TITAN ENERGY PAKISTAN (PVT) LTD

FL-2/1, Block-6, Gulshan-e-Iqbal, Karachi-75300, Pakist
Ph. : 92-21-34966809-10-11, 34967005 Fax : 92-21-349603

No. TEPPL/Gen-License/NEPRA/6

To,

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

Subject: **Application of Titan Energy Pakistan (Private) Limited (TEPPL) For grant of Generation License in respect of 9MW Wind Power Project at Jhimpir District Thatta Sindh.**

Reference: **NEPRA /R/LAG-30/TEPPL/1352 dated Febuary 06, 2014**

Our Reference: **Letter No. nil Dated September 25, 2013**

Dear Sir,

It is stated that Titan Energy Pakistan (Private) Limited has submitted the subject application for the grant of Generation License for 9MW Wind Power Project on dated September 25, 2013, but it could not received favorable decision of the Authority due to cap of 500MW and our application returned back without approval.

Meanwhile NEPRA has conducted a hearing in the matter of review of determination of upfront tariff for Wind Power Generation.

In the result of that hearing decision has reached in favor of those companies who applied for the grant of upfront tariff within 365 days from the determination by the Authority.

Therefore in the light of above we are again sending our application for the approval of Generation License at par with the other companies those applied for the same within 365 days from the determination. Bank draft of Rs.132,480/- as License application fee is attached herewith.

Thanks & best regards

Yours faithfully

for M/s Titan Energy Pakistan (Pvt) Ltd

(Dilshad Habi Khan Lodhi)
General Manager

Encl: i) Original Generation License Application
ii) Pay Order No. 2153361 dated 08-05-2014 for Rs.132,480/-

TITAN ENERGY PAKISTAN (PVT) LTD.

FL-2/1, Block-6, Gulshan-e-Iqbal, Karachi-75300, Pakistan.
Ph. : 92-21-34966809-10-11, 34967005 Fax : 92-21-34960380

September 25, 2013

The Registrar
National Electric Power Regulatory Authority
Islamabad

Subject: Application for Generation License

Dear Sir,

I, Dilshad Nabi Khan Lodhi, General Manager, being the duly authorized representative of Titan Energy Pakistan (Private) Limited by virtue of Board Resolution/ Power of Attorney, dated 24th September, 2013, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to Titan Energy Pakistan (Private) Limited pursuant of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

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

A Bank Draft in the sum of Rupees 128,928/- (One hundred twenty eight thousand nine hundred twenty eight only), as License application fee accordance with schedule –II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulation, 1999, is attached herewith.

Kindly acknowledge the receipt.

Yours truly

For **Titan Energy Pakistan (Private) Limited**

DILSHAD NABI KHAN LODHI
General Manager

TITAN ENERGY PAKISTAN (PVT) LTD.

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Ph. : 92-21-34966809-10-11, 34967005 Fax : 92-21-34960380

AN EXTRACT OF THE MINUTES OF THE MEETING OF THE BOARD OF DIRECTORS OF M/S TITAN ENERGY PAKISTN (PVT) LIMITED HELD ON 24TH SEPTEMBER 2013

Resolved that an application to be filed for Generation License with M/s. National Electric Power Regulatory Authority (NEPRA), Islamabad.

Further Resolved that Mr. Dilshad Nabi Khan Lodhi, General Manager of M/s. Titan Energy Pakistan (Pvt) Limited is hereby authorized to sign singly the necessary documents / papers, pay the filing fees, appear before the authority as required, to do and cause to be done all acts, deeds and things which may be necessary to give effect of this resolution and to do all acts necessary for completion and processing of the application for Generation License.

Further Resolved that a certified true copy of the resolution be submitted to M/s. National Electric Power Regulatory Authority (NEPRA), Islamabad under signature of the Company Secretary.

CERTIFIED TRUE COPY
For and on behalf of
TITAN ENERGY PAKISTAN (PVT) LIMITED.

ABDUL WAHID
COMPANY SECRETARY

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE

(COMPANY REGISTRATION CELL)

CERTIFICATE OF INCORPORATION

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

Corporate Universal Identification No. **0067040**

I hereby certify that "**TITAN ENERGY PAKISTAN (PRIVATE) 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 **Islamabad** this **Twenty Eighth** day of **July Two Thousand and Eight.**

Fee Rs. 7,000/-.

(SAILA MASOOD)
Deputy Registrar of Companies

THE COMPANIES ORDINANCE, 1984

(PRIVATE COMPANY LIMITED BY SHARES)

MEMORANDUM

AND

ARTICLES OF ASSOCIATION

OF

TITAN ENERGY PAKISTAN (PRIVATE) LIMITED

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN
COMPANY REGISTRATION OFFICE

(COMPANY REGISTRATION CELL)

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Fee Rs. 7,000/-.

Certified to be True Copy
Joint Registrar of Companies

(SAILA MASOOD)
Deputy Registrar of Companies

The Companies Ordinance, 1984

(Private Company limited by Shares)

MEMORANDUM OF ASSOCIATION

OF

TITAN ENERGY PAKISTAN (PRIVATE) LIMITED

NAME

I. The name of the company is "TITAN ENERGY PAKISTAN (PRIVATE) LIMITED".

REGISTERED OFFICE

II. The registered office of the company shall be situated in the Province of Sindh.

OBJECTS

III. The objects for which the Company is established are as all or any of the following and in construing the following sub-clauses the scope of no one of such sub-clauses shall be deemed to limit or affect the scope of any other of such sub-clause and that every sub-clause shall be deemed a substantive clause and no limited or restricted by reference to or inference from the terms of any other sub-clause or by the name of the company:-

1. To establish and run electric power project in order to engage in the business of generation, transmission and distribution of electricity in all its forms and perspectives and undertake all such activities as are connected, linked or associated therewith and seek necessary approvals, registrations and licenses from relevant authorities and for that purpose to do all such acts, deeds or things as would be required for effective discharge or this object.

2. To carry on the business of power production in all its forms and perspectives through all means, techniques, systems and procedures as may be feasible and develop in future and own or acquire all requisite facilities and seek necessary approvals, registration and licenses from relevant authorities and undertake all such activities as are connected, linked or associated therewith.

3. To carry on any where in Pakistan the business of power generation and distribution in all its branches and aspects and in particular to construct, lay down, establish, maintain and fixed all necessary power stations together with ancillary works, cables, wires, lines, accumulators, lams and to generate, accumulate, distribute, sell and supply electricity.

4. To carry on all or any of the businesses of generating, purchasing, importing, transforming, converting, distributing, supplying, exporting and dealing in electricity and all other forms of energy and products or services associated therewith and of promoting the conservation and

efficient use of electricity and to perform all other acts which are necessary or incidental to the business of electricity generation, transmission, distribution and supply.

5. To purchase or otherwise acquire, produce, manufacture, refine, treat, purify, blend, reduce, distill, store, transport, market, distribute, supply, sell and otherwise dispose off and generally trade in any and all kinds of petroleum and petroleum products, oils, gas, hydrocarbons, pertrochemicals, asphalt, bituminous substances and the products and by-products which may be derived, produced, repaired, developed, compounded, made or manufactured there from and or acquire and take over the running or likely to be running business of alike nature with or without assets, liabilities, rights, privileges, goodwill, registration, trade mark, import and export registration, or any other facilities.

6. To locate, establish, construct, operate, use, manage and maintain thermal power plants, gas fired power plants and coal fired power plants, power grid station, compressed natural gas stations, transforming, switching, conversion, and transmission facilities, grid stations, cables, overhead lines, sub-stations switching stations, tunnels, cable bridges, link boxes, heat pumps, plant and equipment for combined heat and power schemes, offices, computer centres, shops, dispensing machines for pre-payment cards and other devices, showrooms, depots, factories, workshops, plants, printing facilities, ware houses and other storage facilities.

7. To carry on business of electrical engineers, electricians, engineers, contractors, consultants, representatives and manufacturers of electrical plants, supplying light, heat and power by electricity, galvanism, magnetism or otherwise, suppliers of electricity whether for the purpose of light, heat, motive power, industrial or other purposes and generally to install, execute, provide, work and maintain all necessary plant, machinery, equipment, cables, wires, accumulators and apparatus.

8. To undertake educational activities in the field of wind power, solar power, bio-fuels, biomass and all alternate energy related matters in the field of power processing and or for the purpose to establish, acquire, own, run and manage institutions, training centers, computer labs and all requisite facilities and seek necessary approvals, registration and licenses from relevant authorities and undertake all such activities as are connected, linked or associated therewith.

9. To carry on all or any of the businesses of wholesalers, retailers, traders, importers, exporters, suppliers, distributors, designers, developers, manufacturers, installer, filters, testers, repairers, maintainers, contractors, constructors, operators, users, inspectors, reconditioners, improvers, alterers, protectors, removers, repairers, replacers, importers and exporters of and dealers in, oil products, gas products, electrical appliances, systems, products, and services used for energy conservation, equipments, machinery, materials and installations, including but not limited to cables, wires, meters, pylons, tracks, rails, pipelines and any other plant, apparatus equipment

systems and things incidental to the efficient generation, procurement, transformation, supply and distribution of energy.

10. To ascertain the tariff for bulk supply that will secure recovery of operating costs, interest charges and depreciation of assets, redemption at due time of loans other than those covered by depreciation, expansion projects, payment of taxes, and reasonable return on investment, to quote the tariff to bulk purchasers of energy, and to prefer petition to the appropriate authority for approval of the schedule of tariff and of adjustments or increases in its bulk supply tariff, where desirable or necessary.

11. To carry on the business of gas, oil and petroleum, fabricate, contract, erect, lay, and manufacturers of plant, machinery and apparatus for oil and petroleum, gas manufacture, refine, treat, purify, blend, reduce, distill, store, transport, market, distribute, supply, sell and otherwise dispose off and generally trade in any and all kinds of gas, petroleum and allied products.

12. To carry on the business as gas and petroleum engineers, providing consultancy services, preparation of feasibilities for all sorts of energy related industries and to manufacture, buy, sell, import, export and to deal in all sorts of energy equipments.

13. To refine, process, formulate, produce, buy, sell, export, import, indent or otherwise deal in all types chemicals, petro-chemicals and petroleum industry or any material used or capable of being used in the petro-chemical industry, industrial chemicals or any mixtures, derivatives and compounds thereof.

14. To set up, install, erect, establish, run, control, manage and operate an industrial undertaking for the manufacture, production, formulation and blending of, lubricating oils and gas any where in Pakistan.

15. To own prospect for, explore, acquire by lease, licence or otherwise, open work, develop and maintain natural deposits of gas, petroleum and other mineral and chemical substances of all kinds and to carry on and conduct the business of working, obtaining and supplying to other persons such gas, oil, petroleum, and other substances.

16. To buy, import, export, indent, stock, contract, tender, distribute, acquire, secure and grant agency, distribution rights, representations and trade in or deal in any manner in gases of all kinds and gas plant, machinery, instruments, implements, appliances, equipments, tools, dies, presses and apparatus.

17. To acquire by concession, grant, purchase, barter, licence either absolutely or conditionally and either solely or jointly with others any lands, buildings, machinery, plants, equipment, privileges, rights, licences, trade marks, patents, and other movable and immovable property of any description which the company may deem necessary or which may seem to the Company cable of being turned to account, subject to any permission as required under the law.

18. To act as representatives, for any person, firm or company and to undertake and perform sub-contracts, and also act in the business of the Company through or by herein in any part of the world and either alone or in collaboration with others and by or through agents, sub-contractors or otherwise.

19. To go in for, buy or otherwise acquire and use any patent design, copyright, licence, concession, convenience, innovation, invention, trade marks, rights, privileges, plants, tools or machinery and the like in Pakistan or elsewhere, which may for the time being appear to be useful or valuable for adding to the efficiency or productivity of the Company's work or business, as permissible under the law.

20. To acquire and carry on all or any part of the business or property and to undertake any liabilities of any person, firm, association or company's possession of property suitable for any of the purposes of the Company or carrying on any business which this company is authorized to carry on end in consideration for the same, to pay cash or to issue shares of the Company.

21. To enter into arrangements with the government or authority (supreme, municipal, local or otherwise) or any corporation, company or persons that may seem conducive to the Company's objects or any of them and to obtain from any such government, authority, corporation, company or person any charters, contracts, rights, privileges and commission which the company may think desirable and to carry on exercise and comply with any such charters, contracts, decrees, right, privileges and concessions.

22. To enter into partnership, to amalgamate or merge movable with immovable and / or to buy on all interests, assets, liabilities, stocks or to make any arrangement for sharing profits, union of interests, co-operation, joint-venture, reciprocal concession or otherwise with any person, firm or company carrying on or proposing to carry on any business which this Company is authorized to carry on or which is capable of being conducted so as directly or indirectly to benefit this Company and to have foreign collaborations and to pay royalties / technical fees to collaborators, subject to the provisions of the Companies Ordinance, 1984.

23. To establish, promote or assist in establishing or promoting and subscribe to or become a member of any other company, association or club whose objects are similar or in part similar to the objects of this Company or the establishment or promotion of which may be beneficial to the Company, as permissible under the law.

24. To open accounts with any Bank or Banks and to draw, make, accept, endorse, execute, issue, negotiate and discount cheques, promissory notes, bills of exchange, bills of lading, warrants, deposit notes, debentures, letter of credit and other negotiable instruments and securities.

25. To arrange local and foreign currency loans from scheduled banks, industrial banks and financial institutions for the purpose of purchase,

manufacture, market, supply, export and import of machinery, construction of factory, building and for the purpose of working capital or for any other purpose.

26. To sell or otherwise dispose of the whole or any part of the undertaking of the Company, either together or in portions for such consideration as the Company may think fit and in particular by issue of debentures, debenture-stock or securities of any Company purchasing the same.

27. To borrow money by means of loans or other legal arrangements from banks, or other financial institutions, or Directors in such manner as the Company may think fit and in particular by issue of debentures, debenture stock, perpetual or otherwise convertible into shares and to mortgage, or charge the whole or any part of the property or assets of the Company, present of future, by special assignment or to transfer or convey the same absolutely or in trust as may seem expedient and to, purchase, redeem or payoff any such securities.

28. To pay all costs, charges, and expenses preliminary or incidental incurred in formation or about the promotion and establishment of the Company and to remunerate any person, firm or company for services rendered or to be rendered in or about the formation or promotion of the Company or the conduct of its business.

29. To give any servant or employee of the Company commission in the profits of the Company's business or any branch thereof and for the purpose to enter into any agreement or scheme of arrangement as the Company may deem fit and to procure any servants or employees of the Company to be insured against risk of accident in the course of their employment by the Company.

30. To establish and support or aid in the establishment and support of associations, institutions, funds and conveniences calculated to benefit persons who are or have been Directors of or who have been employed by or who are serving or have served the Company or any other Company which is subsidiary or associate of the Company or the dependents or connection of such persons and to grant pensions, gratuities, allowances, relief and payments in any other manner calculated to benefit the persons described herein.

31. To distribute any of the Company's property and assets among the members in specie or in any manner whatsoever in case of winding up of the Company.

32. To guarantee the performance of contract and obligations of the Company in relation to the payment of any loan, debenture-stock, bonds, obligations or securities issued by or in favour of the Company and to guarantee the payment or return on such investments.

33. To carry out joint venture agreements with other companies or countries within the scope of the objects of the Company.

34. To cause the Company to be registered or recognized in any foreign country.

35. To do and perform all other acts and things as are incidental or conducive to the attainment of the above objects or any of them.

36. To apply for and obtain necessary consents, permissions and licences from any Government, State, Local and other Authorities for enabling the Company to carry on any of its objects into effect as and when required by law.

37. It is declared that notwithstanding anything contained in the foregoing object clauses of this Memorandum of Association nothing contained therein shall be construed as empowering the Company to undertake or to indulge in business of banking directly or indirectly as restricted under the law or any unlawful operation.

38. Notwithstanding any thing stated in any object clause, the company shall obtain such other approval or license from Competent Authority, as may be required under any law or the time being in force, to undertake a particular business.

39. It is, hereby, undertaken that the Company shall not engage in banking business or any business of investment company or non-banking finance company or insurance or leasing or business of managing agency or in any unlawful business and that nothing contained in the object clauses shall be so construed to entitle it to engage in such business directly or indirectly and the Company shall not launch multi-level marketing (MLM), Pyramid and Ponzi schemes.

LIABILITY OF MEMBERS

IV. The liability of the members is limited.

CAPITAL

V. The authorized share capital of the Company is 1,000,000/- (Rupees One Million Only) divided into 100,000 (One Hundred Thousand Only) ordinary shares of Rs.10/- (Rupees Ten Only) each with powers to increase and reduce the capital of the company and to divide the shares in the capital for the time being into several classes in accordance with the provisions of the Companies Ordinance, 1984.

We, the several persons whose names and addresses are sub[illegible]d below, are desirous of being formed into a company in [illegible] of the M[illegible] take the number of shares in the capital of the company [illegible]

take the number of shares in the capital of the company set opposite our respective names.

We, the several persons whose names and addresses are subscribed below, are desirous of being formed into a company in pursuance of the Memorandum of Association and we respectively agreed to take the number of shares in the capital of the company set opposite our respective names.

Serial No.	Names & Surnames Present & former in full (in block letters)	Father's/Husband's name in full	Nationality With any former Nationality	Occupation	Residential address in full	Number of shares taken by each subscribers	Signatures
1	MR. ABDUL AZIZ ESSA NIC-NO. 42201-0801278-5	ESSA DAWOOD (LATE)	Pakistani	Industrialist	G-2,/A&B, BLOCK-17, GULSHAN-E-IQBAL, KARACHI.	3,400 (THREE THOUSAND FOUR HUNDRED)	
2	MR. HUZAIR YUNUS NIC-NO. 42401-1897014-1	YUNUS DADA	Pakistani	Industrialist	C-42, GULSHAN-E-IQBAL, BLOCK-17, KARACHI,	3,300 (THREE THOUSAND THREE HUNDRED)	
3	MR. SHAQUIL HAQUE 42301-5048342-7	MUHAMMAD AKRAM HAQUE	Pakistan	Industrialist	HOUSE # 303, HAWAIN HOMES, BLCO # 2, CLIFTON, KARACHI.	3,300 (THREE THOUSAND THREE HUNDRED)	
					TOTAL	10,000 (TEN THOUSAND)	

Dated the 1st day of July, 2008

Witness to above Signatures

Signature: _____
Name: MR. ABDUL HAMEED
Father's Name: MR. REHMATULLAH
NIC No.: 42101-0416864-7
Full Address: PLOT NO.1318, FLAT NO.3, SIDDIQABAD, FEDERAL 'B' AREA, BLOCK-3. KARACHI
Occupation: PRIVATE SERVICES
Nationality: PAKISTANI

Certified to be True Copy
Joint Registrar of Companies

The Companies Ordinance, 1984

(Private Company Limited By Shares)

ARTICLES OF ASSOCIATION

OF

TITAN ENERGY PAKISTAN (PRIVATE) LIMITED

I-TABLE A EXCLUDED

Table A not to apply

1. Table A of the First Schedule to the Companies Ordinance, 1984 shall not apply to this Company except as may be reproduced hereinafter.

II-INTERPRETATION

2. Headings and marginal notes to any Articles herein shall not necessarily control the subject matter of article, in these presents, unless there is something in the object or the context inconsistent therewith.

Ordinance	Means "the Companies Ordinance, 1984"
Board	Means "Board of Directors of the Company"
Company	Means "TITAN ENERGY PAKISTAN (PRIVATE) LIMITED"
Member	Means a "member of the Company defined by Section 2(21) of the Companies Ordnance, 1984"
Directors	Means "Directors of the Company including an alternate Director"
Secretary	Means "a Secretary of the Company and the expression secretary shall include the person appointed to perform the duties of secretary"
Office	Means "the registered office of the Company"
Seal	Means "the common seal of the Company"
Register	Means "a register of members maintained under Section 147 of the Companies Ordinance, 1984"
Month & Year	Means "the English Calendar month and year."
Dividend	Means "cash dividend includes bonus"

Subject as aforesaid any words or expression defined in the Ordinance shall except where subject or context forbids, bear the same meanings in these Articles.

III - STRUCTURE

PRIVATE COMPANY

3. (A) The Company is a private company and accordingly no invitation shall be issued to public to subscribe for the shares or the debentures of the Company.

(B) The number of members (exclusive of persons in employments of the Company) shall be restricted to fifty, provided that for the purposes of this provision where two or more persons hold one or more shares in the Company jointly, they shall be treated as a single member.

(C) The right to transfer the shares in the Company shall be restricted in a manner hereinafter appearing.

IV – CAPITAL

4. The authorized share capital of the Company is Rs.1,000,000/- (Rupees One Million only) divided into 100,000 (One Hundred Thousand) Ordinary Shares of Rs.10/- (Rupees Ten Hundred) each.

SHARES AT THE DISPOSAL OF DIRECTORS

5. (A) Subject to the provisions of these Articles, shares shall be under the control of the Directors who may allot or otherwise dispose of the same to such persons on such terms and conditions as the Board of Directors

(B) The Directors may offer or otherwise allot shares of this Company to any of the financial institutions or security holders in the form of debentures, PTCs or TFCs or agree to offer or allot, as the case may be, in conversion or for redemption of such securities issued for the financial accommodation provided by such institutions or lenders of moneys to the Company, at par or otherwise as they think fit keeping in view circumstances at such time. And the Directors themselves or receive from members of the Company advance on issue of such securities on profit and loss sharing basis or on such other terms as they think fit and with or without a right for conversion into the shares of the Company in full or in part.

SHARES FOR CONSIDERATION OTHER THAN CASH

6. Shares of the Company may be allotted as payment or part payment for any property sold or transferred, goods or machinery supplied or for services rendered in or about formation or promotion of the Company or conduct of its business and any shares which may be so allotted may be issued as fully paid up otherwise than in cash and if so issued shall be deemed to be so fully paid up shares.

TERMS OF ISSUE & ALLOTMENT

7. As regards all allotment from time to time made, the Directors shall comply with the provisions of Section 73 of the Companies Ordinance, 1984.

SHARES & OTHER CERTIFICATES

8. Every person whose name is entered a member or modaraba, PTC, TFC or any other security holder in a Register shall be entitled without payment to one certificate for all his shares or securities ot each calls, as the case may be or upon payment of such sum for every certificate, after the firs as the directors shall determine, to several certificates each for one or more his securities. Every certificate shall be under the seal of the Company and bear mechanically impressed signatures or autographic signatures of any one Director and counter signed by any other Director or the Secretary or a person appointed for that purpose and shall specify number and class and distinguishing number (if any) of share to which it relates and amount paid up there upon.

JOINT HOLDERS

9. The Company shall not be bound to register more than four persons as the joint holders of any shares (except in case of executors or trustees of a deceased member) and in case of a share held jointly by several persons, the Company shall not be bound to issue more than one certificate therefore and the delivery of a certificate for a share to any one of the several joint holders shall be sufficient delivery to all. Save as herein otherwise provided for, the Company shall treat a person whose name appears on the register as absolute owner of any shares and accordingly shall not (except as ordered by Court of competent jurisdiction or as by any law required be bound to recognize) be bound to recognize any benami trust or equitable, contingent or other claim to or interest in such share on the part of any other person whether or not it shall have an expression or implied notice thereof.

DUPLICATE CERTIFICATE IN LIEU OF DEFACED LOST OR DESTROYED.

10. If any certificate be worn out or defaced or there be no space left for endorsement of transfer of tendered for subdivision or consolidation then upon the production thereof the Directors may order the same to be canceled and may issue a duplicate certificate in lieu thereof and if any certificate be lost and/or destroyed then upon proof thereof to the satisfaction of Directors and on such indemnity as the Director deem adequate being given a new certificate in lieu thereof shall be given to a member entitled to such certificate and pay all expenses (incidental to investigating by the Company of evidence of such destruction or loss and to such indemnity).

INSTRUMENT OF TRANSFER

11. Any member may transfer all or any of his shares by instrument in writing in usual common form or in the following form or as near thereto as circumstances will admit

TITAN ENERGY PAKISTAN (PRIVATE) LIMITED

I/We..... of ..... in consideration of a sum of Rs..... paid to me by..... (hereinafter called transferee) do hereby transfer to said transferee..... shares number..... In the undertaking called TITAN ENERGY PAKISTAN (PVT) LIMITED to hold said transferee..... his or her executors,

administrators and assigns subject to several conditions on which I/We hold the same immediately before execution hereof and I/We transferee do hereby agree to take said shares subject to condition aforesaid.

As witness our hands..... day of .....

TRANSFER STIPULATIONS

12. The shares of the Company shall be transferable and the following stipulations shall apply to the transfer of shares.

(A) A member may transfer shares to his wife and lineal ascendant or descendent, a Company to its holding company or to its subsidiary or any other subsidiary of its holding company or to another company in respect of whose capital a company member is controlling at least 51 percent of voting shares and also to the extent the Company member may by Special Resolution otherwise direct.

(B) A member proposing to transfer any shares (hereinafter called proposing transferor) shall to give notice in writing (hereinafter called transfer notice to the Company that he desires to transfer the same.

(C) Subject to any direction which may be made otherwise by the Company by Special Resolution, within a period of thirty days from receipt of a transfer notice, the Company shall offer to each existing member such number of the shares included in the transfer notice as in prorate or as nearly as may be to the holding of each member respectively on a footing that if each member desires to purchase any or all of the shares at a fair value, he shall within forty five days of the offer or such longer period as the proposing transferor may accept, be entitled to apply for purchase and the transfer of the same and the proposing transferor shall be bound, upon payment to him of the fair value of the transfer shares to the members applying.

(D) In case a member has not applied for purchase and transfer of any shares to which he is entitled, the Company shall, by Special Resolution within thirty days of a date of which the offer closed, again offer untaken shares to such members as have applied for and transfer of all shares to which they were entitled by the terms of original offer in proportion to holding (including shares bought on original offer) of each member and they shall be entitled within forty five days of the offer to apply for the purchase and transfer of a prorate number of the untaken shares and subject as aforesaid a proposing transferor shall be bound upon payment to him of fair value to transfer shares to members applying.

(E) If the proposing transferor shall fail to execute transfer in respect of any shares sold, he shall be deemed to have executed such a transfer. The Company shall thereupon cause the names of members who have purchased the said shares to be entered in the register as the holders of such shares and thereafter the validity of proceedings shall not be questioned by any person.

(F) In case no member applied for any shares included in the transfer notice or in case any shares are not taken after completion/compliance with the provisions then the proposing transferor shall have the right (which right shall endure for a period of one year from the date of transfer notice) to sell and dispose of his shares to any person and at any price and to apply for registration of the transfer

of the same and the Company shall be bound to give effect to the transfer of such shares accordingly.

REGISTRATION & RETENTION OF TRANSFER INSTRUMENT

13. The instrument of transfer shall be left at the office, accompanied by the share certificate and such other evidence as the Board may require to prove the titled of intending transfer and or his right to transfer shares. Instruments of transfer shall be registered and retained by the Company but any instrument of transfer which the Board may decline to register shall be returned to person depositing the same with in 30 days from the date on which the instrument of transfer was lodged with the Company with the reasons of refusal.

SIGNATURE OF TRANSFER DEED

14. The instrument of transfer of share shall be signed by both the transferor and the transferee. A transferor shall be deemed to remain the holder of share until the name of the transferee is entered in the Register of Members. Each signature to such transfer shall be duly attested by signature of a credible witness who shall add the address and occupation. No transfer shall be registered, non registration whereof is necessary for the purpose of ensuring that the number of members doest not exceed the limit prescribed. And no share shall be transferred to an insolvent person or a person of unsound mind.

NOT LIABLE FOR NOTICE

15. The Company shall incur no liability or responsibility whatsoever in consequence of registering or giving effect to a transfer made or purported to be made by an apparent legal owner of shares (as show or appearing in the Register) to the prejudice of persons having or same shares, notwithstanding that the Company may have had notice of such equitable right, title or notice prohibiting registration of such transfer and may have entered such notice or referred thereto in any book of the Company and shall not be bound or required or regard to give effect to any notice which may be given to it of any equitable right, title or interest or be under any liability whatsoever for refusing or neglecting so to do and shall nevertheless, be at liberty to have regard and attend to such notice and give effect thereto, if directors shall think fit.

PERSON RECOGNIZED ON TRANSMISSION

16. In case of death of a member, survivors where deceased was a joint holder and legal representative or deceased where he was a sole or only surviving holder shall be only person recognized by the Company as having any titled to do and interests in the shares but nothing in this Article shall release estate of a deceased joint holder from any liability in respect of any share jointly held by him.

PROOF TITLE

The Company shall not be bound to recognize executors or administrators unless they shall have obtained probate or letter of administration from a duly constituted court in Pakistan. Provided that in any case where the directors in their discretion think fit, it shall be lawful for them to recognize title of any person claiming to be entitled to the shares, whether in a representative capacity or not and to dispense with production of probate of letters of administration or production of such other evidence of title and upon terms as to indemnity or otherwise as they may think fit.

INCREASE IN & REDUCTION IN CAITAL

18. (A) The Company in general meeting may by special resolution increase share capital by such to be divided into shares of such amount as the resolution shall prescribe. New shares shall be issued upon such terms and conditions and with such rights and privileges annexed thereto as General Meeting resolve upon creation thereof shall direct and if no direction be given them as the directors shall determine. Capital raised by creation of new shares shall be considered as part of original capital in all respects and shall be subject to foregoing provisions unless it may be otherwise resolved upon by General Meeting sanctioning the increase.

(B) The Company may subject to the provisions of Section 96 by Special Resolution reduce its capital by paying off or canceling the capital which has been lost or is unrepresented by available assets or by reducing liability on shares or otherwise and the capital may be paid off upon a footing that it may be called upon again and may if necessary alter its memorandum by reducing amount of its shares capital and of its shares accordingly subject to approval of competent authority.

OFFER OF NEW SHARES

19. Subject to provisions of the Ordinance and any direction to the contrary that may be given by a Special Resolution in General Meeting, all new shares shall before issue be offered to members of the Company in proportion, as nearly as circumstances admit, to the number of existing shares held by each member. Offer shall be made by a notice specifying number of shares offered and limiting a time within which offer, if not accepted will be deemed to be declined and after expiration of that time or on receipt of intimation from a person that he declines to accept shares offered, the directors may dispose of the same in such a manner as is most beneficial to the Company. The Directors may likewise so dispose of any new shares which (by reason of proportion which new shares bear) cannot, in the opinion of the directors, be conveniently offered under this Article.

V – BORROWING POWER

POWER OF BORROW

20. (A) The Directors may borrow from the members or other persons, banks and may themselves advance any sums or money for purposes of the Company.

(B) REGISTER OF MORTGAGES

The Directors shall cause a proper register to be kept in accordance with Section 125 of the Companies Ordinance of all mortgages and charges specifically affecting property of the Company and shall comply with requirements of Sections 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 mortgage or charge at the office and requirements of Section 132 as to giving limitation of payment of satisfaction of mortgages or charges created by the Company.

(C) REGISTER OF PTC's/DEBENTURES

Register of holders of PTC's TFC's 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 PTC's TFC's and debentures and of any member but the Company may impose any reasonable restricted so that at least two hours in each day, when such register is open, are appointed for inspection.

(D) INSTRUMENTOF TRANSFER OF PTC's TFC's & DEBENTURES

Subject to provisions of Section 76 of the Ordinance, no transfer of PTC's TFC's 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.

(E) NOTICE OF REFUSAL TO REGISTER TRANSFER

If the Directors refuse to register transfer of PTC's, TFC's 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.

(F) INSPECTION OR COPY OF REGISTER OF PTC, TFC & DEBENTURE. HOLDERS etc.

The Company shall comply with provisions of Section 136 allowing inspection or copies kept at the office in pursuance of Section 130 and allowing inspection of Register of PTC, TFC or Debenture holders, in pursuance of Section 136 of the Ordinance. The Company shall comply with provisions of Section 146 for supplying copies of Register of PTC, TFC and debentures holders or Trust Deed for securing issue of PTC, TFC or debenture. The Trustees for PTC, TFC and debenture holders shall have the same right to receive and inspect balance sheets 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.

VI – MEETINGS

21. The First Annual General Meeting shall be held within eighteen months from the date of incorporation of the Company. Thereafter all Annual General Meeting of the Company shall be held once at least in every calendar year within the three months following close of the financial year so that not more then fifteen months shall elapse between two such annual general meetings. The above mentioned General Meetings shall be called Annual General Meetings and other General Meetings shall called Extraordinary General Meetings. The Directors may call an Extraordinary General Meeting whenever they think fit.

22. The Directors may or shall on requisition of holders of not less than one tenth of issued capital of the Company, forthwith proceed to convene an Extraordinary General Meeting of the Company and in case of such requisition the following provisions shall have effect:

i The requisition must state object of meeting and signed by requisitionists deposited at the office and may consist of several documents in like form each signed by one or more requisitionists.

ii If the Directors of the Company do not proceed to convene such meeting within twenty one days from the date of requisition having so deposited, requisitionists or a majority of them in value may themselves convene the meeting, but any meeting so convened shall not be held after three months from the date of deposit of requisition.

iii Any meeting convened under this Article by requisitionists shall be convened in a same manner as possible as that in which meetings are to be convened by the directors.

NOTICE OF MEETING

23. Twenty one days notice of every General Meeting, Annual or Extraordinary and by whosever called, specifying date, place and hour of meeting and with a statement of business to be transacted and in case it is proposed to pass a Special Resolution as intention to propose such resolution as an Special Resolution shall be given to persons entitled. A meeting may be convened by such shorter notice and in such manner as all the members may think fit and agree to it. Accidental omission to give such notice or non-receipt of a notice by any member shall not invalidate to proceeding or any meeting.

BUSINESS OF ANNUAL GENERAL MEETING

24. Business to be transacted at Annual General Meeting shall be:

i. Consideration of accounts
ii. Reports of Directors and Auditors
iii. Appointment of Auditors and fixing of their remuneration
iv. Declaration of Dividend
v. Transaction of any other business which ought to be transacted at a General Meeting.
vi. Every three years election of Directors

The above business shall be ordinary business and any other business transacted at Annual General Meeting and Extraordinary General Meeting shall be deemed special business.

QUORUM OF MEETING

25. No business shall be transacted at a General Meeting unless a quorum of members is present at time when meeting proceeds to business. Save as herein otherwise provided two or more members representing not less than 25 per cent of the total voting power entitled to vote and present personally or by proxy shall be a quorum for general meeting. If within half an hour from the time appointed for meeting a quorum is not present, a meeting if convened on requisition of members shall be dissolved and in every other case it shall stand adjourned to some day in next week at the same time and place, unless directors decide otherwise in which case fresh notice will be given to shareholders of adjourned meeting. At an adjourned meeting if quorum is not present within half an hour from time appointed for meeting, then

the meeting shall be dissolved.

PRESIDING THE MEETING

26. Chairman of the Board shall preside at every general meeting of the Company. If he is not present within fifteen minutes after time appointed for holding the meeting or if there is no chairman, then the members present shall choose one of the directors as Chairman of, if no Director be present or Directors present decline to take the chair then the members present shall choose one of their number to be the chairman.

ADJOURNMENT OF MEETING

27. The Chairman may adjourn any meeting but no business shall be transacted at any adjourned meting other than that left unfinished at the meeting from which adjournment took place. When a meeting is adjourned for ten days or more notice of adjourned meeting shall be given as in case of an original meeting.

RESOLUTION HOW DECIDED

28. At any General Meeting a resolution put to vote of the meeting it shall be decided on a show of hands, unless a poll is (before or on declaration of result of show) demanded in accordance with provisions of Section 167 of the Companies Ordinance, 1984.

WHEN POLL TAKEN OR WITHDRAWN

29. If a poll is demanded it shall be taken in such a manner as chairman of the meeting directs and either at once or after an interval or adjournment and the result of poll shall be deemed to be resolution of meeting.

CASTING VOTE

30. In case of an equality of votes, the chairman of meeting shall be entitled to casting vote in addition to the vote or votes to which he may be entitled as member.

VOTING

31. On a show of hands every member present in person or being a corporation present by representative or attorney shall have one vote and upon a poll every member present in persons or by proxy or by attorney or a representative shall have one vote in respect of each share held by him. Voting for election of Directors shall be in accordance with the provisions of Section 178 of the Companies Ordinance, 1984. Votes may be given either personally or by proxy.

PROXY

32. Instrument appointing a proxy shall be in writing. A proxy must be a member. Instrument of proxy shall be deposited at the office not less than forty eight hours before the time of meeting.

VII – DIRECTORS

NUMBER OF DIRECTORS

33. (A) The number of Directors shall not less than two or more than ten.

(B) The following shall be the first Directors of the Company:

1. MR. ABDUL AZIZ ESSA
2. MR. HUZAIR YUNUS
3. MR. SHAQUIL HAQUE

(C) The first Directors including Chief Executive and/or Chairman shall retire at the First Annual General Meeting of the Company. A Director may resign from his office upon giving one month's notice in writing to the Company.

ALTERNATE DIRECTOR

34. A director who is about to leave or is absent from Pakistan for three months or more may with the approval of Board, appoint any person to be an alternate director during his absence and alternate director ipso facto vacate office when he (his appointer) returns.

CASUAL VACANCY

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

OFFICE OF DIRECTOR

36. Office of a Director shall be vacated ipso facto if he acts in contravention of Section 188 or become ineligible under Section 187 of the Companies Ordinance, 1984.

ELECTION OF DIRECTORS

37. Election of Directors shall be held every third year at the Annual General Meeting in accordance with Section 178 of the Companies Ordinance. A director shall be elected for three years unless he resigns earlier. A retiring director shall be eligible for re-election.

POWER TO INCREASE OR REDUCE NUMBER OF DIRECTORS

38. The Company by ordinary resolution increases or reduce the number of the directors of the Company subject to the provision of Section 174 of the Companies Ordinance, 1984.

REMOVAL OF DIRECTORS

39. The Company may by special resolution remove any director before expiration of period of office subject to provision of Section 181 of the Companies Ordinance, 1984.

CHIEF EXECUTIVE

40. The Directors may appoint Chief Executive of the Company for such period and on such terms and conditions as the Board may determine.

CHAIRMAN

41 The Directors may appoint a Chairman who may or may not be the Chief Executive of the Company.

DELEGATION OF POWERS

42. The Directors may entrust or delegate to and confer upon the Chairman and/or Chief Executive such powers exercisable under these presents by the Directors and to be exercised for such objects and purposes and upon such terms and conditions and with such restrictions as they may think expedient and may revoke, withdraw, alter such powers.

DIRECTORS MEETING

43. The quorum at the meetings of the Directors shall be at least two third directors present in person. The directors may meet together for the dispatch of business, adjourn and otherwise regulate their meeting as they think fit. A director may and the secretary, if any, on requisition of a director shall at any time summon a meeting of the directors. The meeting of directors at which quorum is present shall be competent to exercise all authorities powers and discretions by or under these Articles vested or exercisable by directors generally.

RESOLUTION BY CIRCULATION

44. A resolution circulated in writing to all the directors and passed without any meeting of the directors and signed by all the directors shall be as valid and effectual as if it had been passed at the meeting of directors duly convened and held in accordance with the provisions of these Articles.

REMUNERATION OF DIRECTORS

45. The remuneration of directors shall be determined by the Company by an ordinary resolution of members. Remuneration payable to the directors for attending meetings of the Board shall be such sum as the directors may decide from time to time.

APPOINTMENT OF ATTORNEYS

46. The Directors may by powers of attorney under seal appoint any company, firm or person, attorney or attorneys of the Company for such purposes and with such powers as they think fit and may authorize such attorney or attorneys.

VIII - SECRETARY

APPOINTMENT OF SECRETARY

47. A Secretary maybe appointed by the directors at remuneration and upon terms and

conditions as they may think fit and the secretary so appointed may be removed by them but without prejudice to any claim he may leave for the damages for breach of any contract of service between him and the Company.

IX – THE SEAL

CUSTODY OF SEAL AND AFFIXATION OF SEAL

48. (A) The directors shall provide a common seal for purposes of the company and shall have power to destroy the same and substitute a new seal in lieu thereof and they shall provide for the safe custody of the seal.

(B) The seal shall not be affixed to any instrument except by the authority of a resolution of Board and save as provided in these present, in the presence of the chief Executive and one Director of the company or such other persons as the directors may appoint for the purpose who shall sign every instrument to which the seal is so affixed in their presence.

X – DIVIDENDS AND RESERVES

49. The Company in general meeting may declare dividends but no dividend shall exceed the amount recommended by the directors. Provided however, that the Company in General Meeting may declare a smaller dividend. No dividends shall be payable except out of profits. Declaration of directors as to amount of the net profits shall be conclusive.

NO ACCRETION

50. No dividend shall bear any claim of profit or accretion against the Company.

SET ASIDE OUT OF PROFIT FOR RESERVE FUND

51. Before recommending any dividend, the Directors may set aside out of profit such amount as they think proper for depreciation or to a depreciation fund, reserve fund or sinking fund or any special fund to meet contingencies or to repay amount or installments or part payment of Modaraba or TFC's debentures or debentures stocks thereof or for special dividends or equalizing dividends or for improving any part of property and for other purposes as the directors in their absolute discretion think conclusive and to invest several sums so to set aside or so much thereof as is required to be invested on such investment.

XI - CAPITALIZATION

52. A general meeting by resolution may decide that moneys, investments or other assets forming part of undivided profits (including profits or surplus money arising from realization of any capital assets of the company) standing to the credit of the reserve fund or any other fund or in the hands of the company and available for dividend or representing premium received on issue of shares and standing to the credit of share premium account be capitalized.

XII – ACCOUNTS

ACCOUNTS BOOKS TO BE MAINTAINED

53. The directors shall cause true accounts to be kept or all sums of money received and expended by the company all sales and purchases, all assets and liabilities of the company. The books of account shall be kept at the office or at such other place as the directors shall think fit and shall open to inspection by the directors during business hours. The directors shall determine as to what time and places the accounts and books shall be open to inspection of members and no members (no being directors) shall have any right of inspecting any account book or documents except the right as conferred by the law or authorized by the directors or by the company in general meeting.

STATEMENTOF ACCOUNTS

54. The directors shall under section 233 and 236 of the Ordinance cause to be prepared and laid before the Company in General Meeting the profit and loss accounts, balance sheet and report. A copy of balance sheet and report shall not less than twenty one days before the meeting be sent to persons entitled to receive notice of General Meeting in the manner in which notices are to be given as provided under the law.

AUTHENTICATION OF BALANCE SHEET

55. The directors shall comply with the provisions of authentication provided for in section 241 of the Ordinance.

APPOINTMENT OF AUDITORS

56. The auditors shall be appointed at each annual general meeting of the company and shall hold the office until next annual general meeting. Their appointment, remuneration, right and duties shall be regulated in accordance with section 252 of the Ordinance.

XIII – NOTICES

NOTICES

57. Notice of general meeting shall be sent twenty one days before the meeting to every holder of ordinary shares of the Company by post to his address or convenient in any other way.

XIV – INDEMNITY

ACTS INDEMNIFIED

58. Subject to provisions of the companies Ordinance, 1984 every director, manager, auditor and other officer or servant of the company acting in relation to the company and every one of them and every one of their heirs, executors and administrator shall be indemnified by the Company against and it shall be duty of directors out of funds of the company to pay all cost losses and expenses which any such officer or servant may incur or become liable to any reasons of any contract entered into or act or thing done by him as such officer or servant or in any way in discharge of his duties including traveling expenses against all liabilities incurred by him as such director, manager, officer or servant in defending any proceedings whether civil or criminal in which judgment is given in his favour or he is acquitted or in connection with any application under section 488 of the Ordinance in which relief is granted by Court and an amount for which such indemnity is provided shall immediately attached as a lieu on property of the company and have priority as between the members over all

other claims.

XV – WINDING UP

DISTRIBUTION OF ASSETS

59. (A) Without prejudice to rights of holders of shares and subject to special terms and conditions if any on winding up assets available for distribution among members as such be insufficient to repay whole of paid up capital such assets shall be distributed so that as nearly as maybe losses shall be borne by members concerned in proportion to the capital paid up or which ought to have been paid up at commencement of winding up. The assets available for distribution among members shall be more than sufficient to repay whole or excess shall be distributed amongst the members who are holders of ordinary shares in proportion to ordinary shares held by them respectively at the commencement of winding up.

(B) If the Company shall be wound up, whether voluntarily or otherwise, liquidators may, with the sanction of special resolution, divide amongst contributories in specie or kind any par of assets and may with a like sanction vest any part of assets of the company in the trustees upon such trust of the benefit of contributories or any of them as the liquidators shall think fit.

(C) If thought expedient, any such division maybe made otherwise then in accordance with the legal rights of contributories (except where unalterably fixed by the Memorandum of Association) and in particular any class may altogether or in part but in the case any division, otherwise then in accordance with legal rights of contributories shall be determined on any contributory who would be prejudice thereby shall have a right to dissent and ancillary rights as if such determination were a special resolution passed pursuant to section 367 and 390 of the Ordinance.

(D) In case any shares to be divided as aforesaid involve a liability to any person entitle under such division to any shares within ten days after passing resolution by notice in writing directors the liquidator to sell his portion and pay him net proceeds and the liquidator shall if practicable act accordingly.

XVI – SECRECY

MAINTENANCE OF SECRECY

60. Every director, manager, auditor, trustee, member or a committee, officer, agent, accountant or other person employed in business of the Company shall unless authorized by the directors, observe a strict secrecy respecting all transactions of the company with customers and state and with individuals concerning accounts and matters relating thereto and shall not reveal any matters which may come to his knowledge in discharge of his duties except when authorized so to do by the directors or by any law or by the person to whom the matter relates and except so far as maybe necessary in order to comply with any of the provisions in these presents contained.

XVII - ARBITRATION

REFERENCE TO ARBITRATION

61. Whenever any difference arises between the Company and the member, their executors, administrators etc., touching true intent or construction of incidents or anything done executed, any breach of any claim on account of any of such breaches or otherwise relating to the premises or to these presents or to any statute affecting the Company or any of the affairs of the Company every such difference shall be referred to under the Arbitration Act, 1940 to the decision of two arbitrators, one appointed by each party in difference or if they cannot agree then upon decision of an umpire to be appointed by the two arbitrators.

ARBITRATION COST

62. Cost and incident to any such reference and the award shall be in the discretion of arbitrators or umpire as the case may be who may determine amount thereof and may award by whom and in what manner same shall be borne and paid.

We, the several persons whose names and addresses are su[illegible]ibed below, are desirous of being formed into a company in pu[illegible]nce of the Articles of Association and we respectively agreed to take the number of shares in the capital of the company se[illegible]osite our respective names.

We, the several persons whose names and addresses are subscribed below, are desirous of being formed into a company in pursuance of the Articles of Association and we respectively agreed to take the number of shares in the capital of the company set opposite our respective names.

We, the several persons whose names and addresses are subscribed below, are desirous of being formed into a company in pursuance of the Articles of Association and we respectively agreed to take the number of shares in the capital of the company set opposite our respective names.

Serial No.	Names & Surnames Present & former in full (in block letters)	Father's/Husband's name in full	Nationality With any former Nationality	Occupation	Residential address in full	Number of shares taken by each subscribers	Signatures
1	MR. ABDUL AZIZ ESSA NIC-NO. 42201-0801278-5	ESSA DAWOOD (LATE)	Pakistani	Industrialist	G-2,/A&B, BLOCK-17, GULSHAN-E-IQBAL, KARACHI.	3,400 (THREE THOUSAND FOUR HUNDRED)	
2	MR. HUZAIR YUNUS NIC-NO. 42401-1897014-1	YUNUS DADA	Pakistani	Industrialist	C-42, GULSHAN-E-IQBAL, BLOCK-17, KARACHI,	3,300 (THREE THOUSAND THREE HUNDRED)	
3	MR. SHAQUIL HAQUE NIC-NO.42301-5048342-7	MUHAMMAD ABRAM HAQUE	Pakistani	Industrialist	HOUSE # 303, HAWAIN HOMES, BLCO # 2, CLIFTON, KARACHI.	3,300 (THREE THOUSAND THREE HUNDRED)	
					TOTAL	10,000 (TEN THOUSAND)	

Dated the 1st day of July, 2008

Witness to above Signatures

Signature: _____
Name: MR. ABDUL HAMEED
Father's Name: MR. REHMATULLAH
NIC No.: 42101-0416864-7
Full Address: PLOT NO.1318, FLAT NO.3, SIDDIQABAD, FEDERAL 'B' AREA, BLOCK-3. KARACHI
Occupation: PRIVATE SERVICES
Nationality: PAKISTANI

Certified
Joint Registrar of Companies

THE COMPANIES ORDINANCE, 1984

(Section 205)

PARTICULARS OF DIRECTORS AND OFFICERS, INCLUDING THE CHIEF EXECUTIVE, MANAGING AGENT, SECRETARY, CHIEF ACCOUNTANT, AUDITORS AND LEGAL ADVISER, OR OF ANY CHANGE THEREIN

Please complete in typescript or in bold black capitals.

1. CUIN (Incorporation Number): 0 0 6 7 0 2 8
2. Name of the Company: TITAN SHIPPING PAKISTAN (PVT) LTD.
3. Fee Paid (Rs.): 1 0 0 0 — Name & Branch of the Bank: MCB BANK LTD. HYDERABAD BR. KARACHI — Date: Day [ ] Month 0 6 Year 2 0 1 0
4. Receipt No.
5. Mode of payment (Indicate)
6. Particulars*:

Present Name in Full	NIC No or passport No. in case of Foreign National	Father's/ Husband's Name	Usual residential address	Designation	Nationality**	Business Occupation*** (if any)	Date of present appointment or change	Mode of appointment / change / any other Remarks
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
6.1 New appointment/election:								
MR. ABDUL WAHID DOJGI	42301-0752163-1	ISMAIL	FLAT NO.607, AHMED BI MANSION, 6TH FLOOR, PLOT WO3/24/1, CHAND BIBI ROAD, NANAK WARA, KARACHI.	COMPANY SECRETARY	PAKISTANI	PRIVATE SERVICE	09.06.2010	APPOINTED IN B.O.D.M.
6.2 Ceasing of office/Retirement/Resignation:								
MR. SHAQUIL HAQUE	42301-5048342-7	MR. M. AKRAM HAQ	HAWAIN HOME TOWER, FLAT NO.303, CLIFTON, BLOCK-2, KARACHI	DIRECTOR	PAKISTANI	--	09.06.2010	EXPIRED
6.3 Any other change in particulars relating to columns (a) to (g) above:								

7. Name of Signatory: MR. ABDUL AZIZ ESSA — 8. Designation: CHIEF EXECUTIVE/~~SECRETARY~~

9. Signatures of Chief Executive/~~Secretary~~: [signature] — 10. Date: Day 0 9 Month 0 6 Year 2 0 1 0

* In the case of a firm, the full name, address and above mentioned particulars of each partner, and the date on which each became a partner.

** In case the nationality is not the nationality of origin, provide the nationality of origin as well.

*** Also provide particulars of other directorships or offices held, if any.

Company Registration Office Karachi — Securities & Exchange Commission of Pakistan

SNo. 35691 dt. 21/3/11

PARTICULARS OF DIRECTORS AND OFFICERS, INCLUDING THE CHIEF EXECUTIVE, MANAGING AGENT, SECRETARY, CHIEF ACCOUNTANT, AUDITORS AND LEGAL ADVISERS, OR OF ANY CHANGE THEREIN

THE COMPANIES ORDINANCE, 1984

[SECTION 205]

FORM 29

Please Complete in Typewriting or in Block Letters

1. Incorporation Number: 0067040
2. Name of Company: TITAN ENERGY PAKISTAN (PVT.) LIMITED
3. Fee Paid (Rs.): 600 Name and Branch of Bank: KARACHI, MCB - Bahadurabad [1058]
4. Receipt No.: E-2012-125320 Date (DD/MM/YY): 17/11/2012
5. Mode of Payment (Indicate): Bank Challan
6. Particulars*:

6.1. New Appointment/Election

Present Name in Full (a)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation*** (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)
ABOUL AZIZ ESSA	4220108012785	ESSA DAWDOD	G-2 A1B, BLOCK-17, GULSHAN-E-IOBAL, KARACHI.	Director	Pakistan		03/11/2012	Appointed
RAHEEL JAWED ESSA	4220170554565	JAWED AZIZ ESSA	G-2-A-2, BLOCK-17, GULSHAN-E-IOBAL, KARACHI.	Director	Pakistan		03/11/2012	Appointed
IRFAN AZIZ ESSA	4220113063271	ABDUL AZIZ ESSA	G-2-A-13, BLOCK-17, GULSHAN-E-IOBAL, KARACHI	Director	Pakistan		03/11/2012	Elected
HUZAIR YOUNUS DADA	4240118970141	YOUNUS DADA	C-42, GULSHAN-E-IQBAL, BLOCK-17, KARACHI	Director	Pakistan		03/11/2012	Elected
AMIR HAMZA DADA	4220192334973	HAMZA DADA	HOUSE NO.C-39, BLOCK-17, GULSHAN-E-IOBAL, KARACHI.	Director	Pakistan		03/11/2012	Elected
RAHEEL JAWED ESSA	4220170554565	JAWED AZIZ ESSA	G-2-A-2, BLOCK 17, GULSHAN-E-IQBAL, KARACHI	Chief Executive	Pakistan		03/11/2012	Appointed
F. R. MERCHANT AND CO.	N/A	N/A	10 AND 11, 4TH FLOOR, SHAHNAZ ARCADE, SHAHEED-E-MILLAT ROAD, KARACHI.	Auditor	Pakistan		03/11/2012	Appointed

6.2. Ceasing of Officer/Retirement/Resignation

Present Name in Full (e)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation*** (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)
ABDUL AZIZ ESSA	4220108012785	ESSA DAWODD	G-2, A AND B BLOCK-17 GULSHAN E IOBAL KARACHI	Chief Executive	Pakistan		02/11/2012	Retired

6.3. Any other change in particulars relating to columns (a) to (g) above

Present Name in Full (e)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation*** (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)

Name of Signatory: ABDUL AZIZ ESSA Designation: Chief Executive

Signature of Chief Executive/Secretary: Date (DD/MM/YYYY): 17/11/2012

Certified to be True Copy

Deputy Registrar of Companies

Deputy Registrar of Companies

THIRD SCHEDULE

(Se section 156)

FORM A - ANNUAL RETURN OF COMPANY HAVING SHARE CAPITAL

1. Registration No.	0067040
2. Name of the Company	TITAN ENERGY PAKISTAN (PVT.) LIMITED
3. Form A made upto (Day/Month/Year)	03/11/2012
4 Date of AGM (Day/Month/Year)	03/11/2012

PART - A

5 Registered Office Address	FL-2/1, BLOCK-6, GULSHAN-E-IQBAL, KARACHI. KARACHI Sindh
6. Email Address	info@frmerchantandco.com
7. Office Tel. No.	4966809
8. Office Fax No.	4960380
9. Nature of Business	--POWER GENERATION - ALLIED (OTHER)

10. Authorized Share Capital

Type of Shares	No. of Shares	Amount	Face Value
Ordinary Shares		100,000,000.00	

11. Paid up Share Capital

Type of Shares	No. of Shares	Amount	Issue Price
Ordinary Shares		400,000.00	

12. Amount of indebtedness on the date upto which form A is made in respect of all Mortgages/Charges	0.00

13. Particulars of the holding company

Name			
Registration No.		% Shares Held	

14. Chief Executive

Name	RAHEEL JAWED ESSA	NIC	4220170554565
Address	G-2-A-2, BLOCK 17, GULSHAN-E-IQBAL, KARACHI		

Next Page

Company Registration Office Karachi Securities & Exchange Commission

Certified to be True Copy

Deputy Registrar of Companies

1/1/13

Certified to be True Copy

Deputy Registrar of Companies

1/1/13

15. Chief Accountant

Name | NIC

Address

16. Secretary

Name: ABDUL WAHID DOJGI | NIC: 4230107521631

Address: FLAT NO.607, AHMED BI MANSION, 6TH FLOOR, PLOT WO3/24/1, CHAND BIBI ROAD, N

17. Legal Advisor

Name

Address

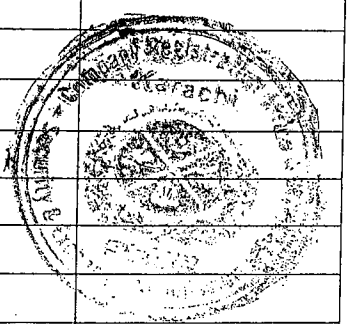
18. Auditors

Name: F. R. MERCHANT AND CO.

Address: 10 AND 11, 4TH FLOOR, SHAHNAZ ARCADE, SHAHEED-E-MILLAT ROAD, KARACHI.

19. List of Directors on the date of Form-A

Name of Director	Address	Nationality	NIC (Passport No. if Foreigner)
ABDUL AZIZ ESSA	G-2 A1B, BLOCK-17, GULSHAN-E-IQ	Pakistan	4220108012785
RAHEEL JAWED ESSA	G-2-A-2, BLOCK-17, GULSHAN-E-IQE	Pakistan	4220170554565
IRFAN AZIZ ESSA	G-2-A-13, BLOCK-17, GULSHAN-E-IC	Pakistan	4220113063271
HUZAIR YOUNUS DADA	C-42, GULSHAN-E-IQBAL, BLOCK-17	Pakistan	4240118970141
AMIR HAMZA DADA	HOUSE NO.C-39, BLOCK-17, GULSH	Pakistan	4220192334973



Previous Page | Next Page

19. List of Directors on the date of Form-A

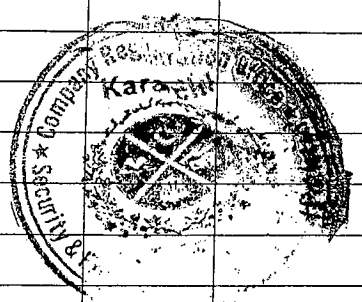
Name of Director	Address	Nationality	NIC (Passport No. if Foreigner)

Previous Page Next Page

PART-B

20. List of members & debenture holders on the date upto which this Form A is made

Folio	Name of Members/Debenture Holders	Address	Nationality	No. of Shares	NIC (Passport No. if Foreigner)
	Irfan Aziz Essa	G-2-A-13, Block-17, Gulshan-e-Ic	Pakistan	500	4220113063271
	Amir Hamza Dada	C-39, Block-17, Gulshan-e-Iqbal,	Pakistan	500	4220192334973
	Abdul Aziz Essa	G-2, A-1-B, BLOCK-17, GULSHA	Pakistan	1900	4220108012785
	Huzair Yunus	C-42, Gulshan-e-Iqbal, Block-17,	Pakistan	3300	4240118970141
	Shaquil Haque	Hawain Home Tower, Flat No.30:	Pakistan	3300	4230150483427
	Raheel Jawed Essa	G-2-A-2, BLOCK-17, GULSHAN-	Pakistan	30500	4220170554565



Previous Page | Next Page

21. Transfer of shares (debentures) since last Form A was made

No.	Name of Transferor (Members)	Name of Transferee	Number of Shares Transferred	Date of Registration of
1	Abdul Aziz Essa	Irfan Aziz Essa	500	10/10/2012
2	Abdul Aziz Essa	Amir Hamza Dada	500	10/10/2012
3	Abdul Aziz Essa	Raheel Jawed Essa	500	09/01/2012

22. I certify that this return and the accompanying statements state the facts correctly and completely as on the date upto which this Form-A is made

Date (DD/MM/YYYY) 17/11/2012

Signature ABDUL AZIZ ESSA

Designation
- [x] Chief Executive
- [ ] Secretary

Previous Page | Next Page

Plant Detail

A. General Information

(i)	Name of Applicant	Titan Energy Pakistan (Private) Limited
(ii)	Registered /Business Office	FL-2/1, Block-6, Gulshan-e-Iqbal, Karachi-75300
(iii)	Wind Farm Location	Jhimpir, District Thatta, Sindh
(iv)	Type of Generation Facility	Wind Base Project

Plant Detail

B.

(i)	Plant Size Install Capacity	9 MW
(ii)	Type of Technology	Wind Turbine
(iii)	No of Units/Size (MW)	6X1.5 MW
(iv)	Unit Make & Model	2010-2012, Sinovel SL-1500 Series Wind Turbine
(v)	Commissioning/ Commercial Operation date	Expected End of 2014
(vi)	Expected Life of the Facility from Commercial Operation/ Commissioning	20 Years
(vii)	Expected Remaining useful Life of the Facility at the time of Grant of Generation License (based on the latest commissioned unit)	20+10 Years

C. Wind Turbine Characteristics

(i)	General Voltage	11 KV
(ii)	Frequency	50 HZ
(iii)	Power Factor	0.9 ~ 0.9

INTERCONNECTION/TRANSMISSION ARRANGEMENT FOR THE DISPERSAL OF POWER FROM THE WINF FARM

The Power generated by Titan Energy Pakistan (Private) Limited (TEPPL) FROM ITS Wind Farm shall be dispersed to the Load Center of Hyderabad Electricity Supply Company Limited (HESCO) through it Grid Station situated at Jhimpir.

Any change in the final Interconnection and Transmission Arrangement(s) for the dispersal of power other than the above shall be communicated to NEPRA lin due course of time.

Information

For

Schedule-II

SCHEDULE-II

1	Total Gross Installed Capacity (6x1.5 MW)	9.00 MW
2	De-rated Capacity at mean Site Condition	
3	Net Capacity of the Wind Farm	33% of the Gross Installed capacity

SL1500 Series Wind Turbine

SL1500/82

（50Hz）

Specification

SINOVEL WIND GROUP CO., LTD.

2010-12

Author	Quan Xiaobei	Checked by	Yao Libin	Checked by	Liu Zuohui	Released by	Jin Baonian

Contents

1 Primary Technical Data

1.1 General data

Table 1 General data

No.	Components	Unit	Value
1	**Data**		
1.1	Manufacturer		Sinovel Wind Co., Ltd
1.2	Type		SL1500/82
1.3	Rated power	kW	1500
1.4	Rotor diameter	m	82.9
1.5	Cut-in wind speed	m/s	3
1.6	Rated wind speed	m/s	10.5
1.7	Cut-out wind speed（10min average）	m/s	20
1.8	Survival wind speed（3s max）	m/s	52.5
1.9	Survival temperature	℃	-20℃～+50℃
1.10	Operate temperature	℃	-10℃～+40℃
1.11	Life time of design	year	＞20
2	**Blade**		
2.1	Length		40.25
2.2	Material		GRP
2.3	Number		3
2.4	Rotor rotational speed	rpm	9.7-19
2.5	Area of the rotor disk	m^2	5398
2.6	Rotational direction(from up wind)		clockwise
3	**Gearbox**		
3.1	Manufacturer		DHI Reductor Plant/NGC
3.2	Drive stage		3
3.3	Drive ratio		1/104.5
3.4	Rated power	kW	1,700（output end）
3.5	Lubricating method		Forced lubricating
4	**Generator**		
4.1	Rated power	kW	1520
4.2	Rated voltage	V	690
4.3	Rated speed Rotating speed range	rpm	1800 1000～2000
4.4	Power factor		Capacitive 0.95～inductive 0.9
4.5	Insulation level		H
4.6	Protection level		IP54
5	**Converter**		
5.1	Manufacturer		AMSC
5.2	Capacity	KVA	750
5.3	Input/Output voltage	VAC	690/0～800

5.4	Input/Output current	A	200/750
5.5	Range of input/output frequency	Hz	50±2/0～17
6	**Brake system**		
6.1	Major brake system		Air-braking
6.2	Minor brake system		Mechanical braking
6.3	Type of brake liquid		Shell Tellus T32
7	**Main bearing**		
7.1	Manufacturer		SKF/FAG
8	**Yaw system**		
8.1	Type/design		Active
8.2	Control		Multistage planetary gear driven by conversion asynchronous motor
8.3	Range of yaw speed	°/min	18.3-23.2
8.4	Type of anemometer		2D
9	**Onsite control system**		
9.1	Type/Design		Sinovel
10	**Lightning protection**		
10.1	Design standard		IEC61024 and local ambient
10.2	Resistance of earthing	Ω	≤4
11	**Weight**		
11.1	Nacelle	t	55.614
11.2	Generator	t	≈6
11.3	Gearbox	t	25.6
11.4	Hub	t	16.462
11.5	Blade	t	3×6.4

1.2 Table of primary material

Table 2 primary material of components

component	material	performance
Main frame	Q345E-Z25	σ_s >275Mpa ;
hub	Spheroidal graphite QT400-18AL	σ_b>400Mpa; $\sigma_{0.2}$ =250Mpa
Yaw pinion	42CrMo4	$\sigma_{0.2}$ >650 Mpa;
Brake disk	Q345D	σ_s >295Mpa; σ_b>470Mpa;

1.3 Design standard of vibration

Table 3 design standard of vibration

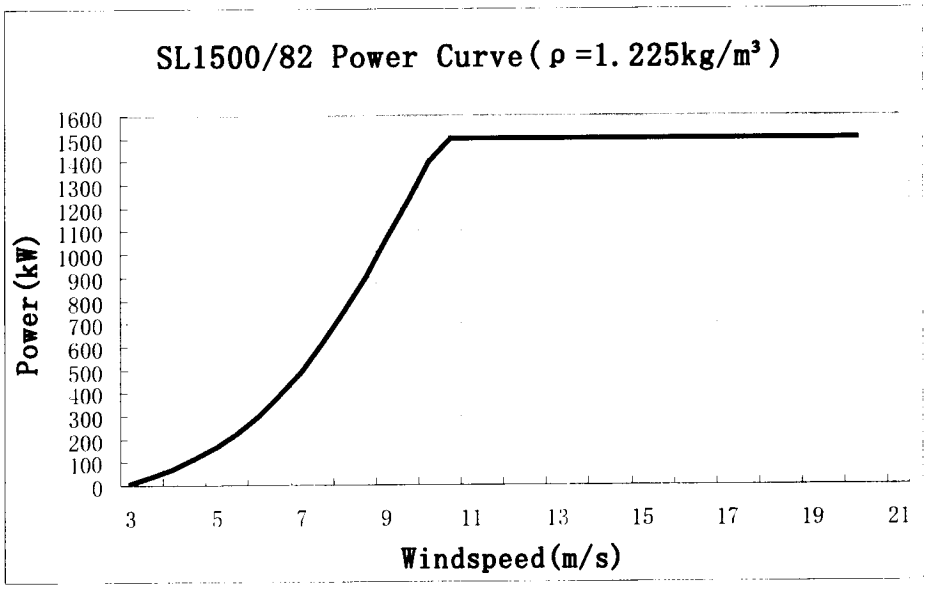
location	Allowable design standards
Nacelle	GB/T 6404
Gearbox	GB/T 8543-1987 / GB/T 6404
High speed shaft/low speed shaft	DIN EN ISO 10680
Generator	GB/T 10068-2000 / GB/T 10069

2 Power curve, thrust coefficient curve and Cp curve

2.1 Power curve at the air density 1.225 kg/m^3

Table 4 Power curve at the density 1.225 kg/m^3

wind speed (m/s)	power (kW)
3	4.46627
3.5	36.2793
4	72.1655
4.5	115.988
5	164.675
5.5	225.812
6	300.021
6.5	386.61
7	489.326
7.5	610.788
8	749.966
8.5	901.953
9	1064.34
9.5	1230.09
10	1395.97
10.5	1500.61
11	1500.61
11.5	1500.61
12	1500.61
12.5	1500.61
13	1500.61
13.5	1500.61
14	1500.61
14.5	1500.61
15	1500.61
15.5	1500.61
16	1500.61
16.5	1500.61
17	1500.61
17.5	1500.61
18	1500.61
18.5	1500.61
19	1500.61
19.5	1500.61
20	1500.61



2.2 Thrust coefficient curve at the air density of 1.225kg/m^3

Table 5 Thrust Coefficient data sheet

SL1500/82 Thrust Coefficient data			
windspeed [m/s]	Ct [.]	windspeed [m/s]	Ct [.]
3	1.10636	12	0.349699
3.5	0.997744	12.5	0.304647
4	0.914581	13	0.268106
4.5	0.845178	13.5	0.237712
5	0.789601	14	0.212103
5.5	0.791005	14.5	0.190332
6	0.792174	15	0.17165
6.5	0.793314	15.5	0.155527
7	0.79468	16	0.141506
7.5	0.79599	16.5	0.129266
8	0.796901	17	0.11853
8.5	0.770161	17.5	0.109046
9	0.736003	18	0.100623
9.5	0.705273	18.5	0.09314
10	0.670687	19	0.086435
10.5	0.590175	19.5	0.080407
11	0.480418	20	0.074977
11.5	0.40617		

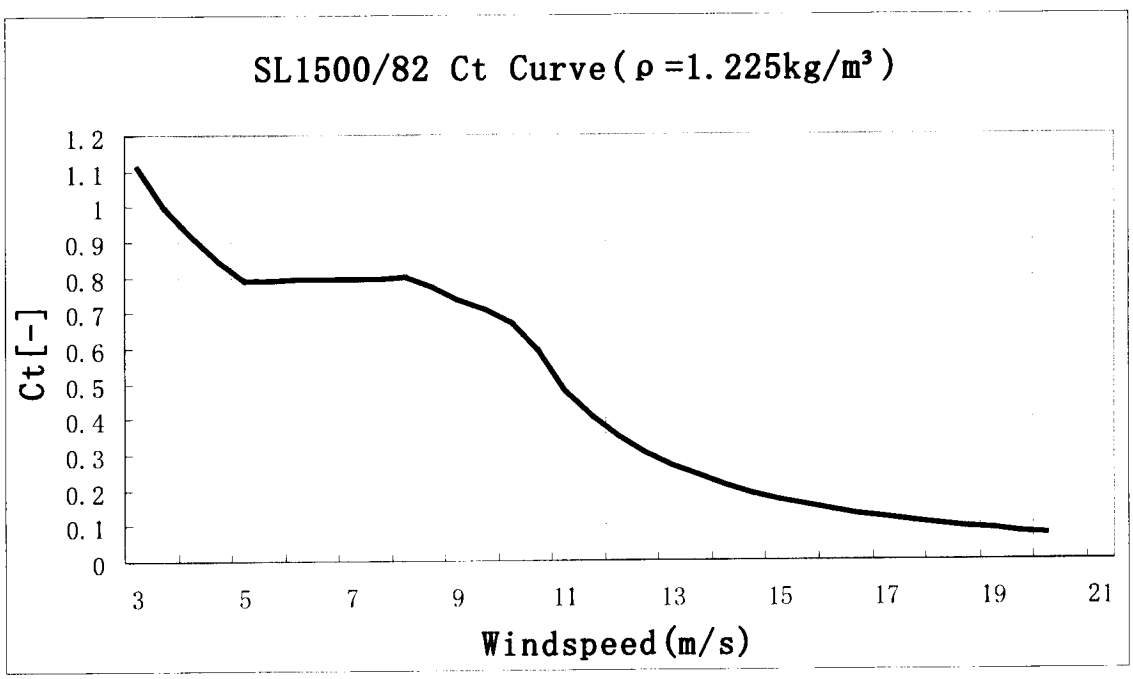


Figure 1 Thrust coefficient curve of SL1500/82

2.3 Cp curve at the air density 1.225kg/m^3

Table 6 Cp data sheet of SL1500/82

SL1500/82 Power Coefficient data			
windspeed [m/s]	Cp [.]	windspeed [m/s]	Cp [.]
3	0.328774	12	0.284893
3.5	0.41763	12.5	0.25206
4	0.460348	13	0.224087
4.5	0.481742	13.5	0.200117
5	0.485604	14	0.179433
5.5	0.485744	14.5	0.161513
6	0.485855	15	0.145888
6.5	0.48598	15.5	0.132222
7	0.486025	16	0.120197
7.5	0.4861	16.5	0.109591
8	0.486178	17	0.100209
8.5	0.483406	17.5	0.091864
9	0.476681	18	0.084414
9.5	0.467785	18.5	0.077758
10	0.455329	19	0.071777
10.5	0.425355	19.5	0.066395
11	0.369883	20	0.061541
11.5	0.323702		

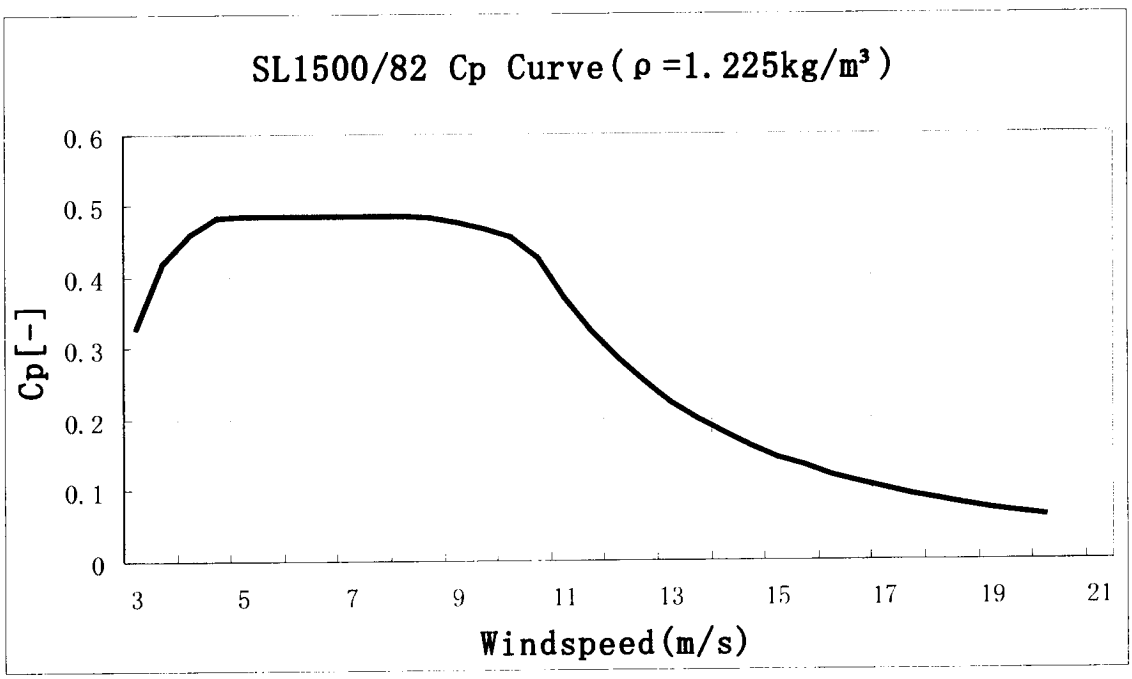


Figure 2 Cp Curve of SL1500/82

3 Technical data of tower

Table 7 Tower data of SL1500/82

Hub height（m）			65m	70m	80m	100m
tower sections	1	length(m)	22.4	24.33	24.1	
		weight(kg)	24157	26673	27053	
	2	length(m)	22.4	24.21	25.3	
		weight(kg)	36974	39790	42937	
	3	length（m）	17.6	18.86	15.5	
		weight(kg)	43972	48782	45124	
	4	length（m）	--	--	12.47	
		weight(kg)	--	--	45834	
Total weight of tower(kg)			105103	115245	160948	
Weight of Foundation ring（kg）			9230	8944	9483	
Material of flange			Q345E	Q345E	Q345E	
Material of tower wall		≤35	Q345C	Q345C	Q345C	
		35-50	Q345D	Q345D	Q345D	
		≥50	Q345E	Q345E	Q345E	

4 Standard Foundation data

Standard foundation data as following, the actual foundation must be calculated according to the tower height, the geological condition and the wind load of the wind farm.

Table 8 Technical data of the standard foundation

Hub height（m）	65m	70m	80m	100m
Weight of concrete iron（t）	30.4	30	32.8	
Volume of concrete（m^3）	260.9	280.6	310.8	
strength of concrete	C25/C30	C25/C30	C25/C30	

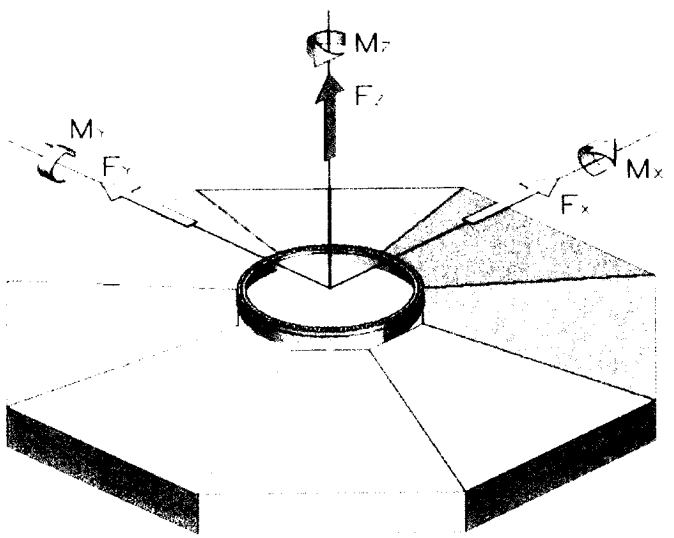


Figure 3 Coordinates of foundation load

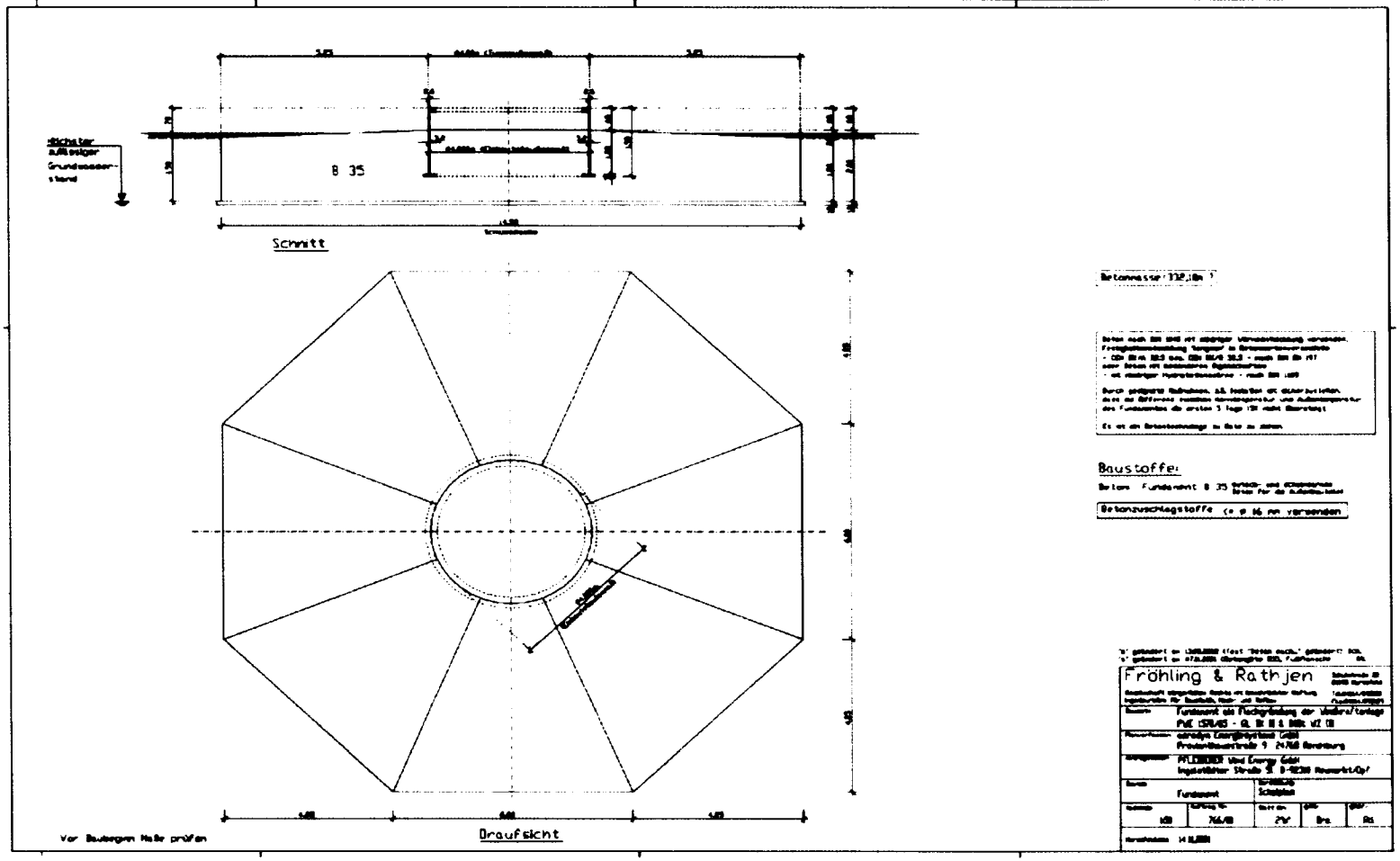


Figure 4 drawing of standard foundation

5 Technical description

SL1500 is a three bladed, horizontal-shaft wind energy converter (WEC) by adopting variable speed, pitch control, active yaw system and double fed generating technology, which is especially developed for utilizing inland wind energy in high efficiency. The rotation speed is variable and the wind turbine can operate in best efficiency as the wind speed varying from 3.0m/s to 10.5m/s. It will achieve the 1500kW rated power at 10.5m/s and keep constant power output from 10.5m/s to 20.0m/s.

For achieving a constant power output at different wind speed and wind direction, SL1500 can one side adjust the respective blade, the other side yaw the nacelle according to wind direction.

5.1 Technical Characteristics

SL1500 has achieved the Lloyd's certificate and by now it is the most advanced technical representation throughout the world. Its technical characteristics are shown as follows:

1) Pitch system installed with storage battery, protects the wind turbine when the grid power fails.

The pitch system still can adjust the blades to protect the wind turbine when the grid power-fail. The storage battery is mounted in the nacelle, which is convenient for maintenance.

2) Thorough lightning proof measures

Adopt metal structure at the tip of blades for protection from destruction. Install carbon brushes at each movable part, discharge the lightning current promptly. Mount lightning rod at the top of nacelle.

3) High performance of Generating System

By adopting asynchronous double-fed generator and IGBT controller, achieve power control and impact current control. Torque little varies as the wind speed changes. Variable speeds operation, no impact current and large generating capacity. By adopting four-quad control of IGBT, normally runs at the power factor of 1, and can be changed from Capacitive 0.95 to Inductive 0.9 for necessary reactive power compensation to the grid.

4) Varied speed, constant frequency and vector control

The technology of Variable speed and constant frequency greatly prolongs the longevity of core components, prominently improves the generation quality and quantity and the capability of protection from grid-dropping.

- Vary rotational speed according to wind speed to make turbine run in high efficiency.
- Vary rotational speed to avoid the torque oscillating caused by instant wind variation and absorb the loading variation caused by gust or turbulence, which improves the longevity of core components and electricity quality.
- Control system adopts advanced CPU WT98 & WT97 of ABB to control entire turbine and sampling, and achieve automatic control and remote supervision.

5) Electric-drive pitch control

Electric-drive pitch control has faster response and higher pitching precision. Three pitch systems are

independent from each other, i.e. the turbine can be shut down safely even if one of the pitch systems malfunctions. There is no oil-leakage trouble. Higher reliability and less maintenance.

6) Sliding yaw system

Sliding pads are equipped between ring gear and main frame, ring gear and side bearing, which achieve the relative rotation between nacelle and tower. The sliding pad can provide a certain friction force so no need of hydraulic yaw brake.

7) Special compact structure of main shaft

The rotor shaft is integrated into the gearbox. Comparing with modular shaft design, this special scheme makes the center gravity of nacelle closer to the tower axis and greatly reduces the overturning moment on yaw system and tower foundation because of wind load and self-weight. It enhances the loading capability of the components and the whole turbine.

8) Converter is equipped in nacelle.

The converter and controller are equipped in nacelle so the distance from the converter output terminal to the generator, which avoid the influence of distributed inductance and capacitance induced by long line connection.

9) Brake system

Two independent brake systems: aerodynamic brake and mechanical brake. Any brake system can shut down the turbine under normal operating and emergency condition.

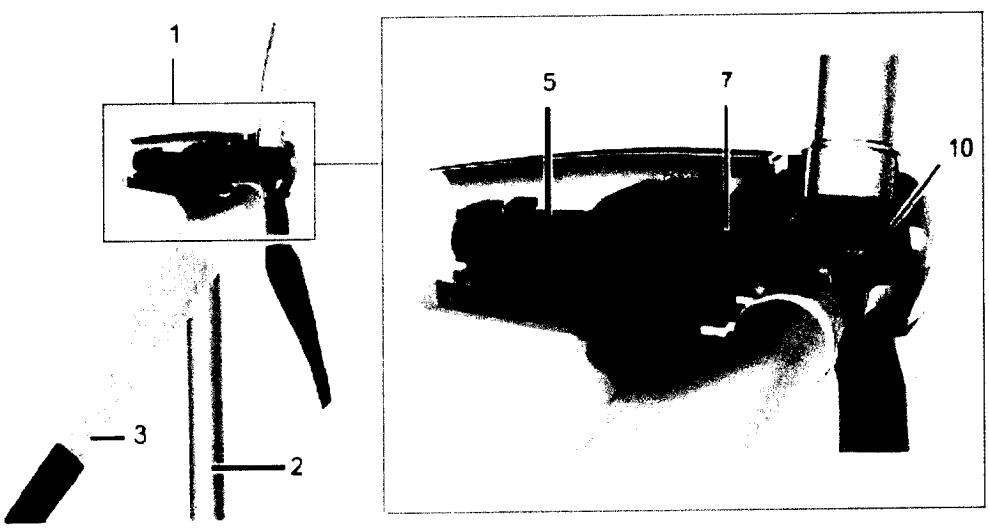


Figure 5 the layout of the whole machine

1—nacelle; 2—tower; 3—blade; 5—generator; 7—gearbox; 10—hub

10) Salt-fog proof measures (antiseptic measures)

SL1500 is designed according to the condition of Sea Island and applicable for coastal region: outside parts of turbine are designed according to ISO12944 C5M; inside parts are designed according to C4 level requirement; choose electrical components according to three-prevention standard; adopt the marine cables.

11) Safe shutdown measures

In order to guarantee the safety of coastal wind turbines during shutdown period, the blades keep feathering and the brakes keep braking. The reliability of wind turbine in extreme wind condition is guaranteed in design step.

12) Vibration damper measures

Vibration of nacelle parts is avoided and improved effectively becausc dampers are equipped between the joints of gearbox and main frame, under the generator base, between the joints of the electric control cabinet and main frame, nacelle cover and main frame.

Cone couplings are utilized, which not only can transmit torque, but also can absorb the vertical and horizontal vibration.

The natural frequencies of tower、 nacelle and blades are different so resonancc is avoided.

5.2 Component Description

5.2.1 Rotor part is comprised of blade, hub and pitch system.

Blade

Rotor diameter is 82m and single blade lcngth is 40.25m. Aerodynamic airfoil and blade profile make blade achieve higher aerodynamic efficiency under the lowest load condition. Material of rotor blade is glass fibre / epoxide resin, glue, gel paint, which are applicable in low temperature rcgion and outer coat of blade is rain, snow and sand proof and good wearing-resistant.

Rotor blade's structure is multi-lamina rid/shell. Lightning protection apparatus is integrated into single blade, which includes: metal tip, conductor installed along the trailing edge of bladc and a grounding cable connecting with blade and nacelle.

Hub

Hub is cast structure which is connected with rotor blade. Pitch bearing and single pitching driver unit are connected with hub.

Pitching system

Pitching system have two functions: first is the primary brake system for turbine and the other is regulating the rotor rotation speed in rated load scope to control the rated output of turbine. Each blade is actuated by one set of drive train unit which includes servo motor、 gearbox、 pinion gear and so on. Keep drive units act synchronously by electric control device and regulating each blade respectively is also workable. Safe shutdown can be realized even if one of the drive units of pitching system malfunctions.

5.2.2 Nacelle is comprised of following components:

Main Frame

The main frame is a welded construction, which is the weight-bearing part. The gearbox, generator and yaw system all connect with it and the yaw drive is also fixed on it.

Gearbox

The gearbox consists of two planetary stages and a downstream spur gear stage. The rotor shaft is integrated in the gearbox, i.e. the hub is attached directly to the drive shaft of the gearbox. It is equipped with an oil cooling system which cools the high-temperature gear oil to a suitable temperature.

Yaw System

The yaw system is used to rotate the nacelle so that the rotor is always facing the wind. The rotation is achieved - based on the signals recorded by the anemometer - by means of four synchronously-controlled yaw motors moving around the ring gear on the tower. The ring gear is used for the linkage of nacelle and tower. The yaw system is set for rotating max.720 degree, and can unmoor automatically.

Generator

The wind power generating device consists of a double-fed induction generator, an encoder, etc.

The generator can rotate in high efficiency by such electronic unit as IGBT, and the power factor can be adjusted from Capacitive 0.95 to Inductive 0.9.

Heat windings are installed to prevent damage to the generator that could arise from humidity and fogging. In addition, PT100 sensors are integrated in the generator for temperature monitoring.

Brake Coupling Unit

The brake coupling unit consists of a hydraulically activated disc brake, which is attached to the rear side and the drive shaft of the gear box, and a connection between disc brake and generator drive shaft.

The brake is used for emergency shut downs of a working and as a locking brake for a non-working wind energy converter. The wear of the brake pads is monitored and displayed on the PC. By means of an automatic adjustment the brake pads are always brought into the right positions.

The coupling transmits the driving torque from the gearbox exit to the generator drive. It is electrically insulating in order to avoid leakage currents. It compensates axial and radial displacements to avoid the vibration.

Vibration/Noise Decoupling

Two layers of vibration dampers are equipped at the joint of gearbox and main frame for use of vibration damping and noise eliminating. The vibration damper is composed of the ring-shaped elastic layers that are enclosed by a retaining ring. In addition, the dampers are also mounted at the generator base, the joints between controller cabinet and the main frame, the nacelle covering and the main frame, which effectively prevent and reduce the vibration.

GRP Covering

The hub and the nacelle are lined with a GRP covering. This covering protects the machines components against the meteorological influence, reduces noise emission and increases the aerodynamic forces. The GRP covering is equipped with a lightning proof earthing cable. The covering connections are sealed with rubber to proof against rain and sand.

Crane for maintenance

The crane is mounted in the nacelle, and can lift the tools and consumables inside or outside of the nacelle.

Water Cooling System

The water cooling system consists of the pump, tank, temperature and pressure sensors, valves, connecting pipeline and cooler, etc. The cooling of generator and power converter all adopts water cooling. The pumping station is installed inside the nacelle and the water-air heat-exchanger is mounted outside of the nacelle. The cooling system would start as the temperature exceeds the setting temperature of the system, by means of the cooler cooling the water until heat balance.

Anemoscope

The anemoscope adopts the ultrasonic mannor, which is mounted on the top of the nacelle. The wind direction and speed can be measured by the anemoscope. The pitch system adjusts the blade angle and the yaw system adjusts the nacelle direction according to the direction and speed of the wind.

Lightning Protection System

A lightning proof system is installed in the blades. The earthing cable is embedded in the nacelle and a lightning rod is mounted outside the nacelle. All these settings connect with a grounding cable. The lightning strike is led via the tower into the ground. Lightning spikes made of stainless steel tooth with carbon brushes or steel brushes are mounted at the joints between the rotating parts (blade-hub, hub-nacelle, and nacelle-tower).

Fire Control Facility

Fire extinguishers are equipped in nacelle and tower: a fire extinguisher on the root platform of the tower and another one on the top platform of the tower.

5.2.3 Tower

The tower is a tubular steel tower, inside the tower there is a ladder with climbing protection system, lighting facility, rest platforms as well as cable routes and cable support.

5.2.4 Foundation

The foundation of the wind turbine adopts the type of entity gravitation. The foundation ring is buried in the foundation in advance, and connected to the tower by the flange. Three sets of adjustable bolts are equipped between the bottom flange of the foundation ring and the foundation surface for adjusting the plane degree of the foundation ring.

5.2.5 Electric Device

The double-fed generator（5）

The pitch system（9，pitch control）and the yaw system（11）

The MPU with 3 input/output points（I/O）and the control module

The MPU module for communication

The monitoring system and the safety chain

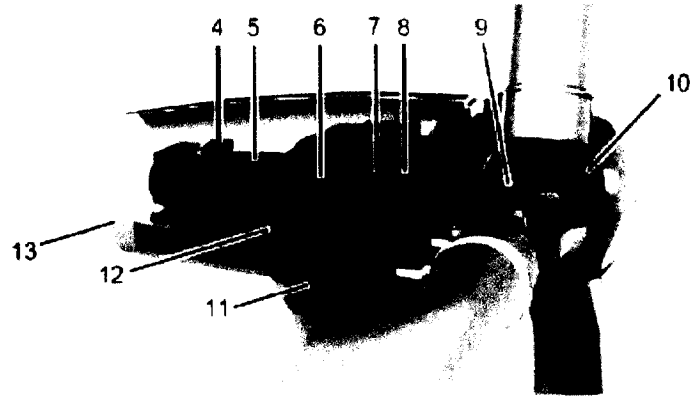


Figure 6 the nacelle

4—Cooling system; 5—Generator; 6—Brake & coupling; 7—gearbox; 8—noise decoupling; 9—pitch system; 10—hub; 11—yaw system; 12—main frame; 13—Cover for nacelle

(1) Electrical equipment

The wind energy converter has a double-fed induction generator with power converter (IGBT voltage source converter) for variable speed operation. The use of a double-fed generator results in the realization of variable speed that has some basic technical advantages over other options:

- Higher degree of electrical efficiency
- Reduction of the harmonic load

The power output and the power factor (cosφ) can be controlled progressively over the complete power range according to the external target value specifications or with a fixed value. The generator and the converter are equipped with several temperature sensors for temperature monitoring and also equipped heating elements for proofing against condensation.

Table 13 Description of the electrical equipment

Type	SL1500
Generator	Double-fed
Converter	IGBT，4 quadrant
Rated power kW	1500
Rated voltage V	690
Power factor（cosφ）	Standard 1.0,be able to control
Harmonic distortion factor	~5%

（2）Control system

The control system consists of the 3 sets MPU units with input/output (I/O). The units depend on the serial interface to communicate, the main CPU control the transducer of the generator through Can bus, the second CPU control the transducer of the yaw and pitch system. The units are placed in the nacelle and the tower base. Each unit independently overtakes the relevant control tasks.

Table 14 Description of the Control System

type	SL1500
form	PLC，programme free
function	be able to control

Table 15 Electric Capability

model: SL 1500				
capability				
Rated power		rated voltage		rated current
1520KW		690V		1255A
Power factor λ				
1/4 Pn	1/2 Pn	3/4 Pn	Pn	Pmax
1	1	1	1	1
Peak value P/Pn				
Transient value		1min	10min	max. Power curve
1.1		1.00	1.00	1.1

SL1500 wind energy converter has the control capability of the reactive power; the power factor can be 1 constantly. If necessary, the reactive power factor can be adjusted as Capacitive cosφ=0.95 or inductive cosφ=0.90. The customer can adjust voltage in the power system based on the control ability.

(3) Central Monitoring System

The central monitoring system can be with the function as monitoring and managing each wind turbine on time, controlling each turbine start and stop, revising the values, displaying the operation interfaces, tabling record, printing, recording events, warning, retrospective accident, analyzing, automating to diagnose the system faults and renew the system; and no losing the technical data at the condition of communication interruption.

The optic cable with the ring net connection transfers the data.

The central monitoring system can display the information as following: (including single turbine and total turbines)

(1) Current active power and reactive power

(2) voltage(V)，virtual value of 3 phases

(3) frequency(Hz)；

(4) current(A)，virtual value of 3 phases

(5) power factor；

(6) speed of the rotor(rpm)；

(7) speed of the generator(rpm)；

(8) time (hour)；

(9) status of WEC；

(10) virtual power production(kWh)；

(11) wind speed on site(m/s);

(12) temperature of the generator(°C);

(13) temperature of the high speed shaft of the gearbox;

(14) oil temperature of the gearbox(°C);

(15) temperature of the nacelle(°C);

(16) status of mechanical brake;

(17) Day power production, month power production and year power production of each wind turbine in all passed time. Total day power production, total month power production and total year power production of all wind turbines. Total power production of each wind turbine and total wind turbines.

(18) fault and stop records of 20 years;

(19) power curve statistic with month, year or specified time interval;

(20) All data in 900s before stop.

(21) total power production (MkWh)

The wind turbine would stop, display and warn when the following conditions happen:

(1) the lower oil level, the lower pressure, the higher pressure of the hydraulic system;

(2) yaw fault;

(3) cable unmooring fault;

(4) control system fault;

(5) abnormal nacelle vibration;

(6) brake pad wear;

(7) mechanical brake fault;

(8) abnormal temperature of the generator, the gearbox and the yaw motor;

(9) overspeed of the rotor and the generator;

(10) Safety system starting.

The wind turbine would stop, display, warn and automatic start again when the following conditions happen:

(1) Low wind speed;

(2) Higher wind speed;

(3) Cable unmooring;

(4) Grid fault.

The monitoring system also displays more information and interfaces so that satisfies the customer completely.

The monitoring system is with a top-priority safety system and out of the influence of the monitoring system fault.

(4) Grid Technology

General

Beginning at 20rpm, the generator can operate in constant torque mode, which makes the system in constant load status. The gust interference can not impress the grid. The wind turbine does not need frequent pitch adjusting under the limit wind speed.

SL1500 adopts the double-fed generator (DFIG), the stator of DFIG connects to the three-phase grid, and the IGBT converter controls the rotor of DFIG.

DFIG has the similar control performance of the synchronization motor, converter at rotor side with two variables: torque and excitation, excitation variable represents the reactive variable at the stator side.

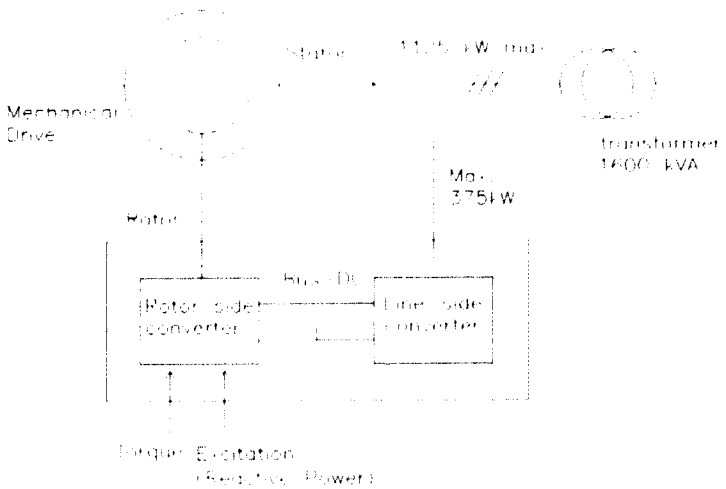


Figure 7 Flow diagram of Double-fed Generator

The 1125 kW active power is provided by the stator and 375 kW by the rotor at max rotational speed and full power. The harmonic wave of the DFIG would be much less than that of the synchronous motor or asynchronous motor with all power entering the grid through the converter.

Power factor λ (cosφ)

If necessary, the power factor can reach max. Capacitive 0.95 or inductive 0.90 at rated voltage.

Start-up

As Bus-DC charging, startup occurs. The DC capacity is charged via a resistance, the current is 4% of the max. Rated current.

Connection for power system

The synchronizing process of DFIG has no impact, after that, the torque and power arises gradually.

(5) Conditions for WEC Operation

The wind turbine can start to operate by satisfaction of the following conditions:

* No person in the nacelle and the tower except the relevant necessary person.

* Finish all maintenance work, remove the rotor lock, close the nacelle cover.
* Remove the locking of all emergency switches.

（6）Operating performance of Converter

Tabel 16 electrical parameter

System power	1500kW
Converter power	750 kVA
Rated voltage	690 VAC， ±10%
Power supply frequency	50Hz， ±2Hz
connecting voltage	1000-1100 VDC
Max effective voltage of rotor	700 VAC
Operating frequency	3 kHz
Power factor	c0.95 – i0.9
Slippage range	±30%
Voltage asymmetry（voltage offset)	2%
current asymmetry	10%
Value of Phase to phase, peak value, max voltage of rotor	2 kV
Value of phase to earth, peak value, max voltage of rotor	2 kV
Times of power supply connection	> 30,000

（7）Remote Monitoring System

SL1500 is equipped the remote monitoring system so as to monitor each wind turbine at remote site on real time. The remote monitoring system can adjust some parameters of the components, and can access the data of power generating through phone line with password protection. When the fault happens, it can be repaired and recovered by relevant software. The characteristics of the remote monitoring system are shown as follows:

* fault monitoring
* fault recovery
* Data processing at long time interval
* operating status displaying
* running

The system can provide relevant parameters, operating status and fault warning for the central

monitoring system with different colors indication and sound alarm.

The central monitoring system has the resistance of the electromagnetic interference with corresponding grade, all control and protection system units can avoid the electromagnetic interference in the electric system.

The remote monitoring station with the remote monitoring system can monitor the running status of the wind turbine, and realize the function of tabling and printing of the relevant parameters for wind speed and power production. The server in the station has the independent net link: IP address of public net and band width with 2M at least.

(8) Local Control System and Switchboard

The local control system would guarantee the normal generating and safe operation of the wind turbine and be with the function of the emergency stop, malfunction alarm, communication with the central monitoring system. The local control system can start, stop, yaw and reset the turbine. It can record and display the power production, the generating time, the interconnecting time. It can not lose the operating data and record when power off or the fault of the grid.

The local control system is independent of the central monitoring and controlling system. It can keep on controlling the wind turbine operation as failing to connect the central monitoring and controlling system.

5.3 Earthing Requirement for Turbine System

The grounding system is integrated all the local grounding electrodes as a whole, which are conductively connected to similar-function metal parts (e.g. tower base, reinforcement parts, metal cable jackets) and grounding conductors.

The individual grounding electrode must be connected individually to the equipotent bonding conductor to ensure that the grounding system resistance can be measured at any time.

Steel or copper can be used as the material for grounding electrodes. When various metals are in contact, they should be inspected for corrosion from electrolytic element couplings.

Metal cable jackets that are not insulated with plastic and laid directly in the soil may be used as grounding electrodes if the connection in the sleeves conducts as well as the metal jacket.

When selecting and positioning the ground electrodes, the local conditions, soil and permissible ground resistance should be taken into consideration. Grounding system planning must take into account the fact that the grounding electrodes resistance may increase due to corrosion.

The grounding electrodes must have a good connection to the surrounding soil. In dry layers of soils the electrodes have to be embedded in non-cohesive soil, while cohesive soil must be carefully rammed. Stone or gravel in contact with the electrodes will increase the grounding resistance. In such cases, it is advisable to surround the electrodes with cohesive soil.

Horizontal grounding electrodes must be stainless, and generally installed at a minimum depth of 0.8m. In any case, the selected type and installation depth must ensure that if the soil dries out or freezes, the ground electrode resistance will not exceed the required value. Vertical grounding electrodes should be

driven into the ground as vertically as possible.

In the case of foundation grounding electrodes, it is advisable to connect existing reinforcement steel to the electrodes. Galvanized or bright steel strip (at least 30mm x 3mm) or bars (at least 10mm in diameter) should be used as the material. Inside the concrete tower bright material may be used, but outside above ground should be at least hot-dip galvanized and only copper should be used for underground end leads. Reinforcement steel and steel parts embedded in concrete may also be used.

Three connections to the foundation grounding electrodes and three connections to the ring electrodes are generally used, which lead separately to the equipotent bonding conductor. The grounding conductors must be protected against corrosion.

The grounding system, as a part of the foundation flange, must be designed to the satisfaction of the local conditions and regulations. The lightning proof measures make use of the same grounding system.

The resistance of grounding system must be equal or less than 4Ω.

5.4 Grounding System for WEC and Transformer

Grounding system for WEC and transformer must be connected together.

Local soil conditions and ground resistance should be taken into consideration when installing the grounding system according to requirement.

Grounding ring should be consist by closed loop conductor and connected to grounding electrode by aluminothermy welding connection. Grounding system should be improved if the ground resistance is not lower enough. Usually lay two grounding connected electrodes around the circular conductor equidistantly.

Grounding system should be made of galvanized steel strips (at least 30 x 3.5mm). The grounding conductors are buried under the ground fetched out by grounding electrode and connected to the inside of tower. The interlinked equipments in nacelle are connected to the tower bottom by grounding cable and form an equipotent bonding with the grounding system.

The conductor ring, located at the tower foundation, interlinks and earths the tower, foundation, the protection zone and movable platform of the electric control cabinet, to realize the equipotent bonding. The mid-voltage cabinet, measure equipment, transformer and low-voltage output cabinet in the transformer station all make grounding at the foundation. The center point of the secondary side of the transformer should be grounded.

Grounding system for SL1500 wind turbines depends on local conditions requirement, electric standard and requirement.

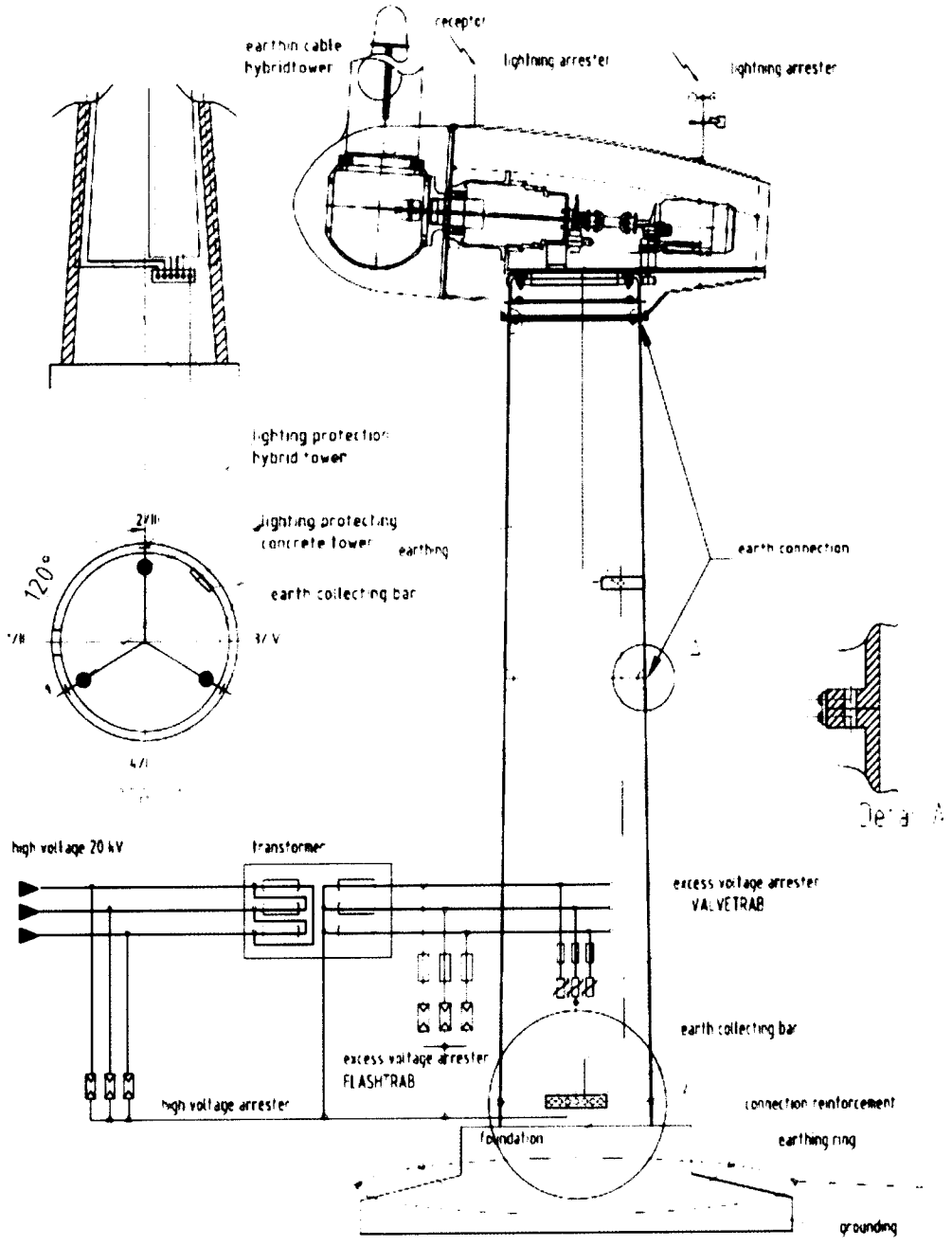


Figure 8 Earthing System

5.5 Installation Requirement

5.5.1 Fundamental requirement for installation region:

Premise for wind turbine installation:

* Turbine foundation construction is finished: steel concrete condenses enough; sandstone is laid completely around the foundation.

* Roads for crane and truck arc constructed.

* All parts and equipments are ready.

* Enough wide fields for rotor assembling.

* Equipments for installation are ready. Quality of Components are checked and accepted by related department and have check-acceptance report/qualification.

* Wind condition requirement during installing is:

Table 17 Wind Speed Requirement for Installation

operation	Wind speed
Tower erection	<8m/s
Nacelle installation	<8m/s
Rotor installation	<6m/s

5.5.2 Fundamental requirement for crane:

Two cranes are needed for turbine installation, small crane for lower location installation and big crane for higher location installation. When transforming the horizontal position of component to vertical, small crane should cooperate with big crane.

Crane driver take a responsible role during installation, who should be aware of crane position and component distribution. Executing leader should introduce explicitly weight and balance point of the part and needed preparation.

Arrange only one leader on the installing spot to avoid leading confusion and selection for this leader should negotiate with the crane driver. Gesture and signal of crane leader should be consistent during entire installing. The leader should keep in the eyes of crane driver and cooperate closely with each other.

5.6 List of Technical Standard

EN 10204	Metallic Products–Types of Inspection Documents–Acceptance Test Certificate
EN 61312	Lightning and Electromagnetism Impact Protection
IEC 61312	Earthing Standard
IEC 61400-24	Lightning Protection of WEC
DIN	1000V Power System Installation of DIN VDE 0100 part 540 and Electric Equipment; Earthing, Protection and Equipotential Shield Earthing Conductor
DIN EN 10113-2	Hot roll products of welded fine-grained structure steel
DIN EN 10029	Hot roll steel of Thickness≥3 mm ; Dimensional Tolerance, shape and weight deviation
DIN EN 1290	Non-destructive test of welding seam, Magnetic Powder test of welding seam
DIN EN 1291	Non-destructive test of welding seam-Magnetic Powder test of welding seam—Acceptance Grade
DIN EN 1289	Non-destructive test of welding seam-Leak through test of welding seam—Acceptance Grade
DIN EN 10160	Ultrasonic test of flat steel for thickness ≥6 mm
SEL 072 [1977-12]	Ultrasonic test of thick plate–technical delivery condition
DIN EN 473 [2001-03]	Non-destructive testing-Qualification and certification of NDT personnel-General principles
DIN EN 1712 [2002-09]	Non-destructive test of welding seam-ultrasonic test of welding joint—Acceptance Grade
DIN EN 1713 [2002-09]	Non-destructive test of welding seam-ultrasonic test—declaration for welding defect
DIN EN 1714 [2002-09]	Non-destructive test of welding seam-ultrasonic test of welding joint
DIN EN 287-1	Certification exam of NDT personnel–fusion welding—part 1: steel
DIN EN 719	Welding supervising–task and responsibility
DIN EN 288-3	Welding procedure of specification metal material-part 3:welding procedure test of arc welding
DIN EN 288-2	Welding procedure of specification for metal material-part 3:welding procedure test of arc welding
DIN EN ISO 9692-2	Welding joint preparing -part 2: hidden arc welding of steel
DIN EN 25817	Arc welding joint; guiding requirement for defect quality rate
DIN 18800-7	Steel structure–part 7: qualification of contractor
ISO 4406	Hydraulic Fluids-Method for Coding the Level of Contamination by Solid Particles
DIN 3990	Calculation of Load Capacity of Cylindrical Gears
ISO DP 9614	Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Intensity
DIN 45681	Detection of Tonal Components of Noise and Determination of a Tone Adjustment for the Assessment of Noise Immissions
DIN ISO 1940-1	Mechanical Vibration; Balance Quality Requirements for Rotors in a Constant(Rigid)State
DIN ISO 286-1	System of Limits and Fits; Bases of Tolerances, Deviations and Fits
EN 10084	Case Hardening Steels
EN 10083	Quenched and tempered steels
DIN 17022-4	Heat Treatment of Ferrous Materials-Methods of Heat Treatment-Parts 4:Nitriding and Nitrocarburizing
DIN 50190-3	Hardness Depth of Heat-Treated Parts; Determination of the Effective Depth of Hardening after Nitriding
EN ISO 9013	Welding and relevant procedure-hot cutting(oxygen/gas flame) dimensional tolerance and quality rate of surface

DIN EN 10029	Hot roll steel plate of thickness ≥3 mm; dimensional tolerance, shape and weight deviation
EN ISO 9000	System of quality management-principle and vocabulary
DIN EN 10164	Steel products with improved distortion normal to surface of product
DIN 15018-1	Crane ; steel structure; inspection and analysis

Reference No: EPA/2062/11/21/IEE/51

ENVIRONMENTAL PROTECTION AGENCY

GOVERNMENT OF SINDH

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Facsimile: 5065940

Dated: 17-12-2012

DECISION ON INITIAL ENVIRONMENTAL EXAMINATION (IEE).

1.	**Name & Address of Proponent:**	Mr. Dilshad Nabi Khan Lodhi General Manager, M/s Titan Energy Pakistan (Pvt) Limited
2.	**Description of Project:**	9 MW Wind Power Project
3.	**Location of Project:**	Jhimpir Wind Corridor, District Thatta, Sindh.
4.	**Date of Filing of IEE:**	21-11-2012

5. After careful review and analysis of the Initial Environmental Examination (IEE) report, the Environmental Protection Agency (EPA), Sindh has accord its approval subject to the following conditions:

i. During the project execution, safe distances of the under mentioned environmental sensitivities will be maintained:
   - 500m from communities, industries and main transport network
   - 300m from community water well
   - 100m from archaeological / cultural site / monument
   - Distance will be measured from the tip blade of turbines or/and transmission power lines associated.

ii. Project activity will not be carried out within buffer zone of any projected area designated under Sindh wildlife protection act.

iii. Effect on wildlife will be monitored during the migratory season of birds and reports of findings will be submitted to EPA Sindh.

iv. Campsites will be located at least one kilometer away from any settlement to avoid disturbance to the local people.

v. No industrial or residential activity will be permitted on the land allocated for wind energy projects.

vi. The project area will be restored to its original nature to the possible extent. For the purpose, documentation (Photographs) will be kept in record.

vii. The project shall be constructed in the prescribed time strictly as per schedule, which shall be submitted to this office at the start of construction activity.

viii. Employment will be provided to local people and assured for all unskilled jobs. Skilled jobs will be given to the locals after providing them proper field training, where a minimum training will be required.

ix. Benefits to local people will be offered under Corporate Social Responsibility (CSR) policy, community development schemes will be decided in consultation with local communities and may be facilitated by involving district/local Government office.

x. The proponent shall ensure facilitation to the EPA officer(s)/official(s) for the regular inspections to verify the compliance of the PEP Act, Rules and Regulations framed there under and the conditions contained in this approval.

xi. Compensation will be provided to the inhabitants in case of loss of agriculture land, crop property, etc., in accordance with the rates, that are agreed upon. All conflicting issues regarding compensation etc. should be settled in advance prior to the start of activity.

6. This approval shall be treated cancelled if any of the conditions, mentioned in para-5 above is violated. In follow up of the cancellation of this approval prosecution under the provision of Pakistan Environmental Protection Act, 1997 will be initiated against the proponent.

7. The proponent will be liable for compliance of Regulations 13, 14 and 18 of EIA/IEE Regulation, 2000.

8. The proponent will be liable for compliance of Regulations 18 of EIA/IEE Regulation, 2000, which permits the authority i.e. Environmental Protection Agency to enter, inspect and monitor the development of the project so that the conditions are effectively monitored.

9. This approval does not absolve the proponent of the duty to obtain any other approval or consent that may be required under any other law in force.

10. Implementation Report of all the mitigation measures and EMP laid down in the IEE Report be submitted to this office on quarterly basis for review. No violation of any Regulations, Rules, Instruction and Provisions of PEP Act, 1997, shall be made.

11. All the environmental conditions of this approval shall be incorporated in the terms and conditions of tender document and will be component of health safety and environment policy in the project for commitment and compliance.

12. The relevant organization/proponent will submit separate EIA to EPA, Sindh for construction of new grid station to cater electricity generation from proposed wind energy project.

Rafiuddin
Director General

بسم الله الرحمن الرحيم

In The Name of Allah, The Most Beneficent, The Most Merciful

Titan ENERGY

Initial Environmental Examination

Proposed 9 MW Wind Power Project - Taluka & District Thatta

November 2012

ENVIRONMENTAL MANAGEMENT CONSULTANTS

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Table of Contents

Executive Summary

TEPPL, the proponent intends to establish a 9 MW wind farm in the Jhimpir Wind Corridor. They have about 68-02 of TEPPL land about 13km off Thatta – Thano Bulla Khan road in Taluka and District Thatta, where they are carrying out feasibility studies after getting LOI from the Alternate Energy Development Board (AEDB). The Project includes designing, testing, manufacturing, and operation as well as maintenance of wind turbines. The proponent will have choice on turbine design including generator type, gearbox vs. gear-less, materials, besides control on maintaining inventory. The proposed 9MW Wind Power project includes installation and operation of 6 wind turbines at the proposed wind farm.

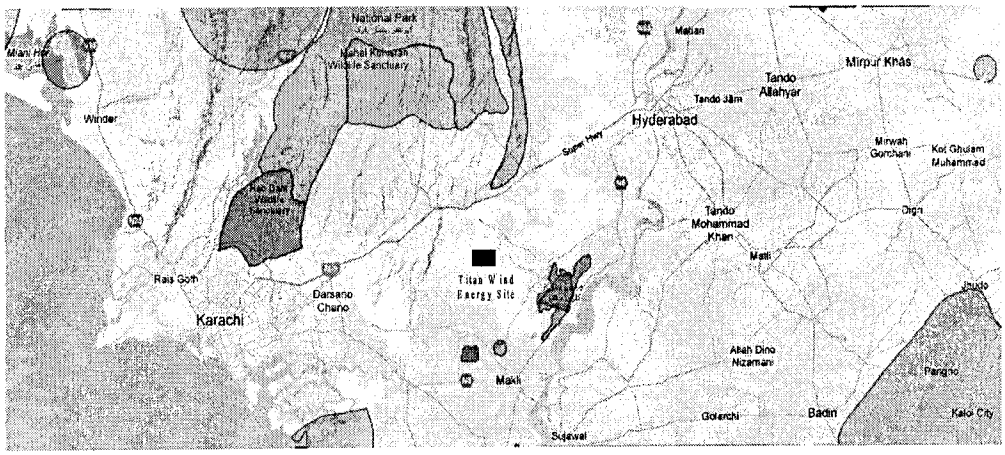


Figure 1: The Project Area

Wind potential of different areas is usually characterized by assigning one of the seven wind classes, each corresponding to range of wind speed and power density at specific height above the ground. The wind statistics for the site show that by international wind classification, power density places the Jamshoro, Nooriabad, Talhar and Keti Bandar sites in the ***excellent*** category, while Thatta, Thana Bola Khan, Hyderabad and Gharo are placed in the category of ***good*** sites for generation of wind power.

Site specific wind speed comparison is being initiated at the TEPPL site, to finally select the wind corridor of Jhimpir as the preferred site.

This Initial Environmental Examination (IEE) evaluates the potential environmental, social, economic, cultural, and natural impacts of the proposed 9 MW Titan Wind Power Project. Environmental Management Consultants (EMC) Pakistan have been contracted as a third party consultant by TEPPL (hereinafter referred as proponent) to conduct the initial Environmental Examination (IEE) of the proposed Wind Farm Project.

The main objectives of the 9 MW Titan Wind Power Project is to:

- ✓ Respond to the national need to produce power from Alternative or Renewable Energy sources that are alternative to thermal and hydro power production systems;
- ✓ Establish a wind power generation facility in accordance with GOP's policy and guidelines on development and generation of Alternative or Renewable Energy, being implemented through the AEDB;

- ✓ Utilize the potential of wind capacity identified by the AEDB at the Jhimpir Wind Corridor and absorb the transferred technology of wind power generation to reduce the emission of Greenhouse gases including CO_2 in Pakistan through net energy gain, and
- ✓ Utilize the hitherto unexploited wind energy potential which is the resource that will help bridging the gap in supply and demand of energy being faced in Pakistan.

The macroenvironment of the project site can be considered a distinct ecosystem on the north of the railway line. It is more or less level and was found fairly covered with grass and/or brushwood. The physical landscape has evolved under sub-tropical and arid conditions. The entire area is otherwise barren land with scanty vegetation.

Overall assessment of the environmental aspects and screening of potential impacts of the proposed activities pertaining to establishment of 9MW Wind Power Project in Taluka Thatta finds that:

- TEPPL Wind Power project site in the Jhimpir Wind Corridor is the preferred alternative and ideally suited for establishment of the Wind Farm for wind classes 4-5.
- An appropriate number of wind turbine generators (WTGs) will be sited on the 68-02 acres land area, with each WTG spaced at optimum distances apart following the annual maximum wind direction.
- There are no issues on land acquisition, loss of land, or loss of business; no involuntary resettlement will be required.
- Noise emissions from the wind turbines at 9MW Wind Power project site may have a high level at the top but the same will attenuate with distance. The noise level at the living areas at more than 1.5 km or in excess of one rotor diameter equivalents will be within acceptable limits of the World Bank Guidelines and the limits recently proposed by Federal EPA.
- Visual effect, Noise effect, EMI effect, Flicker effect induced by operation of the wind turbines will have no significant impact on the living area, located more than 10 km from the Titan wind farm.
- The induced impact on operation of the wind turbines on the microenvironment will be monitored through environmental management plan, environmental monitoring plan and the IFC's HSE Guidelines, and mitigated, if necessary by adoption of suitable measures at the site.
- Piles for the foundations of WTG towers would be laid at depth of bedrock, which are hard and pose minimum risk to the liquefaction threat during major (> 7 on Richter Scale) earthquake.
- Precious ecology of the microenvironment of TEPPL Wind Power project site will be protected. The land being stony wasteland has no worthwhile vegetation. A few patches of dead wood and dried up shrubs may have to be removed towards land clearance but the same will have only minor impact on the environment.
- There are no cultural heritage, recognized archaeological sites, endangered species of flora, wildlife reserve, or potential tourism sites that may need protection and hence no mitigation measures need to be taken. Mitigation measures have been proposed for the protection of the spiny-tailed lizard (Uromastix hardwickii) *Sandha* and the straying high flying birds including the black kites, a few eagles and very few falcons. The TEPPL land is not a habitat for the Houbara bustard, nor is it a site for trophy hunting by the sheikhs of the Emirates. High flying black kites do abound near the poultry farms outside the TEPPL land.
- The number of the few Houbara bustard and high flying eagles and falcons still around will be recorded during the pre-construction, construction and operation phases. Mitigation measures such as hiring the services of sharp shooters will be in place to stupefy the high-flying stray birds and later on release them to safe environment. This is already one of the conservation

practices to safe the wildlife in India. In order to implement the proposed mechanism Sindh Wildlife Department will be taken onboard so that appropriate steps are taken to save the wildlife from extinction.

- Due vigilance will be kept for protecting the wildlife that may still be there.
- Adoption of mitigation measures identified for different stages of the project will be keenly monitored to further enhance the environmental performance of the 9MW Wind Farm.

Assessment of impact of activities during construction processes and operation stages at the 9MW Wind Farm site in taluka Thatta shows that the impacts will be of temporary nature and small order. They are not expected to have any significant adverse impacts on the microenvironment and macroenvironment of the Project. The minor impacts resulting from said activities or operation of facilities would be mitigated.

IEE of the 9MW Wind Farm has identified the key environmental aspects that need to be attended to. Mitigation measures for the likely impact have been suggested. General specification/ details have been worked out in respect of type of structures, grade of concrete, and all other materials of construction for the Construction Phase of 9MW Wind Farm.

It is recommended that:

- The structures and materials conform to recommended standards and follow standard practice of civil works.
- Environmentally sound materials and goods are selected, with priority being accorded to products meeting national and international standards.
- Traditionally well-tried materials are chosen for provision of utilities services in the Project.
- Temporary inconveniences due to construction works are minimized through planning and coordination with local population and organizations in the neighborhood.
- The foundations of the wind turbine towers are of concrete on bearing soil. Bearing capacity, settlement, static and dynamic loading conditions are determined while seismic conditions pertain to placement of the site in zone 2A (Moderate to High hazards) and taken into account in the working designs that will submitted for approval.
- The stability of soil is verified before laying the foundations of the wind turbines.
- No resettlement of population or relocation of structures will be involved since the wind farm includes no residential colonies in its vicinity
- Environmental Performance Monitoring will be an integral part of the Project to ensure environmental safeguards.

Review of Guidelines for classification of polluted and unpolluted sites with respect to their airshed, watershed, soil, sensitivity of ecosystem including fauna, flora, wildlife, aquatic life, historical and archaeological sites and their values, along with assessment of impact by using the "Checklist of actions affecting environment and significance of their impact" has been used in this IEE Study for assessment of impact of different activities for establishment of 9MW Wind Farm.

Screening of potential environmental impacts at the different stages viz. siting, construction, installation of machinery and equipment and finally operation, leads to the conclusion that:

- The wasteland at 9MW Wind Farm has remained an isolated component of the ecosystem of Lower Sindh for a long time. Location of the Wind Farm will comprise value -addition to the wasteland, besides having no significant impact on the micro and macroenvironment, will not degrade the ecology of the stony wasteland in Thatta Taluka.

- Visual effect, Noise effect, EMI effect, Flicker effect induced by operation of the wind turbines will have no significant impact on the living area, located at more than 10 km or three times the required distance of seven rotor diameter equivalents outside the 9MW Wind Farm. The induced impact on operation of the wind turbines on the microenvironment will be monitored through environmental management plan, environmental monitoring plan and the IFC's HSE Guidelines, and mitigated, if necessary by adoption of suitable measures at the site.
- There are no cultural heritage, recognized archaeological sites, endangered species of flora, wildlife reserve, or potential tourism sites that may need protection and hence no mitigation measures need to be taken. Mitigation measures have been proposed for the protection of the spiny-tailed lizard (Uromastix hardwickii) Sandha and the straying high flying birds. The number of the few Houbara bustard and high flying eagles and falcons still around will be recorded during the pre-construction period. Mitigation measures such as hiring the services of sharp shooters will be in place to stupefy the high-flying stray birds and later on release them to safe environment.
- Finding of archaeological artifacts during the construction phase will be immediately reported to the Department of Archaeology, Sindh.
- The proposed 9MW Wind Farm, when commissioned, would add value to the otherwise wasteland on the north of National Highway N5 in Taluka Thatta and become an integral part of the macroenvironment of Taluka Thatta.

Based on the findings of the environmental assessment, it is reasonable to suggest that the environmental impacts of establishment of 9MW Wind Farm are minor and can easily be mitigated by implementing the Environmental Management Plan (EMP), Environmental Performance Monitoring Plan and IFC's HSE Guidelines as well as Equator Principles all of which form an integral part of the IEE process.

This IEE Study finds that the value-addition characteristics of 9MW Wind Farm would respond to the principles of sustainable development that aim at "socially equitable and economically viable development to improve the quality of life for all citizens of the Earth, without altering the balance in the ecosystem".

The Study therefore recommends that the IEE Report should be approved with the provision that the suggested mitigation measures will be adopted and the Environmental Management Plan will be followed in letter and spirit.

1.0 Introduction

1.1 General

1.1.1 Name Of The Project

Establishment of 9 MW Wind Power Project, in Taluka and District Thatta - Sindh.

1.1.2 Location

Project site is located in Jhimpir Wind Corridor between 24 59 22.16N, 67 49 26.06E4, 13 km off Thatta-Thano Bulla Khan Road, Taluka and District Thatta in Sindh; as shown in Figure 1.1

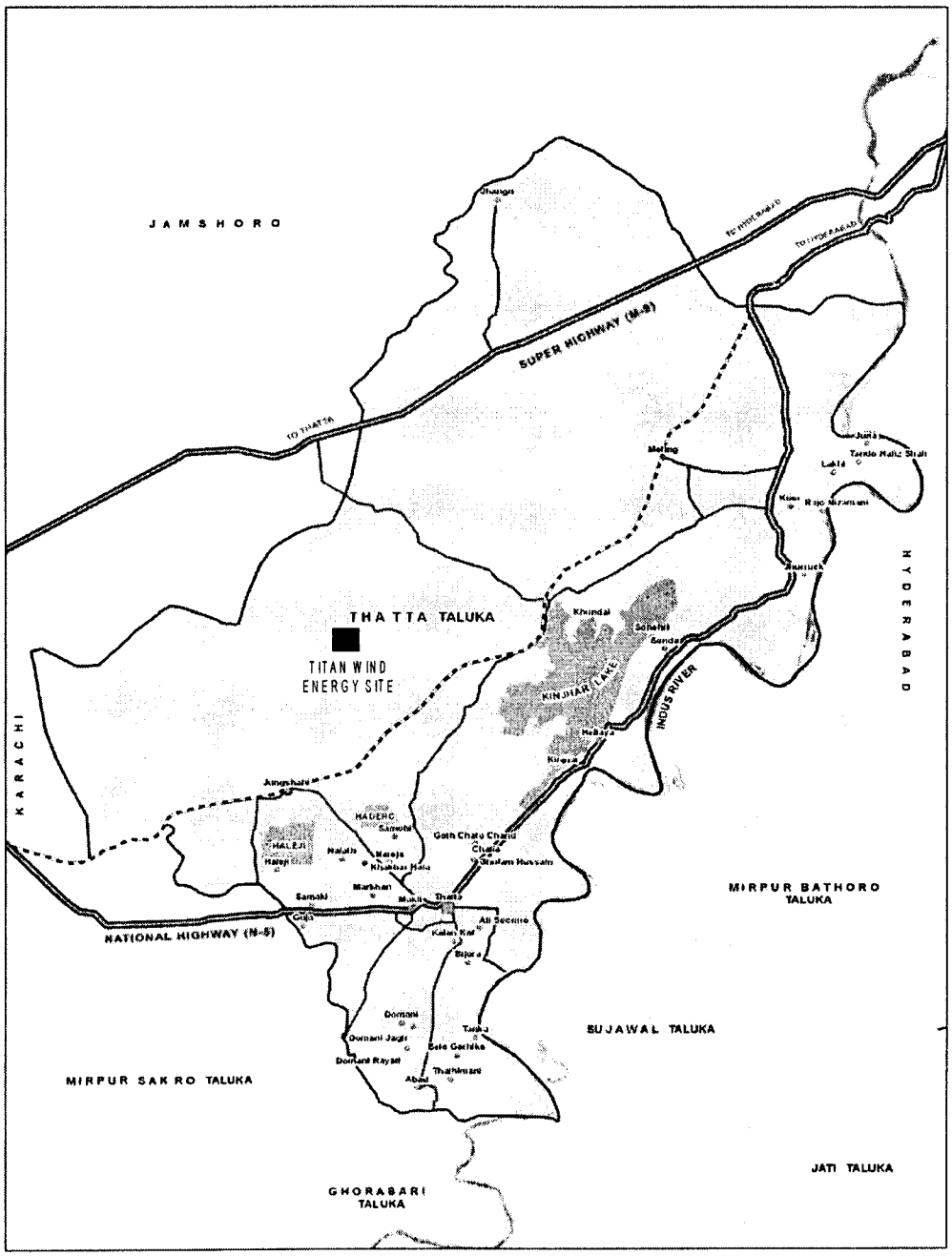


Figure 1.1: Location of Proposed Wind Farm

1.1.3 Name of Project Proponent

Titan Energy Pakistan (Pvt.) Ltd
Mr. Dilshad Nabi Khan Lodhi
General Manager
Address: FL-2/1, Block-6, Gulshan-e-Iqbal, Karachi-75300.
Tel: +92-21-34966809
Fax: +92-21-34960380

1.1.4 Name of Environmental Consultant

Environmental Management Consultants (EMC)
Mr. Syed Nadeem Arif
Managing Director
Email: mail@emc.com.pk
Address: Office # 503, Anum Estate Building
Main Shahrae Faisal (Opposite Duty Free Shop)
Karachi, Pakistan.
Tel: +92-21-34311466, 34321532
Fax: +92-21-34311467

1.2 Brief Description of Project

Titan Energy Pakistan (Pvt.) Ltd, the proponent intends to establish a 9 MW wind farm in the Jhimpir Wind Corridor. The proponent has acquired 68-02 Acres of Land by the Government of Sindh where it is carrying its feasibility studies after getting LOI from the Alternate Energy Development Board (AEDB). The Project includes designing, testing, manufacturing, and operation as well as maintenance of wind turbines. The proponent will have choice on turbine design including generator type, gearbox vs. gear-less, materials, besides control on maintaining inventory. The proposed Titan Energy-Wind Power project includes installation and operation of 06 sets of wind turbines in Phase I for the production of 9.0MW (1500 KWx6). The hub height is 80m and the runner diameter is 82m.

Table 1.1: General Information of the Project

Total Capacity[MW]	9
Number of Turbines	6
Turbine Model	SL1500/HH80
Gross Output [MWh/yr]	37325.12
Wake Loss	0.65
Losses [%]	9.63
Other Losses	33511.46
Net Output [MWh/yr]	42.51
Net Capacity Factor [%]	42.51

1.3 Objectives Of The Project

The main objectives of the Titan Energy - Wind Power Project are to:

- Respond to the national need to produce power from Alternative or Renewable Energy sources that are alternative to thermal and hydro power production systems;

- Establish a wind power generation facility in accordance with GOP's policy and guidelines on development and generation of Alternative or Renewable Energy, being implemented through the AEDB;
- Utilize the potential of wind capacity identified by the AEDB at the Jhimpir Wind Corridor and absorb the transferred technology of wind power generation to reduce the emission of Greenhouse gases including CO_2 in Pakistan through net energy gain, and
- Utilize the hitherto unexploited wind energy potential which is the resource that will help bridging the gap in supply and demand of energy being faced in Pakistan.

1.4 Need for the Project

1.4.1 Energy Overview

Electricity demand in Pakistan had already exceeded supply in the year 2002. Despite the unsustainable growth in GDP, it was estimated that the generating capacity will have to escalate by 50 percent by 2010 in order to meet the expected demand. Rising oil consumption and leveling off in oil production together with inadequate refining capacity has left Pakistan (a) with shortfall of over 3500 MW in its theoretically maximum capacity of 17,793 MW, and (b) heavily dependent on petroleum product imports from Middle East.

Natural gas accounts for the largest share of Pakistan's energy use, amounting to about 50 percent of total energy consumption. With depleting reserves of both oil and gas, Pakistan is set to import natural gas. Pakistan currently consumes all of its domestic oil and natural gas production.

A number of technical and non-technical; operational and management constraints e.g. rise in oil price entailing high cost of power production; technical faults in grids; inadequate water storage in reservoirs; unforeseen drastic reduction in Chenab river water flow after the commissioning of Baglihar Dam, have compounded the deficiency into energy crisis and the capacity is not achieved.

Pakistan has remained an energy deficit country, dependent upon imports, mostly oil and oil products. Pakistan has had more success in finding natural gas than oil, and as a result, gas over took oil as the largest source of primary energy supplies, as shown in Figure 1.2.

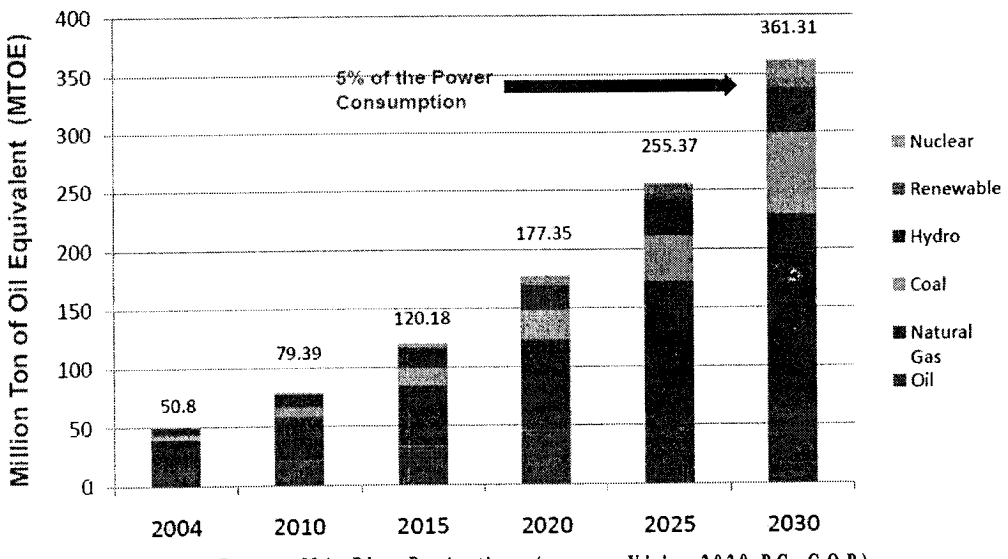


Figure 1.2: Energy Mix Plan Projections (source: Vision 2030-PC, GOP)

Pakistan has three sources of energy, namely Hydel, Thermal (gas/ steam/ furnace oil) and Nuclear.

There are four major power producers in country: WAPDA (Water & Power Development Authority), KESC (Karachi Electric Supply Company), IPPs (Independent Power Producers) and PAEC (Pakistan Atomic Energy Commission).

The break-up of the installed capacity of each of these power producers (as of June-2008) is as follows:

WAPDA Hydel
Tarbela 3478 MW
Mangla 1000 MW
Ghazi – Barotha 1450 MW
Warsak 243 MW
Chashma 184 MW
Dargai 20 MW
Rasul 22 MW
Shadi-Waal 18 MW
Nandipur 14 MW
Kurram Garhi 4 MW
Renala 1 MW
Chitral 1 MW
Jagran (AK) 30 MW

Total Hydel ==> 6,461 MW

WAPDA Thermal
Gas Turbine Power Station, Shahdra 59 MW
Steam Power Station, Faisalabad 132 MW
Gas Turbine Power Station, Faisalabad 244 MW
Gas Power Station, Multan 195 MW
Thermal Power Station, Muzaffargarh 1350 MW
Thermal Power Station, Guddu 1655 MW
Gas Turbine Power Station, Kotri 174 MW
Thermal Power Station, Jamshoro 850 MW
Thermal Power Station, Larkana 150 MW
Thermal Power Station, Quetta 35 MW
Gas Turbine Power Station, Panjgur 39 MW
Thermal Power Station, Pasni 17 MW

Total Thermal ==> 4811 MW

WAPDA's Total Hydel + Thermal capacity is ==> 11,272 MW

KARACHI ELECTRIC SUPPLY COMPANY (KESC)
Thermal Power Station, Korangi 316 MW
Gas Turbine Power Station, Korangi 80 MW
Gas Turbine Power Station, SITE 100 MW
Thermal Power Station, Bin Qasim 1260 MW

Total (KESC) ==> 1756 MW

INDEPENDENT POWER PRODUCERS (IPPs)
Hub Power Project 1292 MW
AES Lalpir Ltd, Mahmood Kot Muzaffargar 362 MW
AES Pak Gen, Mahmood Kot Muzaffargar 365 MW

Altern Energy Ltd, Attock 29 MW
Fauji Kabirwala Power Company, Khanewal 157 MW
Gul Ahmad Energy Ltd, Korangi 136 MW
Habibullah Coastal Power Limited 140 MW
Japan Power Generation, Lahore 120 MW
Kohenoor Energy Limited, Lahore 131 MW
Liberty Power Limited, Ghotki 232 MW
Rousch Power, Khanewal 412 MW
Saba Power Company, Sheikhupura 114 MW
Southern Electric Power Company Limited, Raiwind 135 MW
Tapal Energy Limited, Karachi 126 MW
Uch Power Limited, Dera Murad Jamali, Nasirabad 586 MW
Attock Gen Limited, Morgah Rawalpindi 165 MW
Atlas Power, Sheikhupura 225 MW
Engro Energy Limited, Karachi — - MW
Kot Addu Power Company Limited (Privatized) 1638 MW

Total (IPPs) ===> 6365 MW

PAKISTAN ATOMIC ENERGY COMMISSION
KANUPP 137 MW
CHASNUPP-1 325 MW

Total (Nuclear) ===> 462 MW

Hydel electricity generated by WAPDA varies between two extremities, i.e., between minimum of 2,414 MW and maximum of 6,761 MW depending upon the river flow.

Total Power Generation Capacity of Pakistan (including all sources) is **19,855 MW** and the electricity demand (as of April 2010) is 14,500 MW and PEPCO is merely generating 10,000 MW.

The Power generation companies are not buying furnace oil from PSO by saying they don't have money to do that but Pakistanis are all paying for electricity that is generated from furnace oil.

This is the reason that top refineries like PRL are operating at 40% of their capacities.

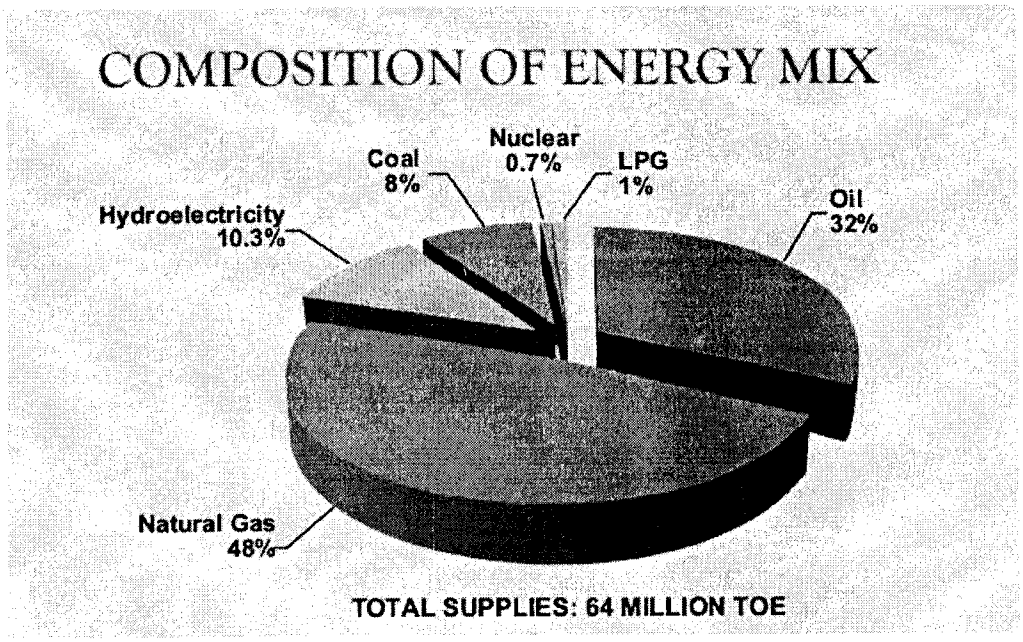


Figure 1.3: Electrical Power Generation Capacity and Power Demand in Pakistan

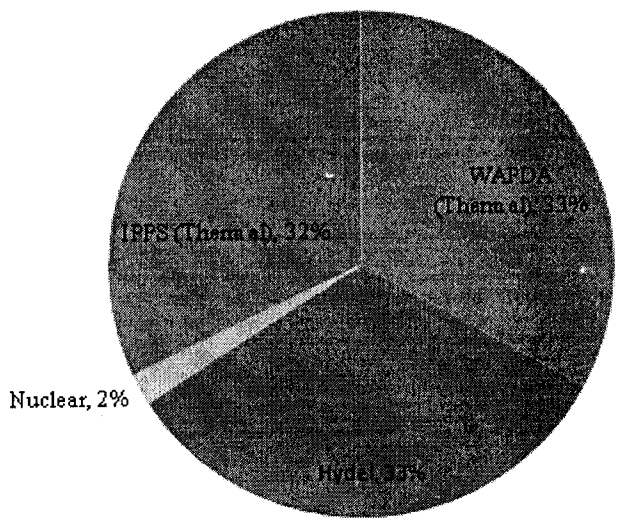


Figure1.4: Electrical Power Generation Capacity

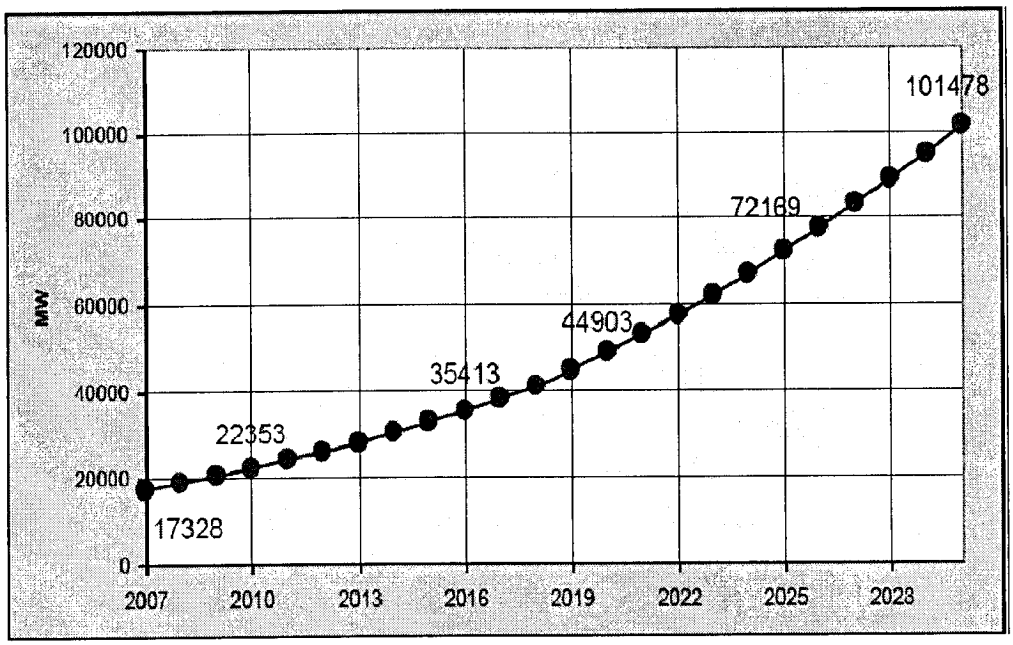


Figure 1.5: Electric Power Demand (2005-2025) Pakistan

1.4.2 Global Energy Supply Scenario/Global Demand Forecast

Wind and solar power-generation system combined will, by the year 2025, match conventional generation systems. Wind power generation capacity will reach 7,500GW by 2025; Conventional power stations will be phased out completely by 2037; Demand for energy supply is expected to rise by 50 per cent globally by 2030; Low-carbon energy industry is set to be worth $3 trillion per year by 2050.

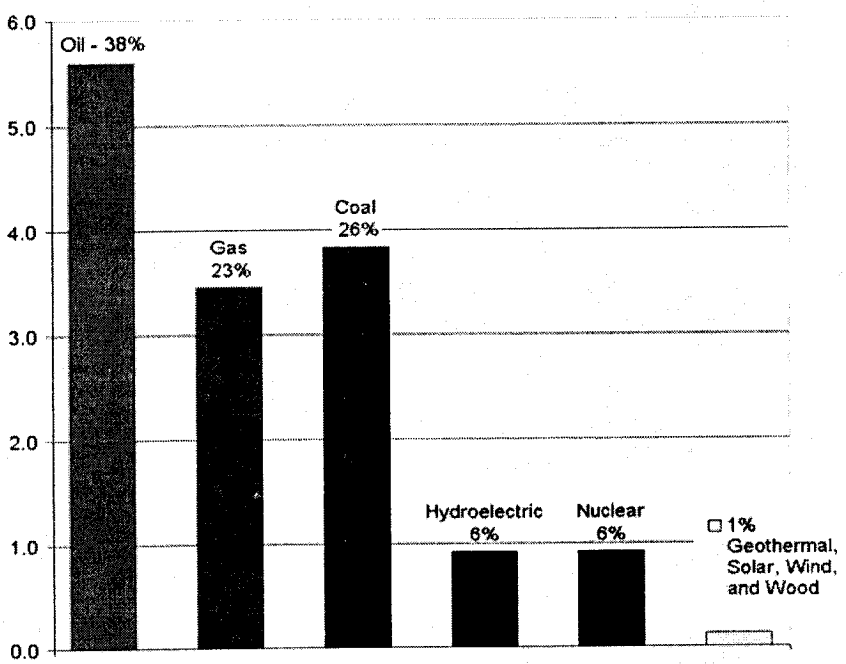


Figure 1.6: Worldwide Energy Supply in Terawatts TW

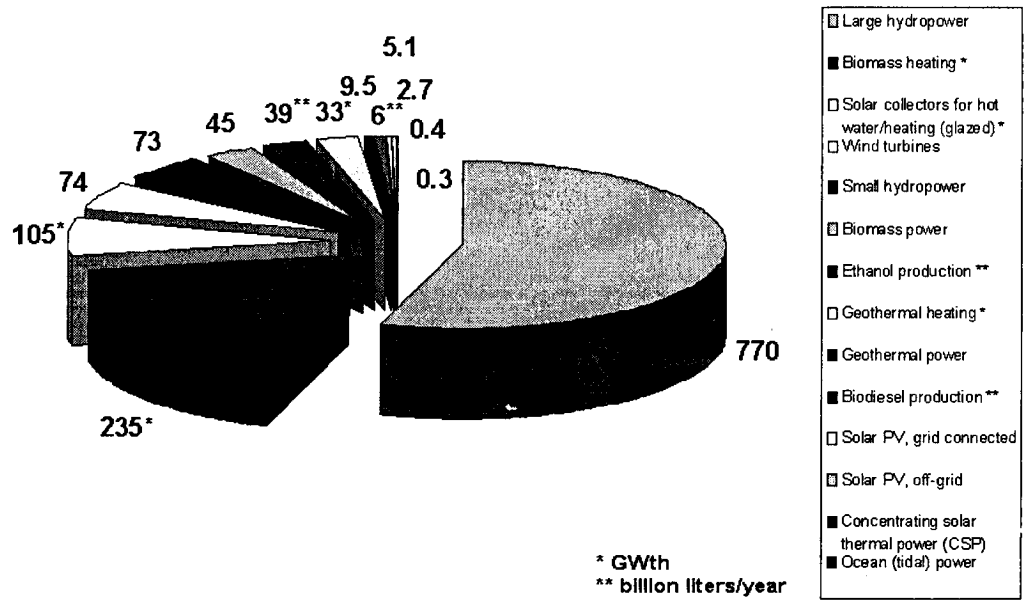


Figure 1.7: Renewable Energy, End of 2006 (GW)

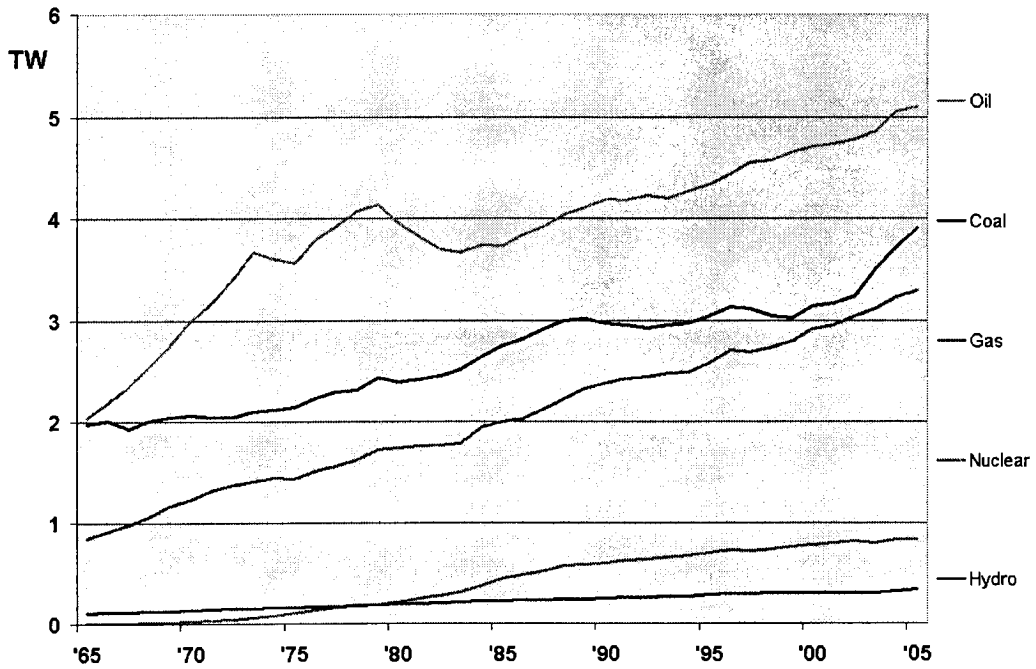


Figure 1.8: Rate of World Energy Usage in Terawatts (TW), 1965-2005

1.4.3 Potential of Alternative Energy

The following are the alternative renewable energy sources that are renewable and do not deplete:

Solar Influence Dependent

1. Solar radiation

2. Biomass
3. Wind
4. Ocean wave energy

Earth-related

1. Tidal Energy due to earth's rotation
2. Geo-thermal energy due to heat of earth's interior.

For environmental and commercial reasons, the answer lies in harnessing Solar and wind energy potential both of which have immense in Pakistan. Solar energy is, however, yet to mature as a viable alternative even in the industrialized countries. On the other hand there has been a steady rise in the installed capacity of wind power production systems. The global rise in wind power production is shown in the following figures:

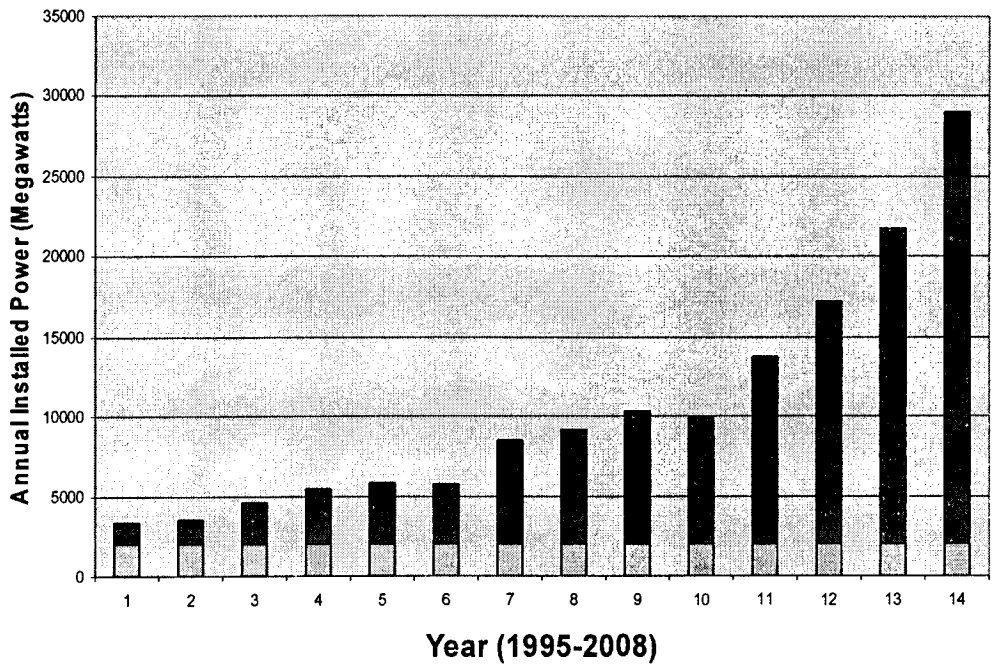


Figure 1.9: Wind Power Installations (1995-2008)

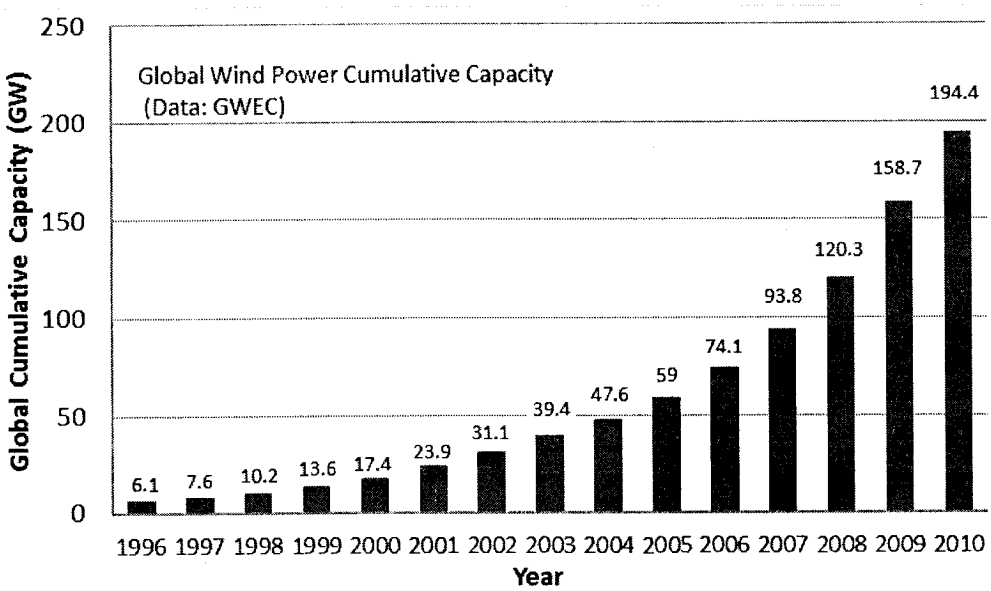


Figure 1.10: Global Wind Power Cumulative Capacity.

The total amount of economically extractable wind power is considerably more than present use from all sources. At the end of 2010, worldwide nameplate capacity of wind-powered generators was 197 Giga watts (GW). Wind power now has the capacity to generate 430 TWh annually, which is about 2.5% of worldwide electricity usage. Over the past five years the average annual growth in new installations has been 27.6 percent. Wind power market penetration is expected to reach 3.35 percent by 2013 and 8 percent by 2018. Several countries have already achieved relatively high levels of wind power penetration, such as 21% of stationary electricity production in Denmark, 18% in Portugal, 16% in Spain, 14% in Ireland and 9% in Germany in 2010. As of 2011, 83 countries around the world are using wind power on a commercial basis.

A large wind farm may consist of several hundred individual wind turbines which are connected to the electric power transmission network. Offshore wind power can harness the better wind speeds that are available offshore compared to on land, so contribution of offshore wind power in terms of electricity supplied is higher. Small onshore wind facilities are used to provide electricity to isolated locations and utility companies increasingly buy back surplus electricity produced by small domestic wind turbines. Although a variable source of power, the intermittency of wind seldom creates problems when using wind power to supply up to 20% of total electricity demand, but as the proportion rises, increased costs, a need to use storage such as pumped – storage hydroelectricity, upgrade the grid, or a lowered ability to supplant conventional production may occur. Power management techniques such as excess capacity, storage, dispatchable backing supply (usually natural gas), exporting and importing power to neighboring areas or reducing demand when wind production is low, can mitigate these problems.

Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, and uses little land. In operation, the overall cost per unit of energy produced is similar to the cost for new coal and natural gas installations. The construction of wind farms is not universally welcomed, but any effects on the environment from wind power are generally much less problematic than those of any other power source.

Germany has taken a lead in this connection and has been supported by Europe and many states in USA besides Canada in successfully generating clean and cheap wind energy. China and India have followed suit with considerable success, knowing fully well the growing demand and increasing limitations of relying on power generation technologies dependent on petroleum oil and water. Malaysia and Indonesia have also realized this potential, given their vast coastal areas.

Geographically, Pakistan is ideally placed in the tropics and has a number of wind corridors. According to estimates based on the survey by the Pakistan Meteorological Department, tremendous potential of about 43,000 MW exists for generating wind energy in the 9,700 km^2 area in (i) Jamshoro, Nooriabad, Talhar and Keti Bandar corridor, and (ii) Thatta, Thana Bola Khan, Hyderabad and Gharo sites that are placed respectively in the excellent category and good category for generation of wind power. The TEPPL site, according to data available with EMC Associates is placed in the Jhimpir corridor and considered one of the best sites for wind power generation.

1.5 Benefits Of Wind Farm Development

Significant environmental benefits can be gained by installing a wind farm, for example:

1.5.1 Carbon Dioxide & GHG Emissions and Pollution

The most serious threat comes from accelerating climate change, whose effects are already being seen around the world in rising temperatures, melting ice caps and volatile weather patterns. Climate change is a direct result of the greenhouse effect – the build-up of greenhouse gases in the atmosphere above the earth. Carbon dioxide emissions from power plants, industry and the transport sector are by far the largest contributor. The Intergovernmental Panel on Climate Change has predicted that human-induced greenhouse gas emissions will lead to a substantial increase in global mean temperatures, which will rise between 1.4 and 5.8 degrees over the course of this century.

- Wind power generation does not require fuel for turbine operation, and has no emissions directly related to electricity production. As such operation of wind turbines does not produce CO_2, SO_2, NOx or particulate matter or any other form of air pollutant. The manufacturing, transportation, construction at site and installation, however, does consume resources and it is here that energy-intensive processes, generally using fossil fuel are involved.
- The following indicative figures relate to a 9 MW installed capacity and the production of 1 kg of CO_2 for the generation of each 1 kWh of electricity:
- CO_2 (a major contributor to the "greenhouse effect") 27,900 tons/year.
- SO_2 (Sulphur Dioxide is a constituent of acid rain) 427.5 tons/year.
- NOx (Nitrous Oxides are a constituent of acid rain) 207 tons/year.
- Producing energy from the proposed wind farm will prevent these emissions being produced elsewhere in Pakistan, thus helping the GOP's environmental initiatives.
- Developing a renewable energy resource will lessen the need to use fossil fuels such as coal. This conforms with the keenness of GOP to increase the share of renewable energy in electricity production, and its commitments to Kyoto Protocol. Reduction in the gas emissions from fossil fuel generation will be achieved, although the amount obviously depends on the wind farm installed capacity.

1.5.2 Net Energy Gain

The energy return on investment (EROI) for wind energy is equal to the cumulative electricity generated divided by the cumulative primary energy required to build and maintain a turbine.

The EROI for wind ranges from 5 to 35, with an average of around 18. EROI is strongly proportional to turbine size, and larger late-generation turbines are at the high end of this range, at or above 35. This suggests that higher capacity wind turbines are likely to bring better EORI and also better return on investment.

It may be noted that since energy produced by a WTG is several times the energy consumed in construction, there is a net energy gain. It is estimated that reductions in CO_2 emissions range from 0.33 to 0.59 tons of CO_2 per MWh. The energy used for construction is produced by the wind turbine within a few months of operation. Thus the initial carbon dioxide emissions are paid back within about 9 months of operation.

1.5.3 Benefits of Establishment of the wind power generation system

Benefits of establishment of wind power generation system include:

- Reduction in carbon dioxide and other greenhouse gas emission through net energy gain
- Benefit to Alternative Energy Development Board in achieving the objectives of the Government of Pakistan Policy and Guidelines on development and generation of Alternative or Renewable Energy for Power Generation-2006 to involve the private sector in generation of power through renewable resources.
- Benefit to National electricity production system in making renewable energy available to the National Grid of the WAPDA, the main stakeholder.
- Reduction in vulnerability to volatile utility prices.
- Contribution to enhancement in quality of environment of the hinterland of the Wind Corridor and restoration of the status of the area as the major user of wind power by producing sustainable form of energy.
- Contribution to enhancement in quality of life of the people resident in the area that has lost its water, surface soil, vegetative cover, besides the fauna as well as flora and is left with meager resources of its own, except the wind that has the desired velocity that can be utilized for power generation.

In view of the limitations on national reserves of oil and gas besides the unpredictable flow of water to meet the energy demands, and in consideration of the urgent need to normalize the commercial, industrial and agricultural activities, it is considered essential to broaden the outlook on the energy mix and besides exploring indigenous sources that are renewable as well as non-renewable, also increase the share of the renewable sources as alternative to petroleum oil and gas that is presently the main (83.8%) source of fuel.

In consideration of the shortfall in the conventional energy resources the GOP had taken the initiative to establish the Alternative Energy Development Board (AEDB) and to establish Wind Power production systems as one of the alternative renewable sources. The Gharo wind Corridor was identified to harness the potential of this renewable source and thus to meet the rapidly growing demand of the industries, commercial organizations and the urban housing sector.

1.6 Scope of IEE Study

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

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

- Any major adverse impact on the environment (physical, ecological and social) during different phases of projects viz. siting, design, construction and operation are identified.
- Adverse impacts are appropriately addressed and adequate mitigation measures are incorporated in the siting, design, construction and operation phases of project.
- Socioeconomic aspects are identified, and mitigated.
- Alternatives to achieve the objectives are analyzed.
- Environmental Management Plan (EMP) for sustainable development and operation of the project is developed for implementation and monitoring of the project activities.

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

1.7 Basis of Project Categorization for Environmental Assessment

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

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

Schedule I categorizes those projects which are small scale projects or which have narrow range of environmental impacts pertaining to these activities. Schedule II includes projects which are expected to impose severe environmental impacts and need thorough evaluation prior to commencement of project activities.

On the basis of the nature and scope of project, the Titan 9MW Wind Farm Project as accordingly been categorized into Schedule-I. An IEE study was conducted for the project in this respect and the IEE report was subsequently prepared to document the findings of the assessment.

1.7.1 Methodology for Environmental Assessment Study

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

1.7.2 Methodology Adopted for Social Aspects

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

- Identifying the need, if any, for involuntary resettlement and for land acquisition and to prepare an appropriate Involuntary Resettlement Program.
- Reducing the impact on the living environment during the construction period, selecting appropriate construction methods and construction schedule.

This IEE report presents the existing environmental scenario and the results from the assessment and evaluation of the environmental aspects emerging during the installation and operation phases of wind turbines. Following screening of potential environmental aspects, the assessed and evaluated impacts requiring necessary mitigation measures are suggested in the report. The report also includes the Environmental Management and Monitoring Program that will be implemented during siting, construction and operation phases.

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

1.7.3 Project Specific Data Collection

The foremost step was to get the maximum information on physical aspects of the project, as well as construction and operation activities from the proponent.

The next step involved visits by the environmental assessment team comprising group of experts to the project area and its vicinity to conduct reconnaissance survey and to collect baseline data in the context to environmental (physical and ecological) and social aspects.

The survey included a focused group discussion with locals as part of information disclosure and public consultation. Detailed data collection Surveys on physical, biological and social aspects of the project area and its surroundings. This included:

- Wildlife and Birdlife Survey.
- Detailed socioeconomic survey of the project area.
- Literature Review/Baseline.
- All possible archives and published literature was surveyed along with previous IEE/EIA studies conducted in the region.

- Legislative requirements and regulatory requirements pertaining to the project were also reviewed. These included:
- Environmental Regulations, Standards & Guidelines.
- Environmental issues concerning protection and control governed by Pakistan Environmental Protection Act (PEPA) 1997.
- Legal Requirements in Pakistan for Environmental Assessment for New Projects under the Environmental Protection Agency Sindh (SEPA);
- National Environmental Quality Standards (NEQS) for gaseous, vehicular exhaust emissions; noise emissions, and liquid effluents;
- Sindh Wildlife Protection Ordinance 1972;
- Antiquities Act 1975;
- Forest Act, 1927;
- Civil Aviation Rules (1994)
- Biodiversity Action Plan;
- PEPA Guidelines for Public Consultation;
- PEPA Guidelines for Sensitive and Critical Areas;
- Policy for Development of Renewable Energy for Power Generation, 2006, Government of Pakistan;
- World Bank Guidelines on Environmental Assessment;
- IFC's EHS Guidelines for Wind Energy;
- IFC's EHS Guidelines for Electrical Power Transmission and Distribution;
- ADB Guidelines for Environmental Assessment;
- JICA Guidelines for Environmental Assessment;
- Equator Principles;
- Low Frequency Noise and Wind Turbine; British Wind Energy Association, February 2005.
- Impact Identification and Assessment.
- On acquisition of baseline information the environmental aspects were identified (screened) for different activities at the project siting, design, construction and operation phases.
- Subsequently the quantification of the impacts in terms of magnitude and significance was evaluated.
- In order to reduce the adverse impacts of the project mitigation measures were proposed to minimize the impacts and to sustain the project in an environment friendly manner.
- Environmental Management and Monitoring Plan was compiled and included in the environmental assessment report to make it more comprehensive and self-sustaining with the specific purpose of providing working guidelines for the project Proponent and Management personnel who shall be responsible for the construction and operations of the project, so as to enable them to maintain the environmental and social conditions in conformity with the PEPA regulations. The management plan outlines the details required to manage environmental, safety and community risks arising from the project activities as well as social issues. It also gives the details of monitoring that would be required during the operation phase of the project in order to comply with the requirements of sustainable development.

1.7.4 Preparation of Report

This IEE report has been prepared in accordance with the guidelines of the Pakistan Environmental Protection Agency (PEPA), World Bank and IFC. All pre-requisites of report writing in structural format, contents and presentation have been considered and met as per the standard format of the IEE document.

1.8 Structure of IEE Report

The IEE report has been structured on the standard format, prescribed by the Federal EPA. The Report has been presented in the following sections:

Section 1 - Introduction

Section 2 - Description of Project

Section 3 - Legal Requirements

Section 4 - Environmental and Social Baseline

Section 5 - Screening of Potential Environmental Impacts and Mitigation Measures

Section 6 - Public Consultation and Information Disclosure

Section 7 - Environmental Management Plan (EMP)

Section 8 - Findings and Recommendations

Section 9 - Conclusion

1.9 IEE Study Team

This IEE study has been conducted by a team of EMC environmental experts. Valuable input was made by each team member who contributed in compilation of this report. Names and designation / role of the project team members are given as follows:

Table 1.2: IEE Study Team

S. No.	Name	Position
1	Syed Nadeem Arif	Project Manager
2	Mr. Saquib Ejaz Hussain	Team Leader /ESIA Specialist
3	Dr. Mirza Arshad Ali Beg	Senior Environmentalist
4	Dr. Iqbal H. Hashmi	Water Quality Expert
5	Dr. Badar Munir Ghauri	Air & Noise Quality Expert
6	Dr. Syed Ali Ghalib	Expert on Fauna
7	Dr. Syed Asad Ghufran	Expert on Flora
8	Ms. Farhat Shaheen	Environmental Scientist
9	Nida Kanwal	Sociologist

2.0 Description of Project

2.1 The Project

Titan Energy Wind Power Project will be established over 68-02 acres of a land site in Jhimpir Wind Corridor in Taluka and District Thatta in Sindh Province. The Project comprises development, ownership and operation of 1.5 x 6 MW Wind Farm. The development will be in accordance with GoP's policy and guidelines on development and generation of Alternative or Renewable Energy, being implemented through the Alternative Energy Development Board (AEDB). Titan Energy Pakistan (Pvt.) Ltd will soon install masts for recording the meteorological data at their site.

The National Transmission and Dispatch Company (NTDC), which is responsible for transmission and distribution of electricity in the country, will purchase the power generated by TEPPL.

There is no population within 10km radius of the proposed wind farm site. The site is connected to both the ports via National Highway; hence the turbines can easily be transported to the site from both the ports through superhighway.

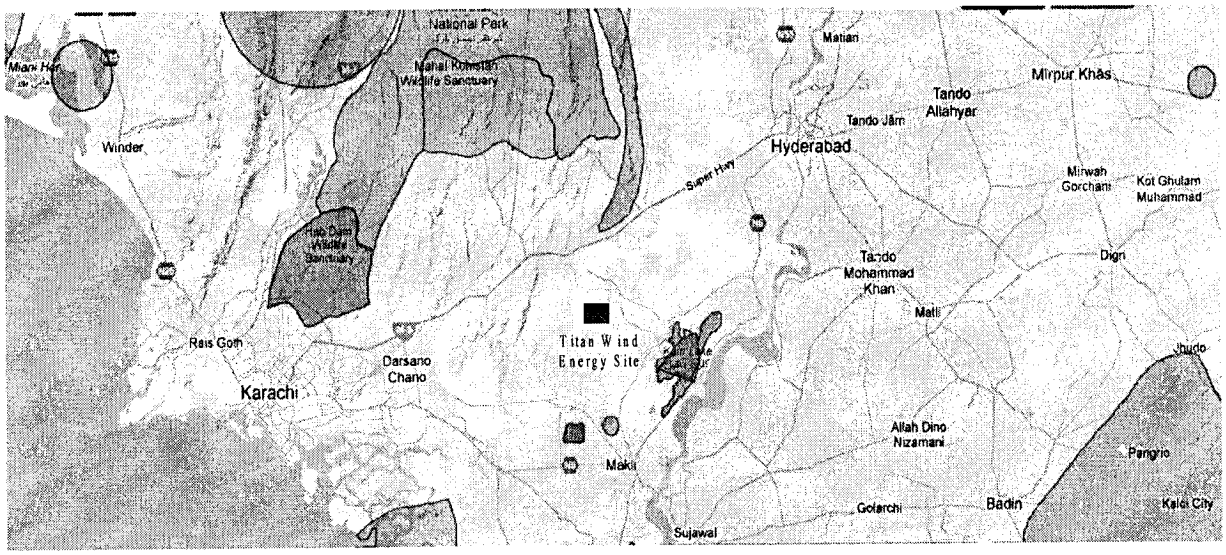


Figure 2.1: Site location

2.2 Project overview

The proposed 9MW capacity Titan Energy Wind Power Project involves erection of 6 sets of 1.5MW WTGs, with a total installed capacity of 9.0MW (1500kW ×6). The hub height is 80m and the runner diameter is 82m. The civil works of the wind farm includes the foundation of WTGS, foundation of box-type transformers, erection platform, power collection route and access roads construction (expansion) in the wind farm. Site for the wind farm is owned by the proponent and is approximately 10km away from Saduro. Site location is ideal for the wind farm and holds excellent power generating capacity through wind. Project details are presented in Table 2.1 below.

The work scope of the project is limited to the WTGs and the work interface is at the exit of the WTG box-type transformer which connects to the grid. The power transmission line works and other parts shall be completed by the Project Owner and the local grid.

The WTGS and the box-type transformers should be designed against 1-in-50-year floods scenario. Of the WTGS for the wind farm, the unit capacity is 1500kW (1.5MW), the hub height is 80m and the rotor diameter is 82m. According to the Code for Design of High-rise Structures, the safety grade of the wind farm is of Grade II.

Table 2.1: General Information of the Project	
Total Capacity[MW]	9
Number of Turbines	6
Turbine Model	SL1500/HH80
Gross Output [MWh/yr]	37325.12
Wake Loss	0.65
Losses [%]	9.63
Other Losses	33511.46
Net Output [MWh/yr]	42.51
Net Capacity Factor [%]	42.51

Table 2.2 Lower Confidence Limits on Net Energy Production			
Probability of Exceedence (%)	1-Year Energy (MWh/yr)	10-year Energy (MWh/yr)	20-Year Energy (MWh/yr)
50	33511	33511	33511
75	30114	30963	31019
90	27055	28669	28774

2.3 Project Components

Scope of the project includes;

- Site feasibility study
- Analysis of projected energy yield from the wind farm
- Land Acquisition for the wind farm
- Import and transport of turbine components to the site
- Surfacing of the site for turbine foundations
- Turbine installations
- Grid connections
- Local maintenance of wind farm and turbine operations

2.4 Terrain feasibility

The terrain is rough hard stone with sporadic vegetation like wild grass etc. The land is generally flat, terrain conditions can be classified as normal; there are no sharp edges the surface is generally plain, somewhere modestly hilly. There is a seasonal rain drain in the area which is charged during monsoon season.

2.5 Soil Condition

The ground and soil conditions are very stable as far as for turbine foundations and crane pads are concern. The bearing capacity is high and stable. The exact statistics will be acquired after geo-technical study of the area.

Wind turbine foundations are typically reinforced concrete blocks or cylinders. The most cost effective designs typically require excavations 10-15 m (33-49 ft.) deep. The projects require roads and equipment pads sufficient to get the turbines to the sites and accommodate the cranes required to install the turbines. Soils that are not readily excavated or graded can significantly increase project costs. An additional consideration when examining site soil conditions is erosion.

2.6 Wind Data Acquisition

Wind data acquired from FFC meteorological mast is hereby provided and referred to as the baseline. The basic information is presented in Table 2.3.

Table 2.3: Mast Details

Name	FFC
Location	395866E 2772672N (UTM WGS84, ZONE42)
Altitude(m)	40
Height(m)	80
Anemometer Sensor height (m)	10/30/60/80
Vane Sensor height (m)	78.5/28.5
Temperature Sensor height (m)	80/5
Measurement Period	28-05-2007 to 02-06-2011

2.7 Grid Connection

The output voltage of the WTGs is 690V, which is boosted to 11kV via the 0.69/11kV box-type transformer. A combined unit is composed of 3 circuits of outgoing lines from the WTGs to the box-type transformers and the converged electricity is then transmitted through 11kV collection lines to the local grid line and there are 2 units of 11kV collection cable lines from wind farm to the local grid substation. Finally, the electricity is sent to the power system.

Power generated from the wind farm will be supplied to the 132 KVA grid network of Jhimpir. The output voltage of the WTGs is 690V, which is boosted to 11kV via the 0.69/11kV box-type transformer. The 1125 kW active power is provided by the stator and 375 kW by the rotor at max rotational speed and full power.

2.8 Wind Resource Analysis and Estimated Energy Output

Pakistan has a considerable potential of wind energy in the coastal belt of Sindh, Baluchistan and in the desert areas of Punjab and Sindh. However, this renewable source of energy has not been utilized significantly so far. As per the collected data from Pakistan Metrological Department, the coastal belt of Pakistan is blessed with a God gifted wind corridor. This corridor has the exploitable potential of 50,000 MW of electricity generation through wind energy.

Sinovel (wind turbine manufacturer in China) has performed wind energy assessment for TITAN wind farm with 9MW planned capacity. Based on the data, the design of the 9 MW wind farm with 6 wind turbines of SL1500/82/HH80 and the energy output considering the wake loss and other losses was calculated. The wake loss and other losses are 0.65% and 9.63% respectively. The net energy of the whole wind farm is 33511.46 MWh/yr.

2.8.1 Data Validation

Wind data from FFC mast installed near the Titan 9MW wind farm site was used for wind resource assessment of the project. Wind data from the meteorological mast was obtained from 28-05-2007 till 30-04-2010. Daily wind data including average (Ave), maximum (Max), minimum (Min) and standard deviation (SD) is collected in a 10-min interval. Data recovery rates indicating the percent of valid data records are presented by year in Table 2.4. From the table it can be seen that the data availabilities of all the years are above 90%, so the wind data is good enough to be used for wind resource analysis.

Table 2.4: Overall Valid Data Recovery of Mast FFC at 80m Height

Year	Possible Records	Valid Records	Recovery Rate (%)
2007	31265	28751	91.96
2008	52704	48010	91.09
2009	52560	47904	91.14
2010	17281	17281	100.00
Overall	153810	141946	92.29

2.8.2 Wind Characteristics

Wind potential of different areas is usually characterized by assigning one of the seven wind classes, each corresponding to range of wind speed and power density at specific height above the ground. Standard wind class definitions are shown in Table 2.5.

Table 2.5: Standard Wind Class Definition

Class	30 m Height		50 m Height	
	Speed m/s	Power W/m^2	Speed m/s	Power W/m^2
1	0 - 5.1	0 -160	0 – 5.6	0 – 200
2	5.1 – 5.9	160 - 240	5.6 – 6.4	200 – 300
3	5.9 –6.5	240 - 320	6.4 –7.0	300 – 400
4	6.5 – 7.0	320 - 400	7.0 – 7.5	400 – 500
5	7.0 – 7.4	400 – 480	7.5 - 8.0	500 – 600
6	7.4 – 8.2	480 – 640	8.0 – 8.8	600 – 800
7	8.2 – 11.0	640 - 1600	8.8 – 11.9	800 – 2000

The following figures show that by international wind classification, power density places the locations e.g. Jamshoro, Nooriabad, Talhar and Keti Bandar sites in the *excellent* category, while Thatta, Thana Bola Khan, Hyderabad and Gharo are placed in the category of *good* sites for generation of wind power.

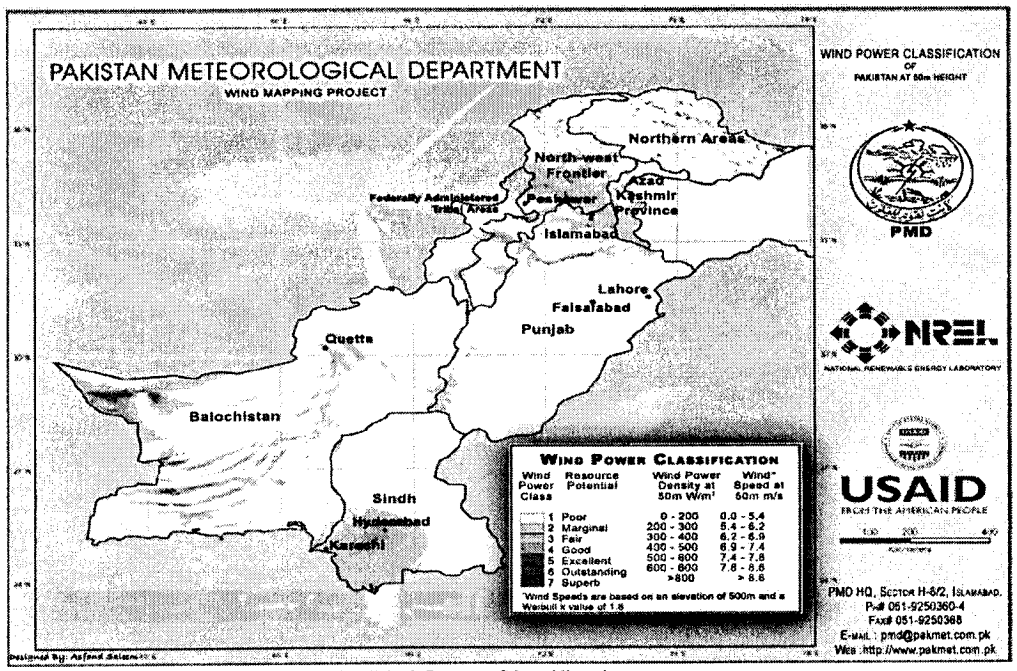


Figure 2.2: Wind Power Classification

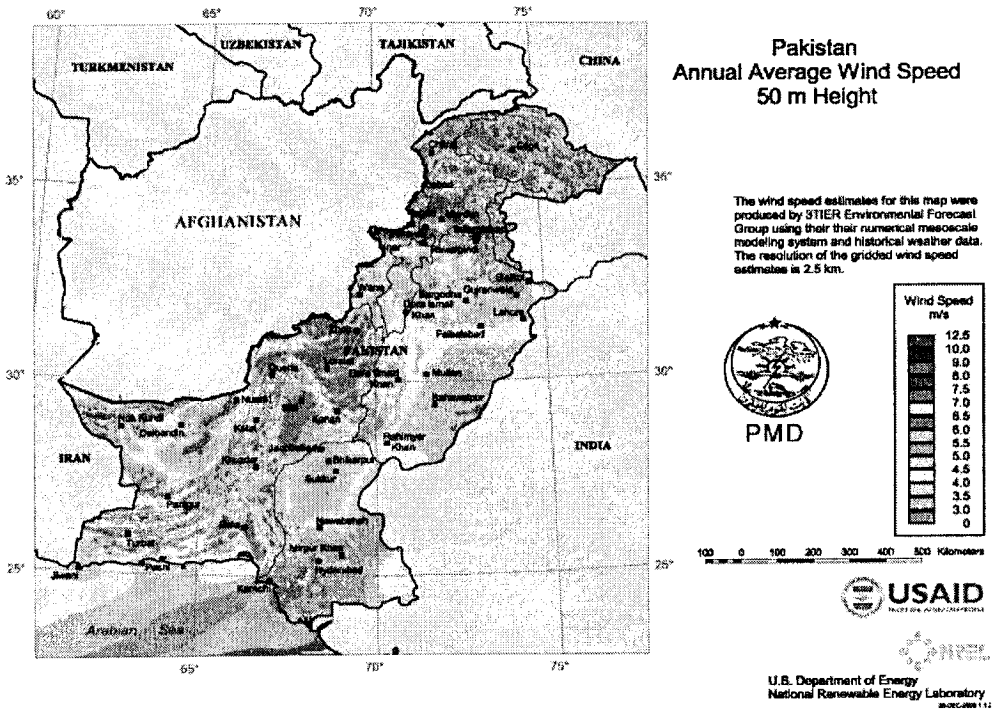


Figure 2.3: Annual Average Wind Speed at 50 m Height in Pakistan

2.8.3 Site Feasibility for establishment of wind farm

Site for the 9MW wind farm was selected after careful consideration of a number of factors most important being the wind regime and terrain features. Screening suitable land for the wind power project eliminated sites where wind turbines either cannot or should not be installed. The screening was based on considerations including:

- National parks or airports or other areas officially protected from development
- Migration routes of migratory bird species

- Areas with high concentrations of rare or endangered birds
- Urban areas
- Some military areas
- Highly culturally sensitive areas (e.g., religious, historic, or archeological sites)

Table 2.6: Projected Energy Yield of the 9MW Wind farm
Power curve at the density 1.225 kg/m^3

Wind speed [m/s]	Power(kW)	Wind speed [m/s]	Power(kW)
3	3.9951059	12	1500
3.5	15.406999	12.5	1500
4	46.561256	13	1500
4.5	95.728628	13.5	1500
5	149.37969	14	1500
5.5	218.10323	14.5	1500
6	295.031	15	1500
6.5	381.404	15.5	1500
7	482.685	16	1500
7.5	600.193	16.5	1500
8	736.01	17	1500
8.5	882.016	17.5	1500
9	1033.26	18	1500
9.5	1177.88	18.5	1500
10	1316.13	19	1500
10.5	1403.81	19.5	1500
11	1455.89	20	1500
11.5	1485.67		

2.9 Design Basis and Standard

Design basis and standards to be used for the proposed wind power project are given below;

- Classification and Design Safety Standard of Wind Power Projects (FD002-2007), IEC61400 part 1 : safety requirements ;
- Technical specification of wind power plant design ;
- Design Regulations on Sub-grade and Foundation of Wind Turbine Generator System ;
- Code for design of concrete structures
- Code for Seismic Design of Buildings
- Technical Code for Building Pile Foundations
- Design Rules for Cranes
- And other relevant laws, regulations, code and specifications as well.

2.10 Wind Turbine Specification

Titan Energy Pakistan (Pvt.) Ltd. will be commissioning six wind turbines in the proposed wind farm to generate 9MW of power through wind. The chosen turbines are manufactured by Sinovel and are rated to produce 1.5MW power per turbine.

2.10.1 Manufacturer

Wind turbines for the 9MW Wind Power Project will be manufactured by Sinovel Wind Group Co. Ltd. which is a well-reputed firm in the global wind energy sector. Sinovel has achieved the Lloyd's certificate for its SL1500 model and the same model will be installed at the

windfarm. SL1500 is by now, the most advanced technical representation of a wind turbine throughout the world.

2.10.2 Technical Details

SL1500 is a three bladed, horizontal-shaft wind energy converter (WEC) by adopting variable speed, pitch control, active yaw system and double fed generating technology, which is especially developed for utilizing inland wind energy in high efficiency. The rotation speed is variable and the wind turbine can operate in best efficiency as the wind speed varying from 3.0m/s to 12m/s. It will achieve the 1500kW rated power at 12m/s and keep constant power output from 12m/s to 20.0m/s.

For achieving a constant power output at different wind speed and wind direction, SL1500 can one side adjust the respective blade, the other side yaw the nacelle according to wind direction.

The 1500kW WTGS has its hub height of 80m and runner diameter of 82m. According to the data and information provided by the WTGS manufacturer, the load (standard value) of the WTGS (excluding the load safety factor, to the foundation ring top) in extra-ordinary operation mode is 391kN in horizontal, 2960kN in vertical and 31419kN in moment. Technical details of the turbines to be installed at the wind farm are given in Tables 2.7-2.17 below;

Table 2.7:Basic Information	
Type	SL1500/82
Rated Power	1500 kW
Rotor Diameter	82.9 m
Cut-In Wind Speed	3 m/s
Rated Wind Speed	12 m/s
Cut-Out Wind Speed (10min Average)	20 m/s
Survival Wind Speed (3s Max)	59.5 m/s
Survival Temperature	-20°C to +50 °C
Operating Temperature	-10 °C to +40 °C
Design Life	20 years

Table 2.8: Rotor	
Blade Material	GRP
Blade Quantity	3
Blade Length	40.25 m
Swept Area	5390.3 m2
Rotational Direction	Clockwise (front view)
Orientation	Upwind

Table 2.9: Gearbox	
Drive stage	3
Ratio	104.125
Lubricating method	Pressure lubricating

Table 2.10: Generator	
Type	Double-fed asynchronous generator
Rated Power	1520 kW
Rated Voltage	690 V
Rated Speed	1800 rpm
Speed Range	1000 to 2000 rpm
Power Factor	Capacitive 0.9 to Inductive 0.9
Insulation Level	H

Protection Level	IP54

Table 2.11: Grid Compliance	
Range of input/output frequency	50±2 Hz
Voltage	690 V±10%
Voltage asymmetry	5%

Table 2.12: Brake	
Brake system	Aerodynamic + Mechanical
Aerodynamic brakes	Full feathering
Mechanical brakes	Passive hydraulic

Table 2.13: Yaw System	
Type/Design	Active
Transmission Type	Sliding pad friction

Table 2.14: Control System	
Control Method	PLC and Remote Control
Lightning Protection	
Design Standard	IEC61400-24
Resistance of Earthing	≤4Ω

Table 2.15: Nacelle Cover	
Material	GRP
Tower	
Type	Conical Steel Tower

Table 2.16: Primary Material of Components		
component	material	performance
Main frame	Q345E-Z25	σs >275Mpa ;
hub	Spheroidal graphite QT400-18AL	σb>400Mpa; σ0.2 =250Mpa
Yaw pinion	42CrMo4	σ0.2 >650 Mpa;
Brake disk	Q345D	σs >295Mpa; σb>470Mpa;

Table 2.17: Design Standard technical data of Vibration	
location	Allowable design standards
Nacelle	GB/T 6404
Gearbox	GB/T 8543-1987 / GB/T 6404
High speed shaft/low speed shaft	DIN EN ISO 10680
Generator	GB/T 10068-2000 / GB/T 10069
Hub height (m)	80m
Weight of concrete iron(t)	32.8
Volume of concrete(m3)	310.8
strength of concrete	C25/C30

2.10.3 Pitch system

Pitch system installed with storage battery, protects the wind turbine when the grid power fails. The pitch system still can adjust the blades to protect the wind turbine when the grid power-fail. The storage battery is mounted in the nacelle, which is convenient for maintenance.

2.10.4 Generator System

A high performance Generating System will be installed at the wind farm. The wind power generating device consists of a double-fed induction generator, an encoder, etc. The generator can rotate in high efficiency by such electronic unit as IGBT, and the power factor can be adjusted from Capacitive 0.9 to Inductive 0.9. Heat windings are installed to prevent damage to the generator that could arise from humidity and fogging. In addition, PT100 sensors are integrated in the generator for temperature monitoring.

2.10.5 Varied speed, constant frequency and vector control

The technology of Variable speed and constant frequency greatly prolongs the durability of core components, prominently improves the generation quality and quantity and the capability of protection from grid-dropping. The WTGs performance can be enhanced by adopting following points;

- Vary rotational speed according to wind speed to make turbine run in high efficiency.
- Vary rotational speed to avoid the torque oscillating caused by instant wind variation and absorb the loading variation caused by gust or turbulence, which improves the longevity of core components and electricity quality.
- Control system adopts advanced CPU to control entire turbine and sampling, and achieve automatic control and remote supervision.

2.10.6 Electric-drive pitch control

Electric-drive pitch control has faster response and higher pitching precision. Three pitch systems are independent from each other, i.e. the turbine can be shut down safely even if one of the pitch systems malfunctions. There is no oil-leakage trouble and higher reliability and less maintenance will be ensured.

2.10.7 Sliding yaw system

Sliding pads are equipped between ring gear and main frame, ring gear and side bearing, which achieve the relative rotation between nacelle and tower. The sliding pad can provide a certain friction force so no need of hydraulic yaw brake.

2.10.8 Special compact structure of main shaft

The rotor shaft is integrated into the gearbox. Comparing with modular shaft design, this special scheme makes the center gravity of nacelle closer to the tower axis and greatly reduces the overturning moment on yaw system and tower foundation because of wind load and self-weight. It enhances the loading capability of the components and the whole turbine.

2.10.9 Brake system

Two independent brake systems: aerodynamic brake and mechanical brake. Any brake system can shut down the turbine under normal operating and emergency condition.

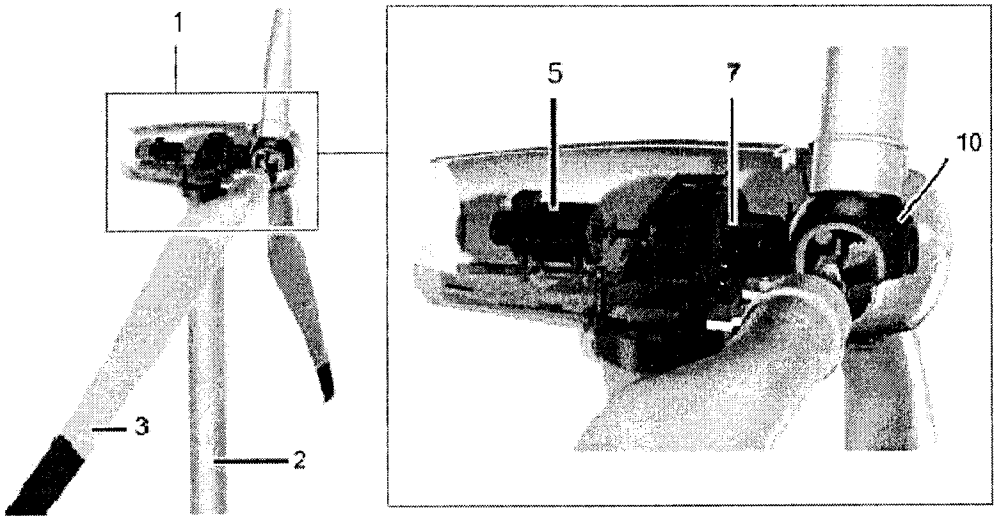


Figure 2.4: the layout of the whole machine 9
(1—nacelle ; 2—tower ; 3—blade ; 5—generator ; 7—gearbox ; 10—hub)

2.10.10 Salt-fog proof measures (antiseptic measures)

The design of SL1500 meets the requirements of the climatic conditions of a coastal: outside parts of turbine are designed according to ISO-12944 C5M ; inside parts are designed according to C4 level requirement. The electrical components are chosen according to the prevention standards; adopt the marine cables.

2.10.11 Safe shutdown measures

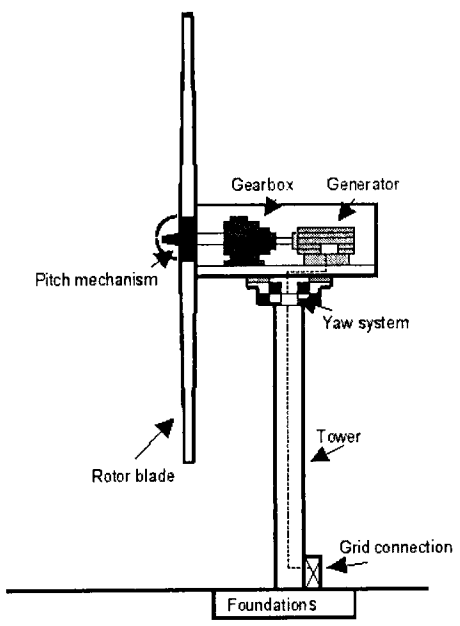
In order to guarantee the safety of coastal wind turbines during shutdown period, the blades keep moving and the brakes remain functional. The reliability of wind turbine in extreme wind condition has been ensured in the designing stage of the wind farm.

2.10.12 Measures to impede Vibration

Vibration of nacelle parts is avoided and improved effectively by providing dampers which are equipped between;

- The joints of gearbox and main frame,
- Under the generator base,
- Between the joints of the electric control cabinet and main frame,
- Nacelle cover and
- Main frame.

In addition, Cone couplings are utilized, which not only can transmit torque, but also can absorb the vertical and horizontal vibration. The natural frequencies of tower, nacelle and blades are different so resonance is avoided.



2.11 Component Description

A typical wind turbine includes mainly a rotor, gear box, generator, yaw system, pitch mechanism, tower,

rotor blade, grid connection and its foundation. Rotor part consists of blade, hub and pitch system.

2.11.1 Blade

Rotor diameter is 82m and length of a single blade is 40.25m. Aerodynamic airfoil and blade profile make the blade achieve higher aerodynamic efficiency under the lowest load condition. Material of rotor blade is glass fibre / epoxide resin, glue, gel paint, which can be used in extreme temperature region and outer coat of blade is rain, snow and sand proof and good wearing-resistant.

Rotor blade's structure is multi-lamina rid/shell. Lightning protection apparatus is integrated into single blade, which includes: metal tip, conductor installed along the trailing edge of blade and a grounding cable connecting with blade and nacelle.

2.11.2 Hub

Hub is cast structure which is connected with rotor blade. Pitch bearing and single pitching driver unit are connected with hub.

2.11.3 Pitching system

Pitching system have two functions: first is the primary brake system for turbine and the other is regulating the rotor rotation speed in rated load scope to control the rated output of turbine. Each blade is actuated by one set of drive train unit which includes servo motor, gearbox, pinion gear and so on. The drive units are made to act synchronously by electric control device and each blade is regulated respectively to maintain its workability. Safe shutdown will be considered even if one of the drive units of pitching system malfunctions.

2.11.4 Nacelle

Nacelle includes following components:

2.11.4.1 Main Frame

The main frame is a welded construction, which is the weight-bearing part. The gearbox, generator and yaw system all connect with it and the yaw drive is also fixed on it.

2.11.4.2 Gearbox

The gearbox consists of two planetary stages and a downstream spur gear stage. The rotor shaft is integrated in the gearbox, i.e. the hub is attached directly to the drive shaft of the gearbox. It is equipped with an oil cooling system which cools the high-temperature gear oil to a suitable temperature.

2.11.4.3 Yaw System

The yaw system is used to rotate the nacelle so that the rotor is always facing the wind. The rotation is achieved by means of four synchronously-controlled yaw motors moving around the ring gear on the tower. The ring gear is used for the linkage of nacelle and tower. The yaw system is set for rotating max.720 degree, and can unmoor automatically.

2.11.5 Generator

The wind power generating device consists of a double-fed induction generator, an encoder, etc. The generator can rotate in high efficiency by such electronic unit as IGBT, and the power factor can be adjusted from Capacitive 0.9 to Inductive 0.9. Heat windings are installed to prevent damage to the generator that could arise from humidity and fogging. In addition, PT100 sensors are integrated in the generator for temperature monitoring.

2.11.6 Brake Coupling Unit

The brake coupling unit consists of a hydraulically activated disc brake, which is attached to the rear side and the drive shaft of the gear box, and a connection between disc brake and generator drive shaft.

The brake is used for emergency shut downs of a working and as a locking brake for a non-working wind energy converter. The wear of the brake pads is monitored and displayed on the PC. By means of an automatic adjustment the brake pads are always brought into the right positions.

The coupling transmits the driving torque from the gearbox exit to the generator drive. It is electrically insulating in order to avoid leakage currents. It compensates axial and radial displacements to avoid the vibration.

2.11.7 Vibration/Noise Decoupling

Two layers of vibration dampers are equipped at the joint of gearbox and main frame for use of vibration damping and noise eliminating. The vibration damper is composed of the ring-shaped elastic layers that are enclosed by a retaining ring. In addition, the dampers are also mounted at the generator base, the joints between controller cabinet and the main frame, the nacelle covering and the main frame, which effectively prevent and reduce the vibration.

2.11.8 GRP Covering

The hub and the nacelle are lined with a GRP covering. This covering protects the machines components against the meteorological influence, reduces noise emission and increases the aerodynamic forces. The GRP covering is equipped with a lightning proof earthing cable. The covering connections are sealed with rubber to proof against rain and sand.

2.11.9 Crane for maintenance

The crane is mounted in the nacelle, and can lift the tools and consumables inside or outside the nacelle.

2.11.10 Water Cooling System

The water cooling system consists of the pump, tank, temperature and pressure sensors, valves, connecting pipeline and cooler, etc. The cooling of generator and power converter all adopts water cooling. The pumping station is installed inside the nacelle and the water-air heat-exchanger is mounted outside the nacelle. The cooling system would start as the temperature exceeds the setting temperature of the system, by means of the cooler cooling the water until required temperature is attained.

2.11.11 Anemoscope

The anemoscope works in ultrasonic manner, which is mounted on the top of the nacelle. The wind direction and speed can be measured by the anemoscope. The pitch system adjusts the blade angle and the yaw system adjusts the nacelle direction according to the direction and speed of the wind.

2.11.12 Tower

The tower is a tubular steel tower, inside the tower there is a ladder with climbing protection system, lighting facility, rest platforms as well as cable routes and cable support.

2.11.13 Foundation

The foundation ring is buried in the foundation in advance, and connected to the tower by the flange. Three sets of adjustable bolts are equipped between the bottom flange of the foundation ring and the foundation surface for adjusting the plane degree of the foundation ring.

2.11.14 Electric Device

- The double-fed generator
- The pitch control and the yaw system
- The MPU with 3 input/output points I/O and the control module
- The MPU module for communication
- The monitoring system and the safety chain

2.11.15 Electrical equipment

The wind energy converter has a double-fed induction generator with power converter (IGBT voltage source converter) for variable speed operation. The use of a double-fed generator results in the realization of variable speed that has some basic technical advantages over other options:

- Higher degree of electrical efficiency
- Reduction of the harmonic load

The power output and the power factor (cosφ) can be controlled progressively over the complete power range according to the external target value specifications or with a fixed value. The generator and the converter are equipped with several temperature sensors for temperature monitoring and also equipped heating elements for proofing against condensation.

Table 2.18: Description of the electrical equipment

Type	SL1500
Generator	Double-fed
Converter	IGBT, 4 quadrant
Rated power kW	1500
Rated voltage V	690
Power factor (cosφ)	Standard 1.0,be able to control
Harmonic distortion factor	~5 %