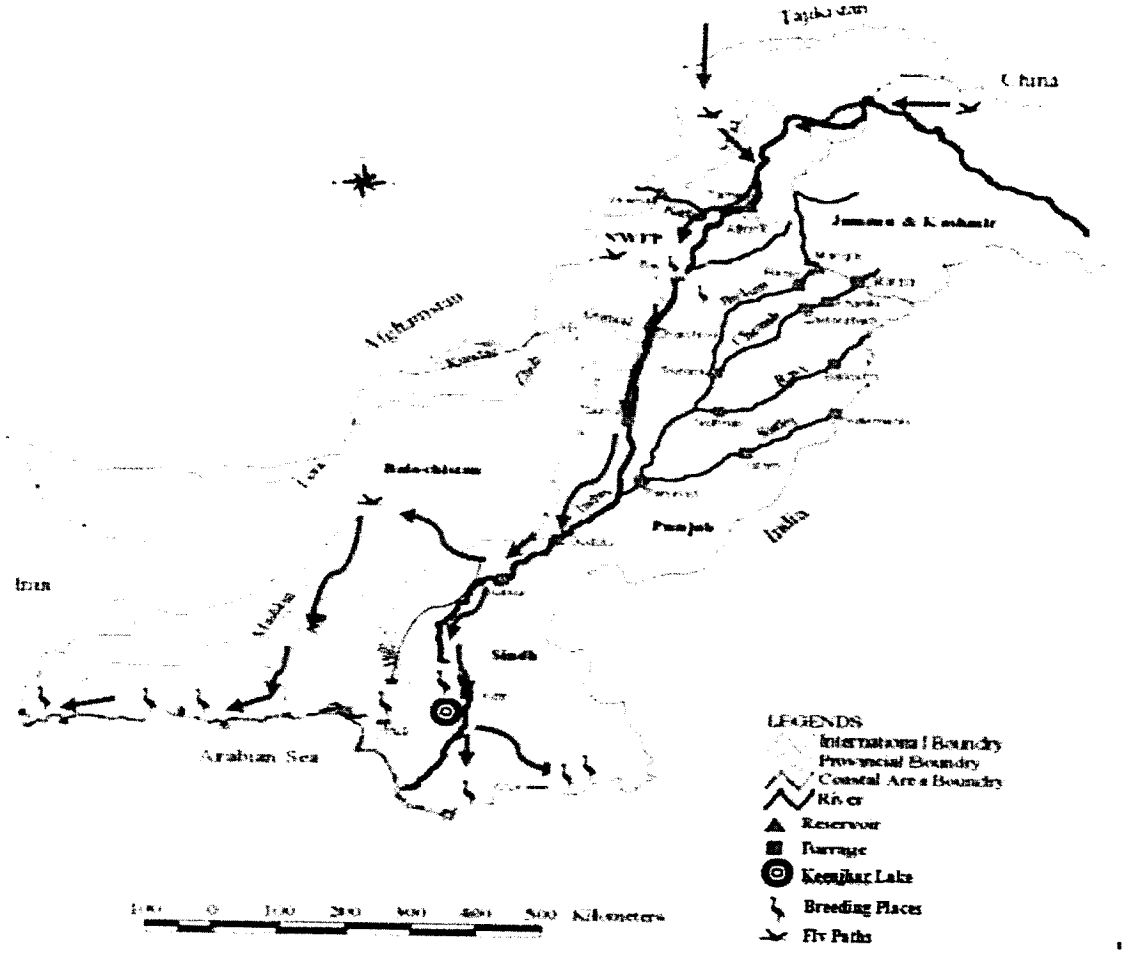

Figure 6.6: Indus Flyway for Migratory Birds/Green Route No.04

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.

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 25 km away from western side of Keenjhar Lake, and birds usually do not land and stay in the western part of Keenjhar Lake.

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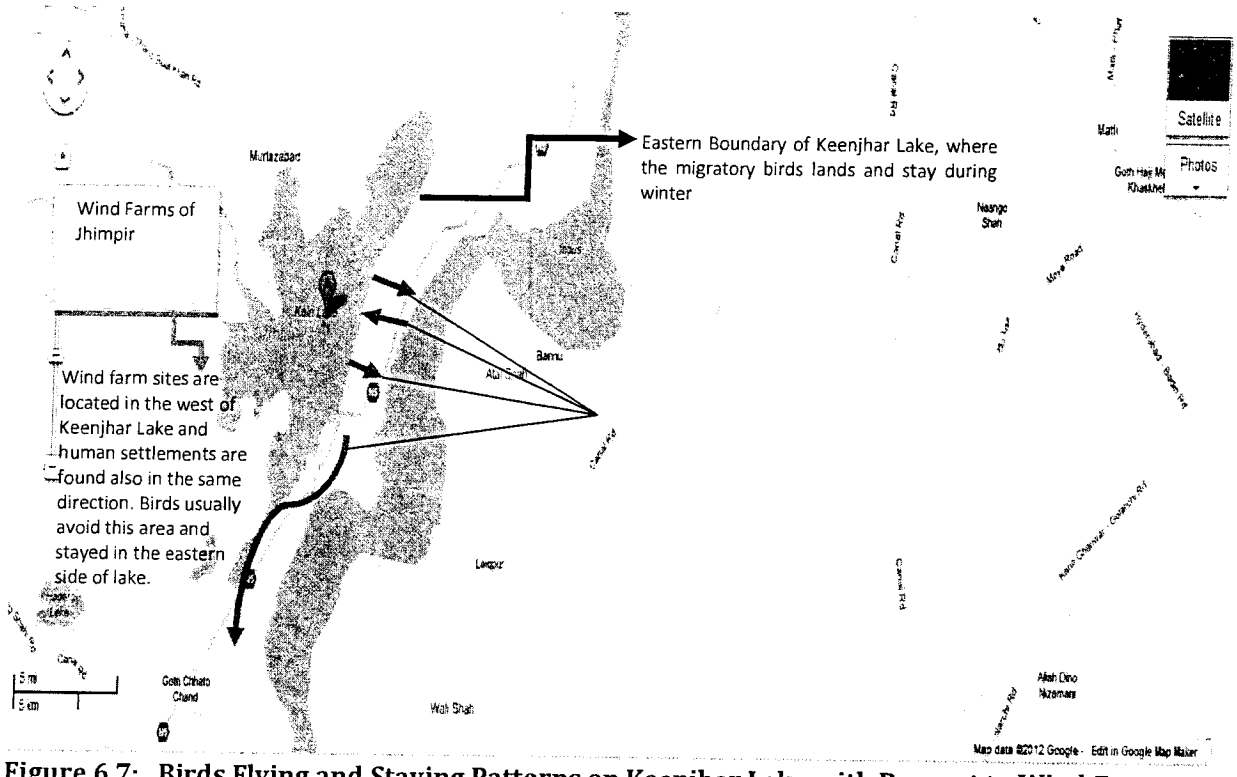

Figure 6.7: Birds Flying and Staying Patterns on Keenjhar Lake with Respect to Wind Farms

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

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 conclusion[8].

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

[9] American 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.

- 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 is allowed unless absolutely necessary.
- Operation camp is located 500m away from perennial water bodies.
- Metro Wind Power Ltd will work with the local WWF located in Thatta and remain involved in the conservation efforts of threatened species

Impact on Migratory Birds	= No Impact
Impact on Local Birds	= Low


=High


=Medium


=Low


=No Impact


=Locally Favorable


=Regionally Favorable

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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, there will be a requirement for minimal vegetation clearing or deforestation during the Project. 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

6.11.2 Re-Settlement

Project is located on government land leased by the GoS to the Project sponsors. The settlements are located outside of 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

6.11.3 Visual Impact on Landscape

The addition of the Project to the local landscape will have a significant visual impact. 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

6.11.4 Aviation Hazard

No aviation hazard will be created by the Project as it is located 95km 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

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. Overall the impact will be low.

Labor Welfare & Safety	◇ = Low
◇◇◇	=High
◇◇	=Medium
◇	=Low
○	=No Impact
☆	=Locally Favorable
☆☆	=Regionally Favorable

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

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, GM), 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;
- 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 Jhimpir 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.**

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 MWPL 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.

Table 7-2 General Public Interviewed during Public Consultation at Jhimpir

S.NO	NAME	OCCUPATION	LOCATION
1	Ghulam Qadir	Unemploymed	Goth Rawal Pollari
2	Dur Muhammad	unemployed	Goth Rawal Pollari
3	Hamza	Labour	Goth Bilal Pollari
4	Juma Pullari	Labour	Goth Yaqoob Pollari

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.**

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;

- The social survey conducted by the social expert must have Livelihood matrix, group discussion, Priorities of locals, pear wise ranking and questioner. Only questioner is not enough for social survey.
- 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.
- Removal of vegetation may be avoided, as for as possible. Plantation programme may be developed in the Project area taking care that invasive species may be avoided to be introduced.

- A certificate must be obtained from the sindh wildlife department to the effect that the proposed WPP area does not fall into the limits of any Protected Area notified by the Department.

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 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. A set questionnaire was also filled. 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;

- Mr. Ghulam Muhammad Gaddani along his team identified the Keenjhar Lake as the Wildlife sanctuary and Ramsar site as nearest protected area which is located approx. 25 kilometers and he briefed about its importance and patterns of the birds during the different seasons.
- He also proposed that to provide the basic facilitates 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 Jhimpir. 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. The Department has created some water conservation ponds in the area. These get filled with water during heavy rains and are used by the local people and the livestock for drinking purposes. These may be safeguarded during the Project activities.

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. A set of questionnaire was also filled. 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;

- Raised concern about mortality of birds and said that project is located near birds flying route.
- Raised concern about Noise pollution drives by wind turbines and it may affect local norms and modify the bird's habitats in that area. But i made him clear that the detail study for noise pollution has already been conducted and incorporated in our IEE report.
- Meanwhile, GE turbines noise and shadow affect has been described in detail in our study. It does not affect local norms and habitat modification.
- 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- 7-3)

Table 7-2 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	General Manager
Mr. Tahir Qureshi	IUCN	Senior Coastal Ecosystem Advisor
Mr. Kamran Ahmad Naqvi	IUCN	Urban Specialist
Muhammad Moazzam Khan	WWF	Ex. DG Marine Fisheries department
Mr. Rab Nawaz	WWF	Technical Advisor
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 be safeguarded against any developmental activity. The animals be 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 be 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 be minimized.
7. Routes involving minimum clearing of vegetation be 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 be disposed off according to waste disposal procedure on a regular and strict basis.
10. Night work during construction be prohibited, night traveling not be allowed unless absolutely necessary.
11. All mitigations related to minimizing noise be 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 be reported and vehicle speeds be randomly checked.
14. Movement of all project personnel be restricted to work areas.
15. Movement of project vehicles be restricted only to the project access road or to routes approved.
16. Operation camp be located 500m away from perennial water bodies.

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.

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. MWPL) 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.

Metro Wind Power Limited 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. Metro Wind Power Limited 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 Metro Wind

Project to 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 Metro Wind Power Limited (MWPL) 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.

- 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

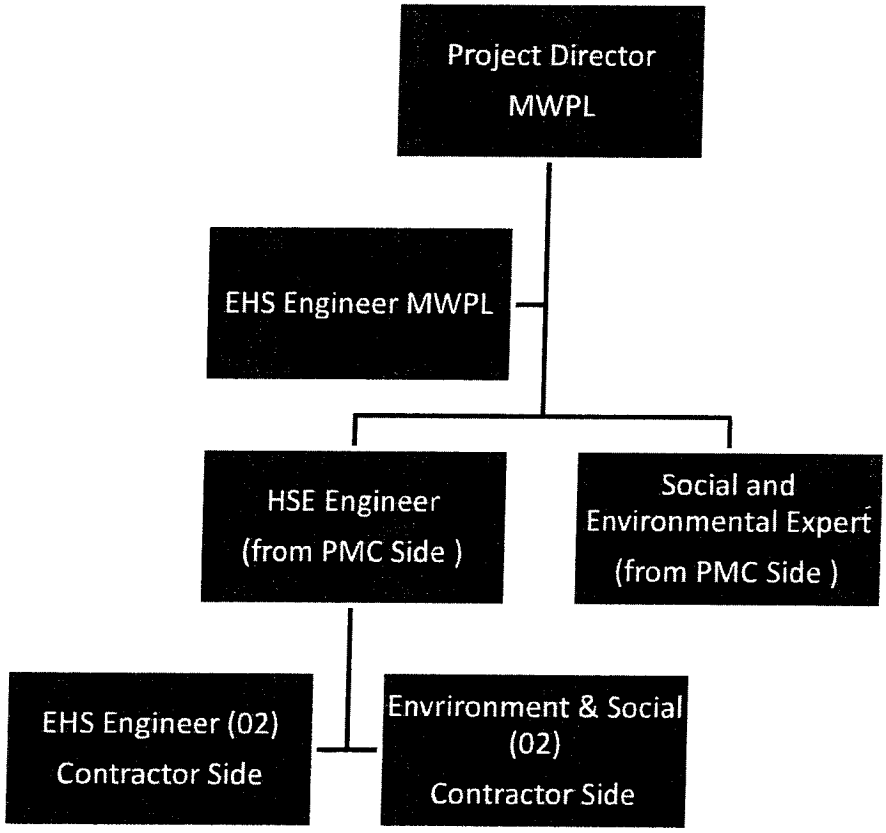
The contractor will be responsible for the following:

- ❖ 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

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)

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.

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.

Metro Wind Power Limited 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.

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 IEE 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 MWPL 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.

8.8 PUBLIC DISCLOSURE REQUIREMENTS

Metro Wind Power Limited (MWPL) will disclose this IEE and EMP to all the stakeholders before the commencement of the proposed Project. The EIA 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 MWPL 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 Metro Wind Power Ltd (MWPL) cost shows the environmental monitoring / training cost that will be borne by the Gul Ahmed Electric Ltd through the EMSC. Detailed cost is shown in Annexure –II.

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-X.**

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.

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.

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,

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 Metro Wind Power 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 Metro Wind Power Ltd (MWPL) 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 Metro Wind Power Ltd (MWPL) 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.

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.