MORO POWER COMPANY (PVT.) LTD.

Electricity Generation Using Wind As Fuel

SCHEDULE I

(Regulation 3(1))

FORM OF APPLICATION In Triplicate

The Registrar
National Electric Power Regulatory Authority.

Subject: **APPLICATION FOR A [GENERATION/TRANSMISSION/SPECIAL PURPOSE TRANSMISSION/DISTRIBUTION] License.**

I, Mustafa Abdullah, CEO, being the duly authorized representative of [Moro Power Company Pvt. Ltd.] by virtue of [BOARD RESOLUTION/POWER OF ATTORNEY] DATED 18TH July 2018, hereby apply to the National Eclectic Power Regulatory Authority for the grant of a [GENERATION LICENSE to the Moro Power Company Pvt. Ltd. Pursuant to Section [15] of the regulations for generation of electric power act 1997.

I, certify that the documents in support attached with this application are prepared and submitted in conformity with provision of National Electric Power Regulatory Authority Licensing [Application and modification procedure] Regulation, 1999 and undertake to abide by the terms and provisions of the above-said regulations. I further undertake and confirm that the information provided in the attached documents in support is true and correct to the best of my knowledge and belief.

A [Bank Draft/Pay Order in sum of Rupees [Rs. 318,000/-], being the non-refundable license application fee calculated in accordance with Schedule ll to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations 1999, is also attached herewith.

Date: 13 August, 2018

Mustaf Abdull

MUSTAFA ABDULLAH
CEO (Authorized Person)

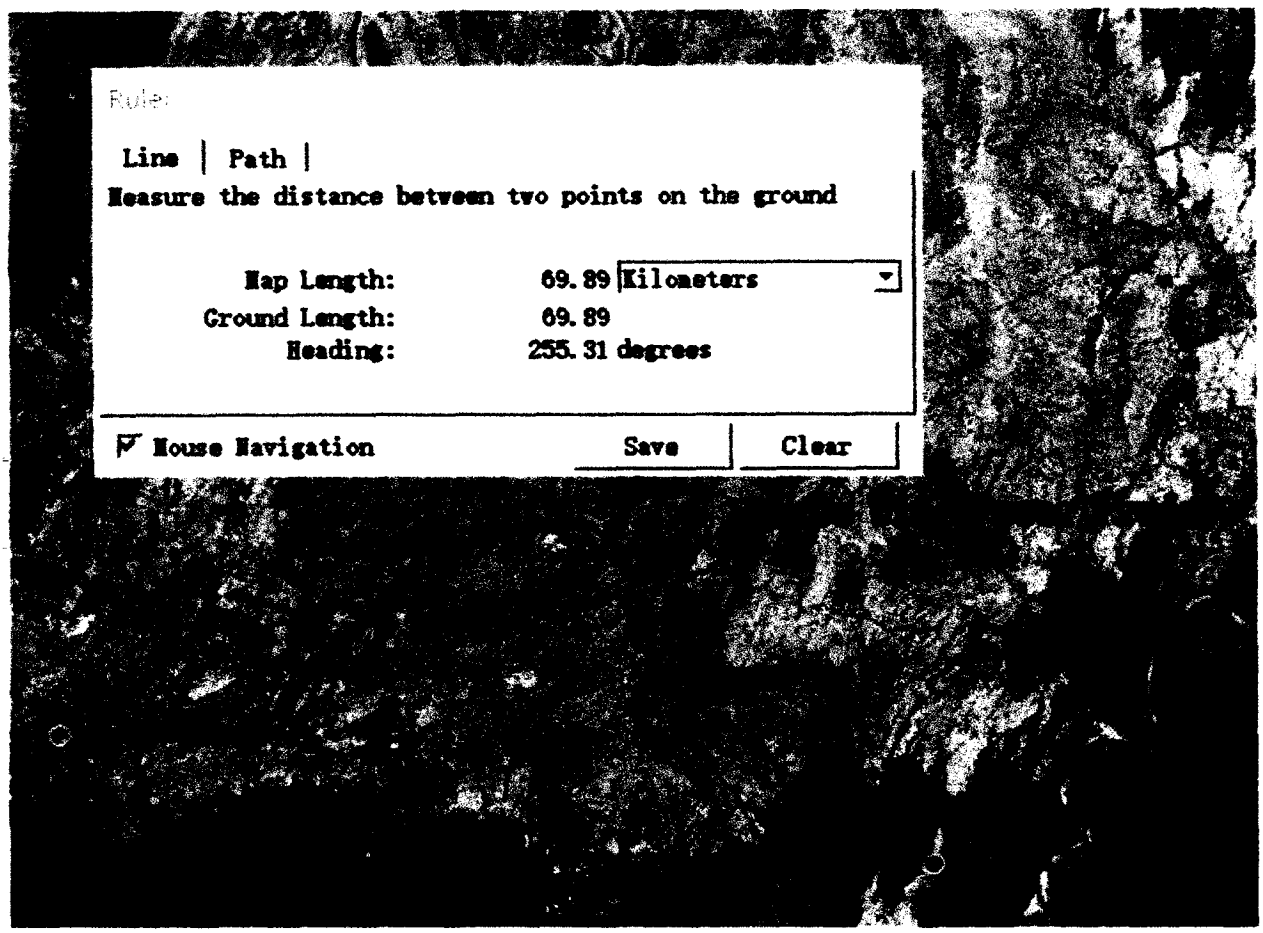
MORO POWER CO. (PVT) LTD.

Office: 4C, M-1, Ittehad Lane 12, Phase II Ext., DHA Karachi.
Ph: + 92 213 5885007 Cell: +92 322 222 5007, Email: gemsindh@gmail.com

PROSPECTUS

BUSINESS PLAN

MORO POWER COMPANY (PVT) LTD.



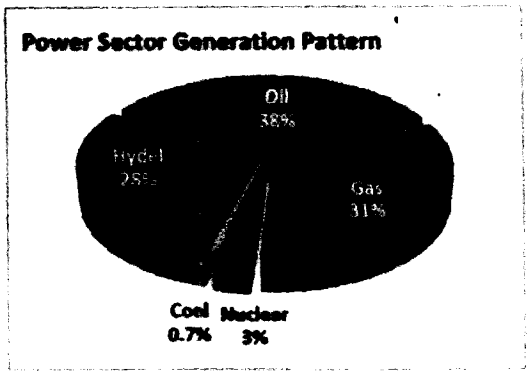
25 MW Wind Power Project

Advisors/Consultants:

a. Munib Ahmed Khan & Company --- Legal Consultant
b. Shafqat Raza --- Chartered Accountants and Financial Consultants.
c. Global Environment Management Services (GEMS) ---- Environment and Technical Consultant.
d. Sinovel, China --- Wind Resource Consultant

1. EXECUTIVE SUMMARY

The purpose of this business plan is to raise equity of US$ 11.5 million for the development of 25 MW wind power project (total cost US$ 50 million)for an alternate energy business. Moro Power Company (Pvt.) Ltd (MPCL) registered in Pakistan with the Security and Exchange Commission of Pakistan (SECP), will sell the Electricity produced (90 GWh/year) to K-Electric Ltd, which is now 66% owned by Shanghai Electric Power, a subsidiary of Chinese State Owned State Power Investment Corporation (a fortune 500 Company). K-Electric's 44% shares are traded on Pakistan Stock Exchange.

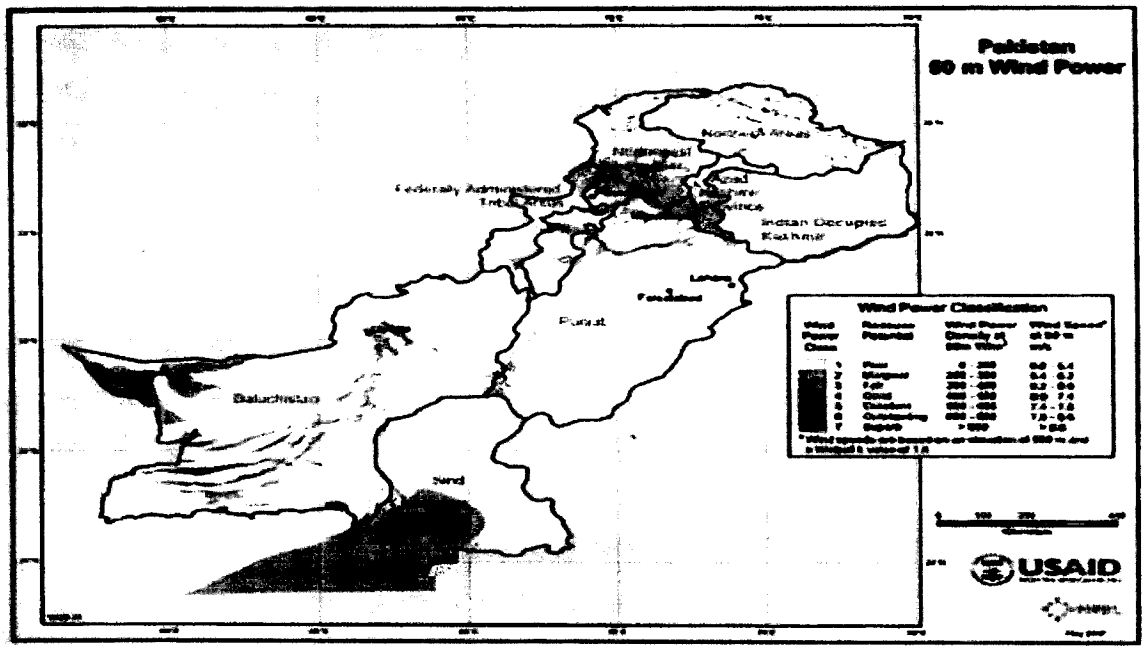


The Environmental concerns have encouraged diversion towards renewable energy. Wind energy has made tremendous rapid development throughout the world including USA, China, Germany, Spain, India, etc and there is a surge in demand in Pakistan also. Wind energy is becoming an increasingly popular method of producing electricity. Wind-generated electrical energy is the world's fastest growing energy source. The advantages of producing power from the wind are numerous. OEM turbine manufacturers are providing competitive advantage with 20 % lower upfront cost compared to 10 years ago and with higher efficiencies of turbines offered and low operating cost, plus the advantage of completely renewable and zero cost of fuel, Wind is inexhaustible. Wind provides stable-priced power. Wind is often economically competitive with conventional energy sources, especially in Pakistan the fossil fuel based electricity tariff is US cents 10.5/Kwh for gas based and for FO/coal based (all imported) the tariff is US cents 8.5 which is variable with fuel prices. In case of Pakistan wind will provide energy security.

Currently, Pakistan is in midst of one of the worst energy crisis in his history. The energy problem has slowed down the economic development and blocks the industrial production. The energy supplies to the key industries (e.g. fertilizer, Cement, textile) have fallen to lower than 50 percent of their energy demand.

Over 65 percent of the Pakistani energy production in Pakistan is based on is fossil energy sources. see Figure below. The import of the fossil energy sources and rising costs of energy requires tapping of new resources, including renewable; Hydro, Wind and Solar.

The Alternate Energy Development Board (AEDB) in collaboration with NREL of USA detected a high potential wind zone in southern Pakistan, called the Gharo-Keti Bandar Wind Corridor (see Figure below. Wind Studies, engaged by AEDB, provided the estimate that the Wind Corridor has a potential of about 50,000 MW useable wind energy and minimum of 12,000 MW can be installed.



With first wind project coming into operation in 2012, now over 500 MW of Wind projects are already in operation and owned by large business houses of Pakistan including Fauji Foundation, Gul Ahmed, Engro, Saphire, Lucky, Tapal, Master, Metro, Artistic Denim and a number of Chinese groups including Three Gourges, Ming yang, China Hydro Power, etc have already set-up their 50 MW each, wind projects in Gharo and Jhimpir wind corridor of Pakistan and most of has already started phase II, to increase their portfolio in Wind business.

Approvals and Permits obtained by MPCL: The developer MPCL had started working on this project in May 2014. Necessary permits including; Registered Name and Corporate Structure completed, Letter of intent obtained, Land selection and acquiring completed, environmental clearance obtained from Sindh Environmental Protection agency, geological survey completed, detailed wind resource study completed, transport study finalized, initial grid/load survey conducted by consultant for STDC transmission pipeline, negotiations with the buyer K-Electric is in progress.

Project Site overview:

Project site is located in the southern region of the Sindh province, 15 Km east of the industrial town Nooriabad, district Thatta and 100 Km from Karachi. A good transport connection from the port of Karachi to the site is given by the Karachi-Hyderabad / Motorway (M-9) and also approachable from Thatta on National Highway. An overview of site is shown in Figure below.

2. MISSION STATEMENT

Management mission is to develop the Moro Power (MPCL) 25 MW Wind Energy Project into a profitable and ecologically friendly venture that will provide its owners steady stream of income from sale of electricity from year one of operation. This project will be promoting green energy.

3. FINANCING

MPCL has already invested over a US$ 1.0 million to-date on this project and is now seeking to raise balance US$ 11.5 million equity from an investor for this Project. The preliminary terms of this agreement call for an investor to receive up to 70% ownership interest in the business coupled with a recurring stream of dividends starting in the first year of operation. The financing will be used to:

- Raise the debt portion of US$ 37.5 million from Foreign Banks. A number of Chinese OEM has shown keen interest in arranging for this loan component from Chinese Banks in exchange of getting EPC contract.
- To successfully install and operate the 25 MW wind project. It is anticipated that 40,000 tons of carbon dioxide emission will be avoided. Carbon credits will be claimed also.
- Loan repayment plan, payment of interest during construction and subsequent interest and principal payment will depend on requirements of lending Banks. It has been estimated that loan repayment can be completed in 8 years from date of operation.

4. Investor Equity

At this time Mr. Mustafa Abdullah is seeking to sell up to 70% interest in business. The investor will receive seats on board of directors; however position of CEO will remain with Mr. Mustafa Abdullah till the financial close. All decision will be taken with consent of investor.

5. Management Team

The Company was founded by Mr. Mustafa Abdullah, who has Master's degree from UK and has 35 years of experience in energy business in USA, Middle East and Pakistan. He has in his team reputable consultants including:

1. Muneeb Ahmed Khan ---- Corporate and Legal.
2. Shafqat Raza --- Finance & Accounts.
3. Global Environment Management Services (GEMS) ---Technical.
4. Sinovel, China --- Wind Technical.

6. EXPANSION PLAN

We expect that the wind business will aggressively expand during the coming years in Pakistan, in view of the fact that compared to its neighbor countries; China and India and even other countries, the wind power is still in nascent phase in Pakistan. Ample land is available near our project which can be acquired for expansion.

7. Project Status

Activity	MPCL
LOI obtained from Sindh Energy Department	✓
Land acquired 240 acres	✓
Completion of Wind Related Studies (Wind and Energy Resource Assessment)	✓
Electricity Grid Study	In Process
Completion of Soil Survey, Geo-tech Survey, Seismic Survey, Transportation Survey, Topographical Survey	✓
Completion of Environmental Impact Assessment	✓
Approval for development of Project by Sindh Environmental Protection Agency	✓
Preparation of Feasibility study	December 2017
Grant of Generation License by NEPRA	in process
Selection of Turbines	In Process
Selection of EPC Contractors	In Process

8. Exit Strategy

On successful start of operation of the project Mr. Mustafa Abdullah may seek to sell the remaining shares, with first choice given to the investor. Based on historical numbers, the shares can fetch a premium of up to two (2) times.

9. Project Implementation

Selection of EPC and O&M Contractor

With an objective of setting up its Project in compliance with the highest standards and, *inter alia,* to select the most efficient and reliable wind turbine generators (**WTG**) suppliers and engineering, procurement & construction contractors for its project, the Project Company conducted thorough research of various WTG suppliers and EPC contractors in the global wind industry.

The Project Company and its technical advisor has shortlisted various technologies and WTG vendors for its wind farm. Subsequently, the Project Company visited such vendors and contractors in China and Germany to, aquire first hand information. Designated EPC contractors selected will provide turn-key EPC solutions for the engineering, procurement, construction, commissioning, testing and completion of the Project – thus not only working towards, *inter alia,* development of its Project to meet the highest technical standards and also towards a bankable EPC contractual structure.

The Project Company has received "keen interest" from various international WTG machines OEM suppliers including: Vestas from Denmark, Nordex from Germany GE from US, Genesa of Spain and a number of Chinese OEM Companies.

Based on its thorough due diligence and following an intense negotiations process with various EPC contractors and WTG suppliers, the Project Company will select the best turbines offering guaranteed efficiency of up to 40%, which is only possible with state of art manufactured turbines with low cut-out speed of 2.0 m/sec and offering maximum out-put at wind speed of 10 m/sec, high swept area, toer height and rotor diameter.

The O&M of the Project will be performed by the EPC Contractor during the first five (5) years following commercial operations date on a turn-key basis extending further to ten (10) years.

10. Tariff & EPA

The expected applicable tariff of NEPRA of US Cents [redacted].0 per KWh will be applicable. The tripirete EPA agreement between NEPRA, [redacted] and Moro Power (MPCL) will be signed. This agreement will be for a period of twenty (20) years with guarantees for 100% evacuation of electricity produced by the project.

11. Project Completion/ Operation

- It is expected the project construction, testing and COD phase will take 15 months from the date of signing of EPC contract.
- During construction a work force of 100 will be working at site. Accomodation arrangements will be made at site.
- A maximum of twenty (20) executives, engineers, and staff will be required to operate the plant. Local accommodation will be provided for 24/7 operation.

12. PROJECTION FINANCIAL SUMMARY (25 MW Wind Energy - Power Plant)

Year	I	II	III	IV	V	VI	VII
oduction Million GWH (GigaWattHour) (AVE)	92.28.000	92.28.001	92.28.002	92.28.003	92.28.004	92.28.005	92.28.006
ake Effect & Net Losses: 2%	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00
Distribution and ansmission Losses 2%	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00	1,845,600.00
Net Energy Generation	88,588,800.00	88,588,800.00	88,588,800.00	88,588,800.00	88,588,800.00	88,588,800.00	88,588,800.00
Net Sales @ US cents 10/KWH	88,588,000	88,588,000	88,588,000	88,588,000	88,588,000	88,588,000	88,588,000

13. Technical Summary for turbine selection:

Two options are available in market of high efficiency turbines, for this project, which can be with gear box (higher tower and longer blades) or gearless turbines with reduce resistance in operation thus giving higher efficiency. Turbines selected will be those having a long track record internationally. O & M will be signed with EPC Contractor for a period of five (5) years, extendable up to ten (10) years and EP/OEM contractor ensuring 40% efficiency and 96% plant availability.

MORO POWER COMPANY (PVT.) LTD.

Electricity Generation Using Wind As Fuel

Dated: 15/8/18

PART II CLAUSE 5 (a)

PROPOSED INVESTMENT

Investment will be as follows.

Equity: 20% Local

Debt: 80% Foreign

Attached are details of sponsors of Moro Power Company (Pvt.) Ltd. (MPCL M/s R.M.Gulistan. Equity share of 20% will be arrange by M/s RMG, howeve we have offers from a number of reputed companies to participate in equity c MPCL's 25 MW Wind Project at Jhimpir, Sindh.

For Debt Financing we have received two offers, one offer of M/s Industrial & Commercial Bank of China Limited (ICBC), & Second offer of leasing company c china, copy attached.

Project Estimated Cost; US$ 35 million.

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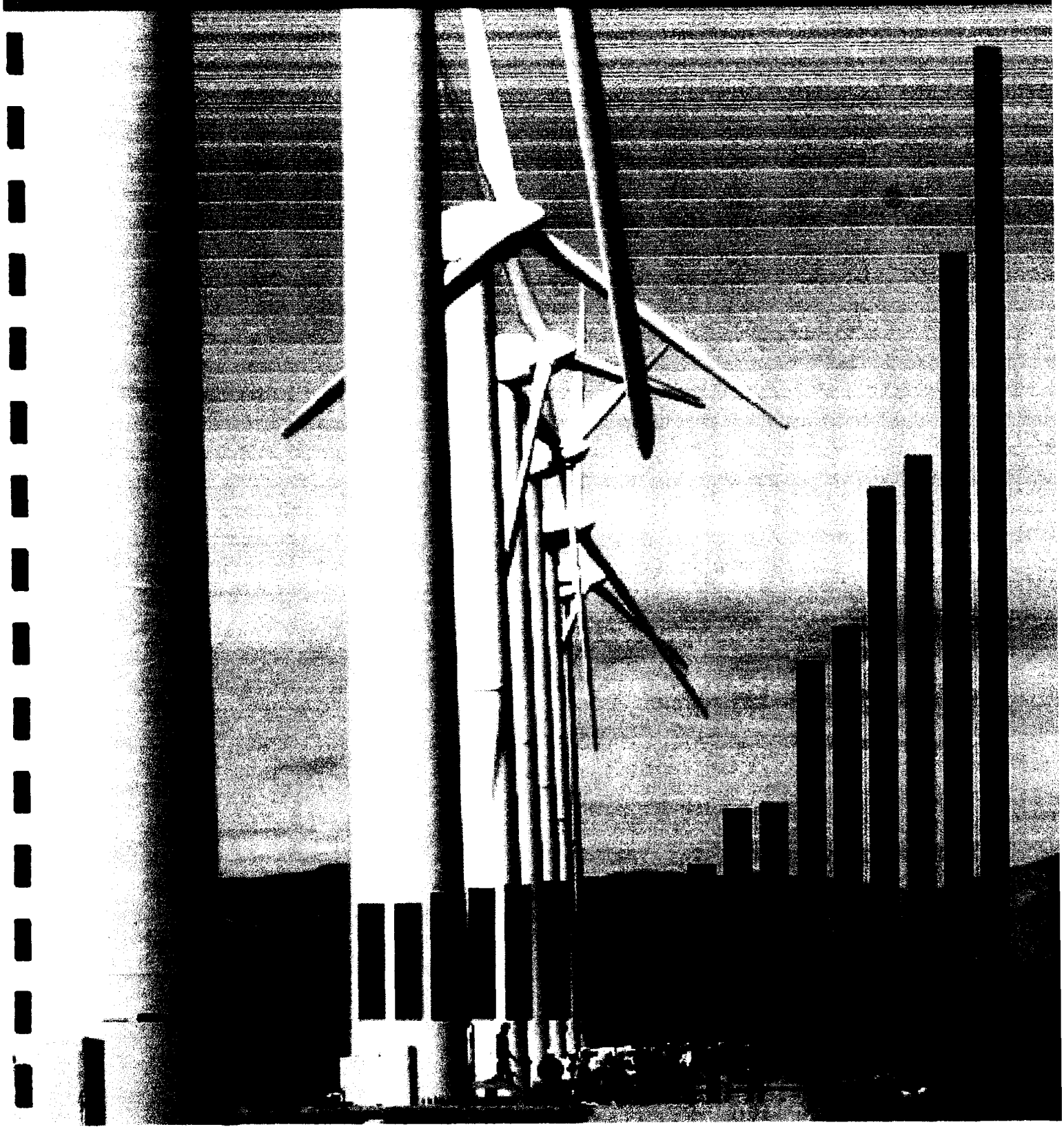
Feasibility Study Report

Moro Wind Power Project

25MW Wind Power Plant, Jhimpir - Sindh



EXECUTIVE SUMMARY

Background information:

Located on the western stretch of the South Asian Continent, The Islamic Republic of Pakistan is largely under the influence of tropical desert climate.

The thermal depression of South Asia and the monsoon winds shape up Pakistan's southern coastal areas and northern mountain areas into a land rich in wind energy resources.

The coastal wind energy rich areas known as Thatta Wind Corridor normally refer to Southern Sindh and the vast plateau to the east and the northeast of Karachi city.

The relative shortage of conventional energy resources in Pakistan coupled with environment issues has spurred the Pakistan Government to commit for renewable resources. The wind power has a special advantage that Thatta Corridor already has a well-built electrical infra-structure for the transmission of electric power. The Power Purchaser under his responsibility only needs to build the evacuation network for feeding the renewable energy into the National Grid.

The wind is smooth with very little turbulence and is mostly available during evening hours. This makes the Wind Power Plants in the area ideal for peak shaving, giving an average of 40% capacity with new turbine design of tower heights of 100 meters and rotor diameter of 120 meters.

Support from Government of Sindh

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

At present, fourteen (14) wind power projects of total capacity approx. 780MW are in operation against utilizable potential of 12,000 MW in the Thatta Corridor. Another eight (08) projects (six of 50 MW each, one of 100 MW) are in the Construction Phase, while ten (10) are expected to start construction in the first half of 2018. A further thirty five LOI's have been given to the Developers for setting up Wind power Projects of 50 MW each.

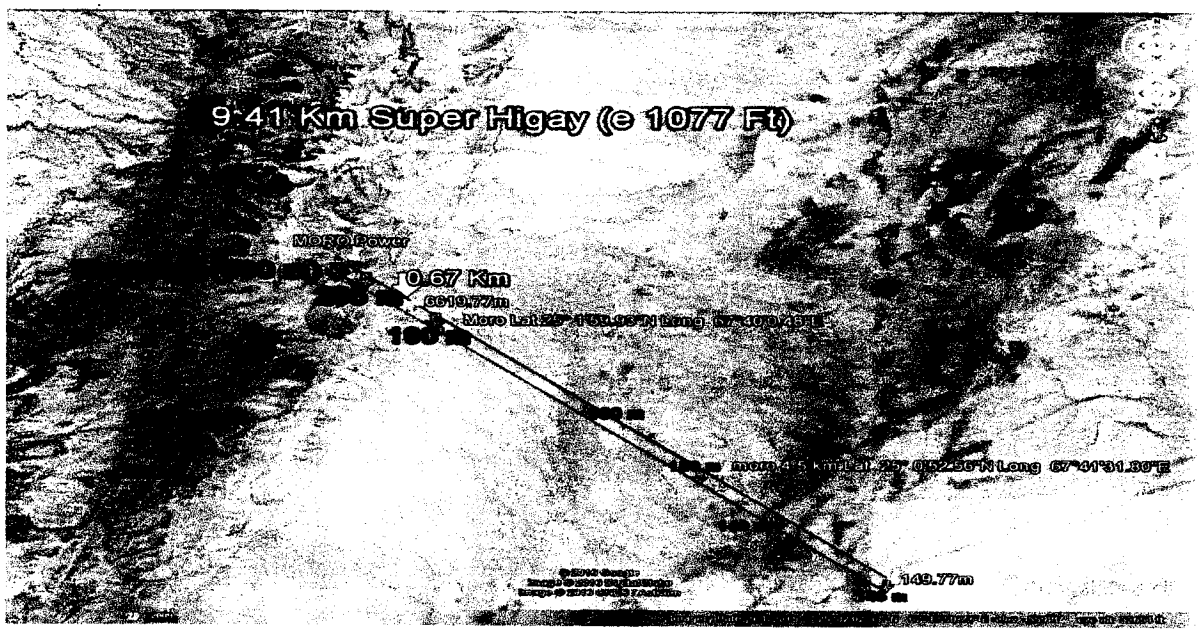
1. The Moro Wind Power Project

Moro Power Company (Pvt.) Ltd (MPCL) is the sponsor of the 25MW Wind Power Project, currently with 100% shareholding in the project company. It can operate as an SPV.

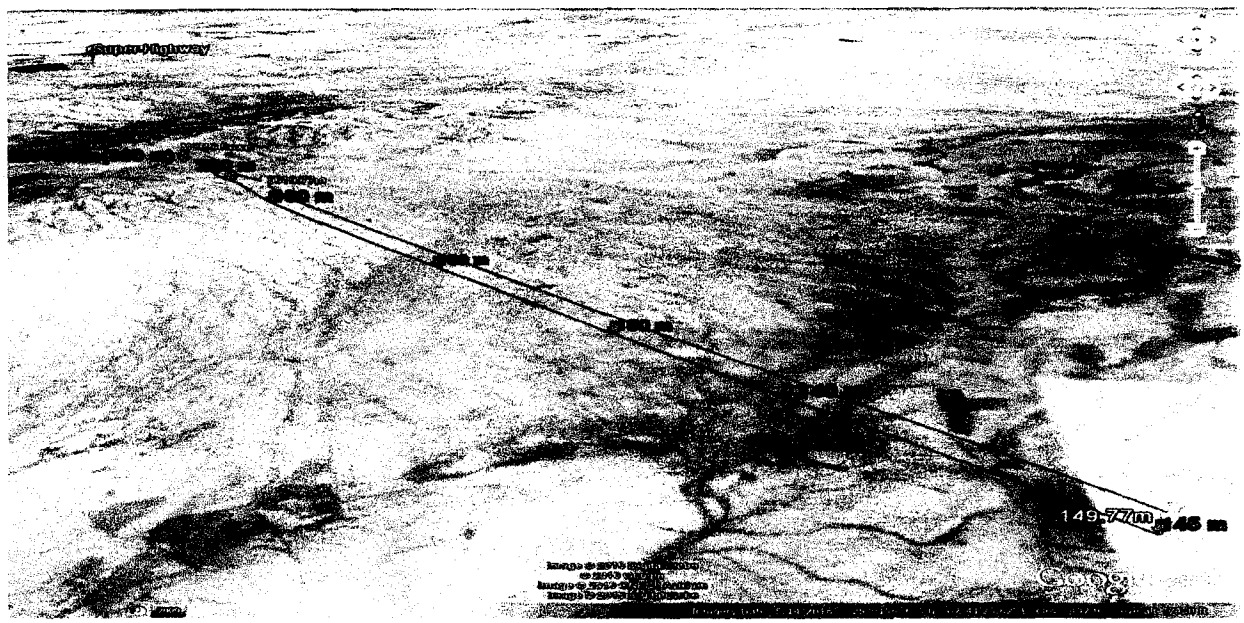
After careful consideration and Wind Resource Assessment results, SANY has been selected as the Wind Turbine Generator (WTG) supplier. Electrical Balance of Plant will come from renowned Chinese and/or European companies, complying with transmission authorities' requirement, whereas the Civil Works will be performed by local Contractors using 100% indigenous materials and services.

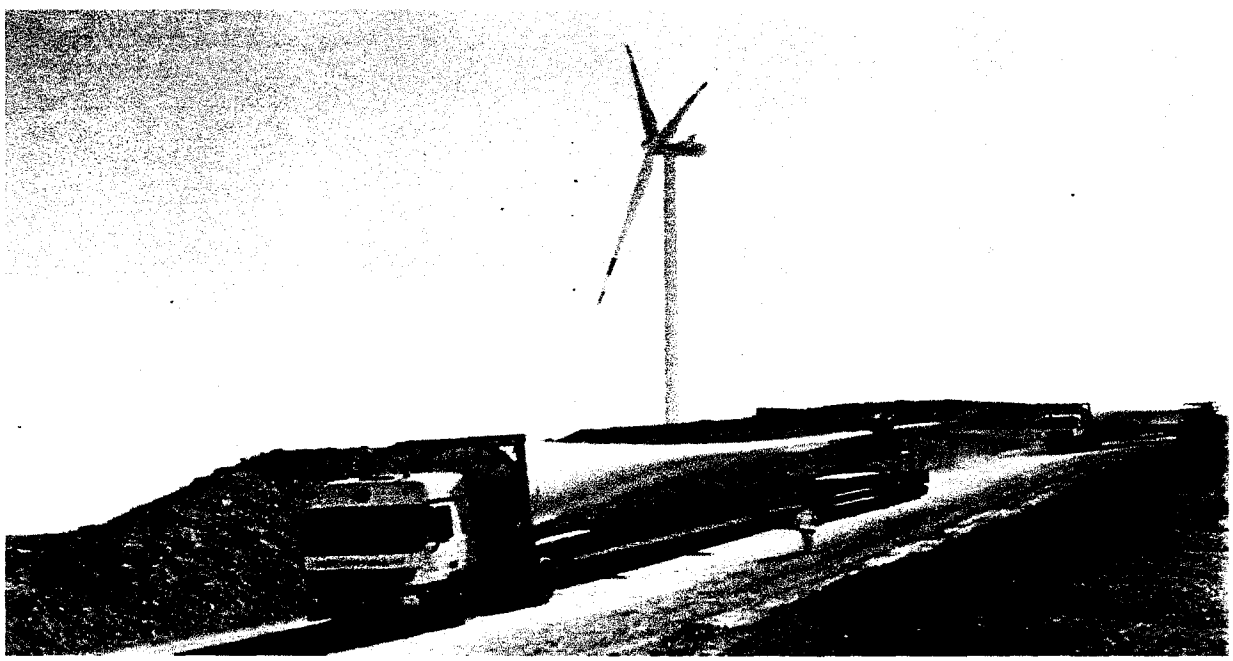
1.1 The project site

The wind farm project is located in Jhimpir, which is located approximately 130 km from Karachi, Pakistan's commercial hub and main coastal/port city. The 25MW Wind Power Project site consists of 240 acres of land, which has been leased by Government of Sindh (GOS) The Karachi-Hyderabad Motorway (Ex-Super Highway) and the National highway are the connecting roads to the project site. The Thatta Wind Corridor is identified as potential area for the development for the wind power projects. The overview of the project site is shown in Figure 1 below.



The terrain is flat at the project site with little vegetation and Savana. There are some very small and scattered pieces of agricultural lands. The area has dry climate. The satellite map of Project Site along is shown in Figure 2 below.





A number of Wind Power Project has used the same route for transportation of all components of their wind power projects through same route. However minor road work is done to reach the actual site in each case.

Further details of Site are given in section 07 and Site Transportation and access study is attached as Annex II.

1.2 The Project Status

The Project Calendar is given in Table 1 below:

Active / Milestone	2017	2018				2019				2020		
	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR
Land acquisition and Grid Data												
Preparation of Feasibility												
Feasibility Study incorporating new requirements												
Approval of Feasibility Study												
Generation License												
Tariff												
Signing of EPA												
Signing of IA												
Financial Close												
Project Construction												
Start of Operation												

The project completion shall take 18 months from the date of Planning till the COD. The construction period is of 12 months from site mobilization till the COD.

1.3 The Project Construction Schedule

The project construction schedule is based on 25 MW project size and is aimed by deploying parallel works. Construction period will be twelve months after financial closure.

Activity / Month	1	2	3	4	5	6	7	8	9	10	11	12
Engineering and Mobilization												
Construction of Temporary Establishment												
Roads & Foundations of WTGs												
Construction of Substation												
Erection of WTGs												
Cables and Interconnection												
Erection and Installation												
Testing and Commissioning												
Reliability Run Test & COD												

1.4 Construction Management

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

Like all power projects in Pakistan, the structure of EPC contract is on a "turnkey" basis, limited to delivering a technically functional plant according to the specifications.

Though the EPC Contractor will be responsible for Construction Management as far as the plant is concerned, the CSR, HSE and other human related issues will supervised by MPCL's appointed special team.

In order to manage all the above operations correctly, Moro Power shall have a Chief Technical Officer (CTO) who shall supervise the quality and progress of Construction and also liaise with other stakeholders including NTDC/AEDB/SEPA for timely approvals and progress according to agreed time schedule.

1.5 O&M Management

The O & M shall be managed by the EPC Contractor for initial (five) 5 years of warranty period followed by a complete Field Service Agreement till end of next 5 years of operations. The local team shall remain part of the O & M and shall gradually take over after having On Job Trainings (OJT).

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

1.6 Health & Safety

During the construction and operation of the project, the guideline of "safety first, (accident) prevention foremost" will be practiced. Comprehensive management and supervision will be applied for all staff members and the whole operation process, in order to ensure safe operation of the equipment and personal safety of workers.

A safety and health supervision department will be established on the wind farm. This department will be responsible for the training and management of safety and health related issues during construction and after the plant is put into operation. There will be a safety manager in-charge of health and safety of men and machinery.

A comprehensive safety system and safety manual will be prepared and carefully implemented during the construction process. The system of work sheet, operation sheet, shift relief, patrol inspection, operation guardianship, maintenance and over-haul will be strictly implemented. The safety regulations during the operation of the wind farm will also be carefully observed to minimize untoward incidences.

1.7 Additional Studies

Apart from general economic viability study based on Country's needs, the Project viability and timely execution within the stipulated time are further confirmed by additional studies required by DAE GOS to accord the approval. These are as follows:

1.7.1 Wind Resource Assessment (WRA):

A Separate Study has been carried out for the WRA including complete analysis of wind data and long term correlation. Please refer to Chapter X for details. The energy yield estimates have been generated including development of wind farm layout, determination of energy yields and uncertainty assessments.

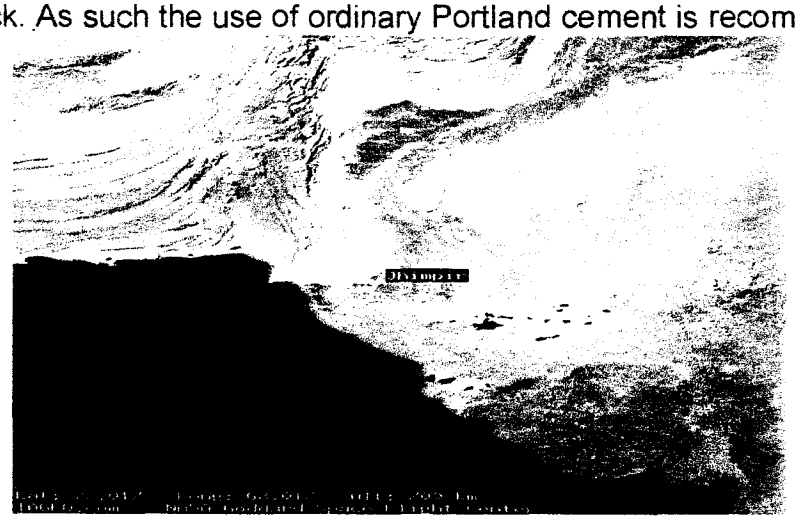
1.7.2 Geological/Topographical Study

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

There were 3 bore holes with average depth of 10 meters. However detailed site survey for each wind turbine tower will be carried out by EPC Contractor.

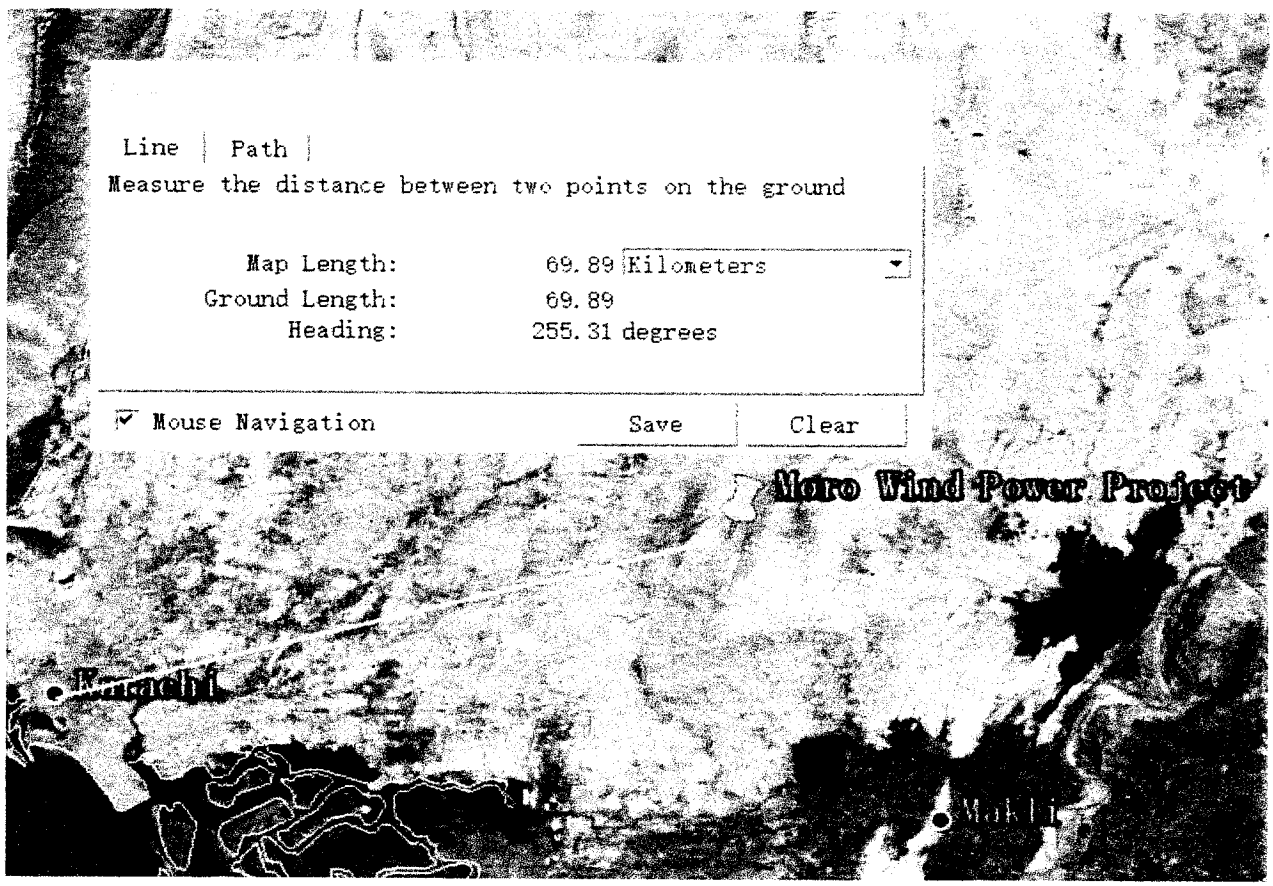
The Sub-surface conditions disclosed by this investigation show a highly fissured chalky limestone with cavities in all borehole locations. The top soil is composed of alluvium material and its thickness ranges from 0.70 – 3.0 m.

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



1.7.3 Logistics Study

The major track to project Site is two-way road. The Port Qasim is the second major Port of Pakistan and is the point of delivery of equipment for the proposed wind power project also. Most of the wind projects have used the same port. It is located towards east of the site as shown in Figure below. Aerial distance between the port and the Site is 69.8 Km. Total track length between Port Qasim Karachi and Site is approximately 100 Km.



1.7.4 Environment Study

A separate environment study has been carried out. The initial environment examination (IEE) report is attached as Annex VII.

There are no significant hazards. The minor adjustments required during construction phase have been addressed and mitigation plan provided. A data collection survey was also done that included geology, meteorology, hydrology, ambient air quality, water quality, soil characteristics, noise levels, shadow forecasting, flora and fauna, land use pattern, and socioeconomic conditions. Information related to the environmental management works is given in Section 15.

1.7.5 Grid Interconnection Study

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

The Project has an installed capacity of 25 MW, using wind turbine generators (WTG), each with a capacity in the range of 2.0 – 2.5 MW.

A substation consisting of step up transformer and other BOP equipment will connect the wind farm to the 132 KVA evacuation network.

Each WTG will generate power at a terminal voltage of 0.69 kV. The power from the turbine will be stepped up to medium voltage (MV) through a WTG step up transformer which will be housed in a separate compartment in close proximity to the wind turbine tower.

Power from all the WTG's in the plant will be delivered to the WPP substation by a MV cable network. It will be connected to the grid via the step up transformers and HV switchgear, built within the boundaries of the wind power plant. The switchgear gantries will be the point of metering and point of common coupling to the 132 KV utility evacuation network.
Grid interconnection point and required reactive power compensation for the Project shall be as per prevalent Grid Code and in accordance with the NTDC approved Grid Interconnection Study. Please refer to the grid interconnection study attached as Annex VI.

2. Financial Study

A financial model has been developed for this study in order to assess the financial viability of the project based on:

- The information currently available
- The information supplied by Moro Wind Energy Limited on anticipated financing terms and anticipated power purchase agreement and tariff.
- Reasonable assumptions concerning future costs and revenue generated.

The model is primarily in the form of a cash flow based model, which calculates the net cash flow (before tax) for the Project.

The Project plans to opt for cost plus tariff or go for competitive bidding if the necessary "auction" process is in place in time.

For further details, the following Annexures of the Feasibility Study Report may please be referred:

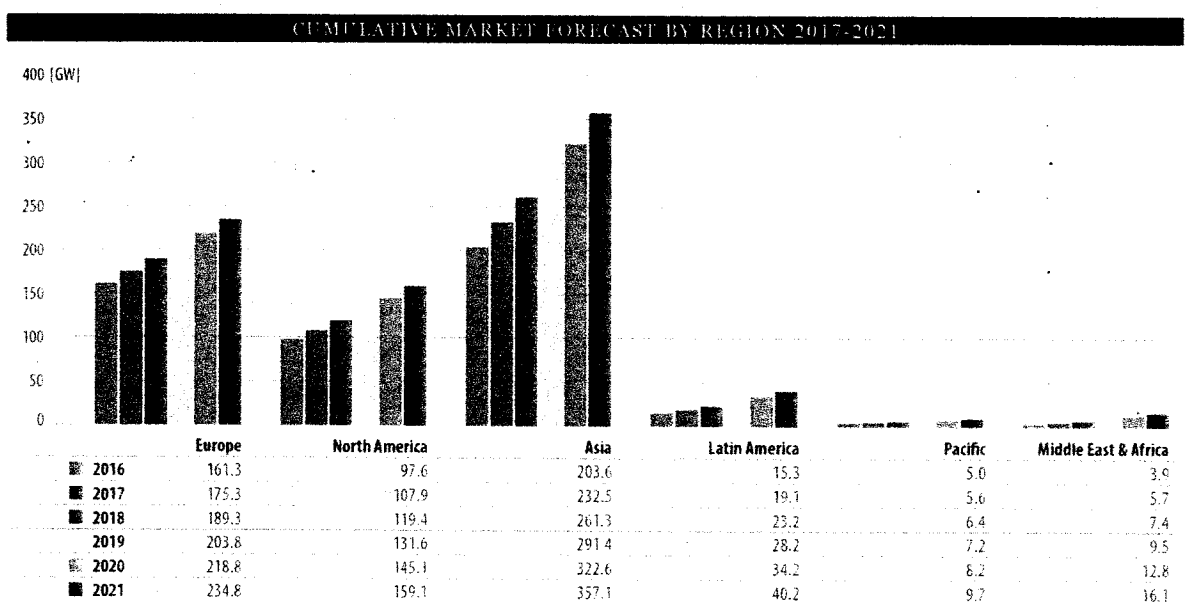
ANNEX – 1: Pakistan Energy Profile and Project Viability Report.
ANNEX – II: Wind Resource Assessment and Energy Yield Estimates Report.
ANNEX – III: Geo Technical Investigation Report
ANNEX – IV: Logistics, Transportation and Access Study Report
ANNEX – V: Initial Environmental Examination (IEE) Report
ANNEX – VI: Electrical Grid Interconnection Study Report.
ANNEX – VII: Financial Analysis Report
ANNEX – VIII: Technology Details of WTGs.

3. Economic Viability of Wind Projects in Pakistan

3.1 World outlook on Wind Energy

The Global Wind Energy Council (GWEC) in its flagship publication *Global Wind Report: Annual Market Update* says that more than 54 GW of clean renewable wind power was installed across the global market in 2016, which now comprises more than 90 countries, including 9 with more than 10,000 MW installed, and 29 which have now passed the 1,000 MW mark. Cumulative capacity grew by 12.6% to reach a total of 486.8 GW.

Wind power penetration levels continue to increase, led by Denmark pushing 40%, followed by Uruguay, Portugal and Ireland with well over 20%, Spain and Cyprus around 20%, Germany at 16%; and the big markets of China, the US and Canada get 4, 5.5, and 6% of their power from wind, respectively. GWEC's rolling five year forecast sees almost 60 GW of new wind installations in 2017, rising to an annual market of about 75 GW by 2021, to bring cumulative installed capacity of over 800 GW by the end of 2021.



	Europe	North America	Asia	Latin America	Pacific	Middle East & Africa
2016	161.3	97.6	203.6	15.3	5.0	3.9
2017	175.3	107.9	232.5	19.1	5.6	5.7
2018	189.3	119.4	261.3	23.2	6.4	7.4
2019	203.8	131.6	291.4	28.2	7.2	9.5
2020	218.8	145.1	322.6	34.2	8.2	12.8
2021	234.8	159.1	357.1	40.2	9.7	16.1

Source: GWEC

Cumulative Forecast shows an exponential increase of Wind Energy in Asia over the next 5 years. Growth in the Global Wind Market is being led by Asia. China will continue to lead all markets, but India has set a new record for installations this past year and has a real shot to meet its government's very ambitious targets for the sector. There are a number of exciting new markets in the region with great potential.

Wind power is now successfully competing with heavily subsidized incumbents across the globe, building new industries, creating hundreds of thousands of jobs and leading the way towards a clean energy future. The world is well into a period of disruptive change, moving away from power systems centred on a few large, polluting plants towards markets increasingly dominated by a range of widely distributed renewable energy sources.

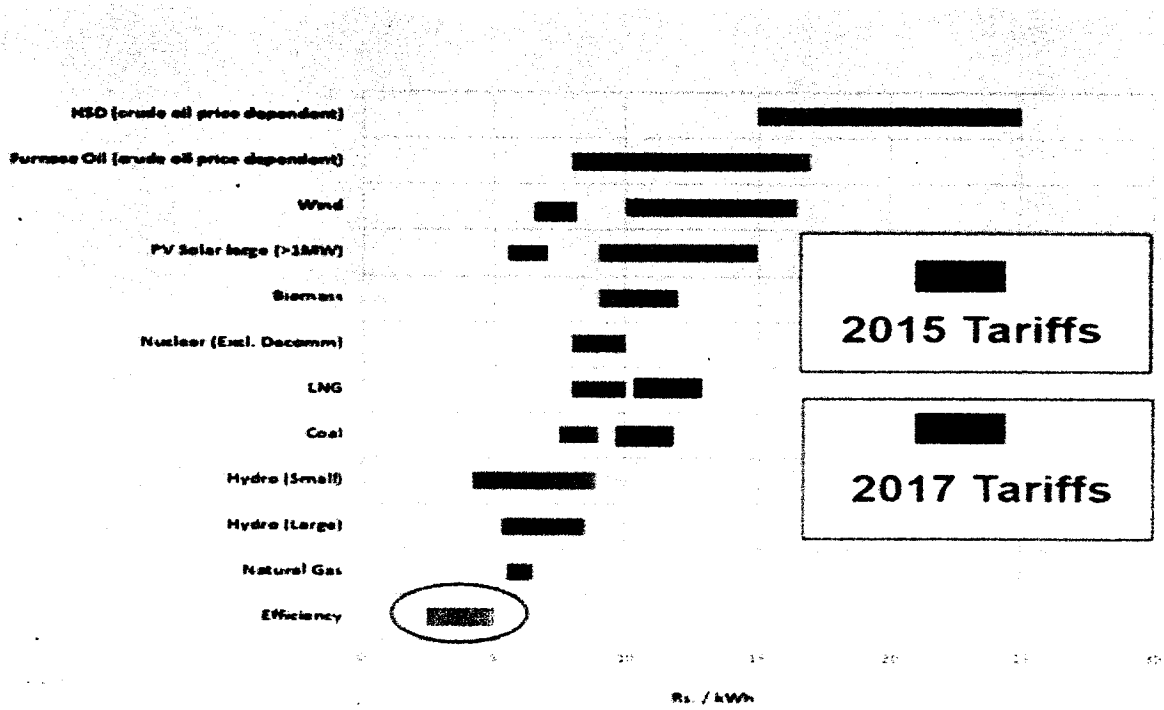
3.2 Wind Industry in Pakistan

While the world and our next door neighbours India and China are already reaping benefits of this natural resource, Pakistan needs to expedite its projects to overcome its energy needs. Recent developments in Wind Regime show that RE Projects including Wind Projects have been marked as "take and pay" without any guarantee of dispatch, while thermal projects including those being run with imported fuel are being considered as must-run, must-dispatch power plants. Besides being detrimental to Country's economy, this is totally opposite to the international approach towards Renewable Industry, where RE plants are on "priority dispatch" basis. In countries such as India, China and Germany etc. thermal plants are running on "take and pay" basis i.e. at a plant load factor of 40-50%. Now that basic electricity short term generation targets have been met, the GoP will definitely turn its attention to the back log of RE projects that was generated due to tariff regime change from upfront to reverse auction through competitive bidding.

Pakistan has a further advantage over the neighbouring countries of having excellent wind resource, a well proven RE policy and a National Grid which caters for the entire Country but still in nascent stage. Wind Energy future is brighter as it can compete with the existing power producing plants based on imported coal and imported LNG.

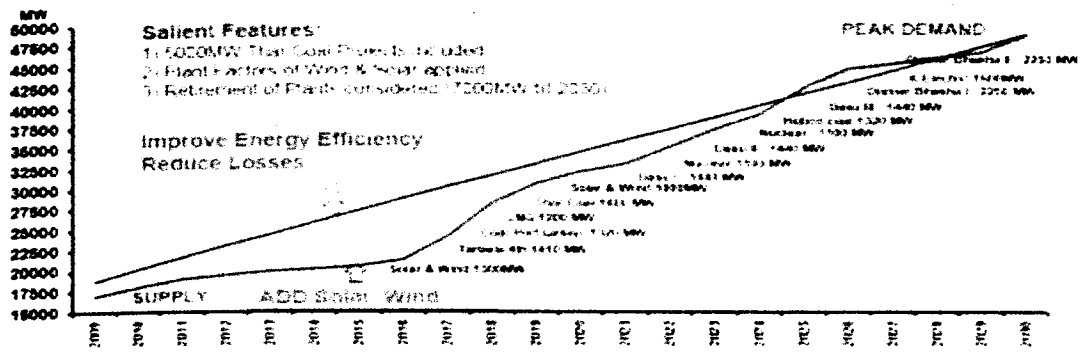
Pakistan's current major electricity sources are thermal and hydro generation, meeting approximately 70% and 28% (respectively) of the country's annual electricity demand. Per Energy Policy, by 2025, Renewables (Wind & Solar) should contribute more than 3000MW at least to meet our Climate Change commitments. Pakistan's carbon footprint 0.47kg of carbon dioxide per kWh of generation should not become bigger. The increase in carbon dioxide production due to installation of coal fired power plants in Sindh needs to be mitigated through increased installation of Wind and Solar Power Plants.

Considering huge utilizable wind potential of more than 12,000MW in Thatta Wind Corridor (plant load factor close to 40%) but just 5% utilized, there is a very strong case for Wind Projects in Sindh.
The slide below shows the expected tariffs of Wind, Solar, Coal and Gas in Pakistan in 2017 as compared to the 2015 tariffs (Source: Pakistan Business Council, Energy Expert Group). While the Wind & Solar tariffs are on the decrease, the Coal and Gas fired power plants LCOE is on the increase resulting into increased tariffs.



It should be noted that the primary thermal generation fuels employed are furnace oil, gas and imported coal. Oil import is a significant burden on the national exchequer. Import of gas has been projected as a viable option to overcome the depleting domestic reserves, but gas import has significant issues, mainly the substantial capital investment and the infrastructure, security difficulties. Such infrastructure costs are not included in the projected tariffs.

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



Source: PBC EEG Integrated Energy Plan 2015

Looking at how the Country's future electricity needs might be met, wind has the potential of being a strong contributor throughout because of being the cheapest, environmental friendly natural resource with a huge potential, especially in Sindh.

According to PBC Integrated Energy Plan 2015, Pakistan's electricity needs will not be met till 2026 even if all the proposed power plants come into operation as planned. This includes the planned 3000MW contribution (not installed capacity) from Solar & Wind by 2025.

Further like many other responsible countries, Pakistan needs to get to a zero emissions power system well before 2050, if we have to meet our climate change and development goals. Pakistan has the potential and sufficient local resources to meet the Climate Change goals committed at the Paris Agreement.

Wind Industry has achieved a degree of maturity in Pakistan. The private Sector is ready to invest in the Pakistan Wind Industry to provide lowest LCOE to the electricity deprived consumers of Pakistan.

Hybridizing Wind with Solar should also be encouraged to increase plant factor, stabilization of network and increase of land utilization factor. Besides seriously considering hybridization with Solar, Moro Wind Power envisages Battery Energy Storage for its WPP once 5 years into production to provide stable, clean and cheap electricity to Pakistan.

4. The various authorizes in Pakistan who are involved in organizing and act as regulatory authorities are listed below:

4.1 National Electric Power Regulatory Authority (NEPRA)

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

There are a number of other important stakeholders involved in facilitating the RE IPPs.

- Alternate Energy Development Board (AEDB)
- Department of Alternate Energy, Sindh (DAE-GOS)
- National Transmission and Dispatch Company (NTDC)
- Central Power Purchase Agency Guarantee Limited. (CPPA-GL)

4.2 Alternate Energy Development Board (AEDB)

Pakistan, like other developing countries of the region, is facing a serious challenge of energy deficit. Renewable Energy (RE) resources can play an important role in bridging this deficit.

More importantly, RE can also play in important role in rural electrification. Realizing the importance of RE, the Government of Pakistan created the Alternative Energy Development Board (AEDB) in May 2003 to act as the central national body on the subject of Renewable Energy. The main objective of this organization is to facilitate, promote and encourage development of Renewable Energy in Pakistan with a mission to introduce Alternative/ Renewable Energy at an accelerated rate to achieve 5% share of RE in the energy mix of the country.

However after the approval of 18th amendment, the Government of Sindh, established energy department. Since its establishment, GOS has been issuing letter of intent for wind solar project in Jhimpir Sindh, following same pattern of AEDB Islamabad. Energy department GOS is on board with AEDB Islamabad, NEPRA, NTDC and CCPA.

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

4.3. Department of Alternate Energy Government of Sindh

Energy Department, Government of Sindh has been mandated to resolve matters relating to development, generation, supply and distribution of hydro and renewable power. Department of Alternate Energy is also responsible for respective planning, policy formulation, processing of renewable power projects and enactment of legislation with regard to renewable and hydro power generation and distribution.

4.4 National Transmission and Dispatch Co. (NTDC)

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

NTDC has been entrusted with the job of technical supervision of the Wind Projects. The Grid Code for WPPs is also formulated by NTDC and agreed with the stakeholders before being approved by NEPRA and accordingly implemented. NTDC also supplies the network data and approves the Grid Interconnection Study, which is a necessary for the regulator for the Generation License and Tariff award.

The basic design of the Project, specially the Metering, Protection, Telecom and EHV systems are approved and in some cases witness tested by NTDC before the EBoP equipments can be brought to the site and installed.

NTDC plays a significant role in protecting the assets of the investors and its own network from unspecified and low quality equipment.

5.0 CONCLUSIONS OF FEASIBILITY STUDY

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

The wind climate observed on the Site indicates good annual average wind speed. Thus the annual energy estimates are also good and it is feasible to develop the project based on Sany's turbines of 2.2 MW each. The project IRR as currently being assessed is suitable approx.15.5%.

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

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

WTGs considered in the study equally good for the Project. However equivalent types can be considered also. The negotiations of EPC contract and the price shall play a vital role in final selection.

The Project Site is conveniently located close to the grid of NTDC. From here onwards, the Project may enter into negotiation of security documents.

The next steps after approval of feasibility study would be to apply for Generation License and Tariff, and to begin negotiations for EPA and IA as required. The Project may also enter into discussion with lenders at this stage.

It is expected that the Project will achieve financial close by 3rd, quarter of year, 2018 and construction will be completed by 2th, quarter of year, 2020. It is anticipated that the Project of Moro Power would be a valuable addition to the National Grid for generating electricity and contribute to overcome the current energy crises of the Pakistan.

MORO POWER COMPANY (PVT.) LTD.

Electricity Generation Using Wind As Fuel

PART II CLAUSE 5 (a)

M/s R.M Gulistan are Sponsors of Moro Power Company Pvt. Ltd.

25 MW Wind Project

PROPOSED INVESTMENT

Investment will be as follows.

Equity: 20% Local

Debt: 80% Foreign

Attached are details of sponsors of Moro Power Company (Pvt.) Ltd. (MPCL), M/s R.M.Gulistan. Equity share of 20% will be arrange by M/s RMG, however we have offers from a number of reputed companies to participate in equity of MPCL's 25 MW Wind Project at Jhimpir, Sindh.

For Debt Financing we have received two offers, one offer of M/s Industrial & Commercial Bank of China Limited (ICBC), & Second offer of leasing company of china, copy attached.

Mustafa Abdulla

MUSTAF ABDULLAH

CEO

Moro Power Company (Pvt.) Ltd.

MORO POWER CO. (PVT) LTD.

Office: 4C, M-1, Ittehad Lane 12, Phase II Ext., DHA Karachi.

Ph: + 92 213 5885007 Cell: +92 322 222 5007, Email: gemsindh@gmail.com

5-A- (VI)

TURBINE DETAILS.

Proposed no. of Turbines	Capacity of Each turbine MW	Hub height (Proposed) Meter	Rotor Diameter Meters
Five (5)	3.2 MW	120	145
Three (3)	3.0 MW	100	121

II

Year	Make/Standard	Wind Class	Model	Life
2019	IEC-61400-12-1	IEC-S	3.2 MW	30 Years

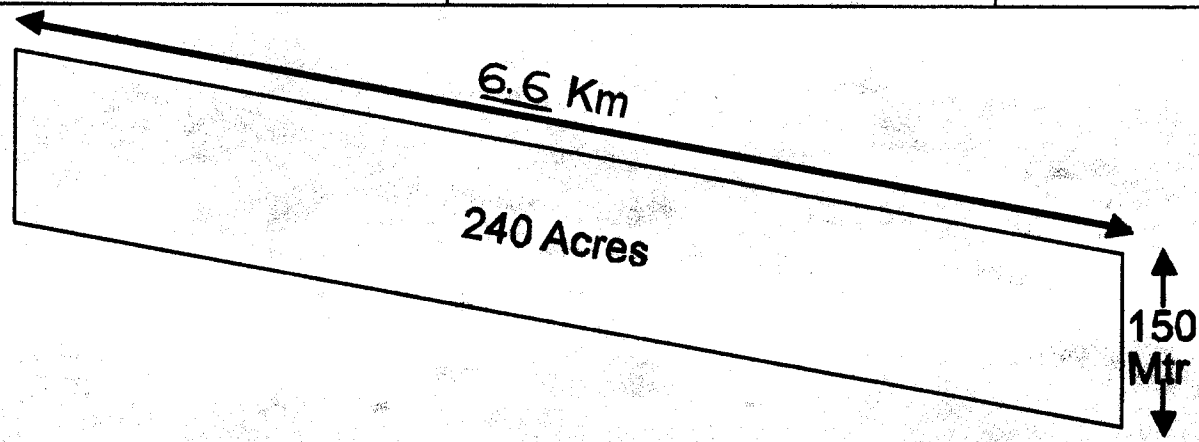
III

Operation Date	Fuel	Auxiliary Consumption	Net Capacity
November 2020	Wind	0.5%	38 to 40%

MORO POWER CO. (PVT) LTD.

MPCL WIND POWER PROJECT LAND CORDINATES

Boundary	Latitude	Longitude
M1	25 ® 2' 24.40" N	67 ® 39' 26.623" E
M2	25 ® 2' 20.527" N	67 ® 39' 23.37" E
M3	25 ® 0' 5.19" N	67 ® 42' 27'.69" E
M4	25 ® 0' 9.31" N	67 ® 42' 30.25" E



MORO POWER CO. (PVT) LTD.

A006126

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, KARACHI

CERTIFICATE OF INCORPORATION

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

Corporate Universal Identification No. 0091537

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

Given under my hand at **Karachi** this **Sixteenth** day of **January,** Two **Thousand** and **Fifteen**.

Incorporation fee Rs. **9,000/=** only

(Sidney Custodio Pereira)
Joint Registrar of Companies
Karachi

THE COMPANIES ORDINANCE, 1984
(Company Limited by Shares)

ARTICLRES OF ASSOCIATION

OF

MORO POWER COMPANY (PRIVATE) LIMITED

1. The regulation contained in Table "A" in the first Schedule to the Companies Ordinance 1984, shall apply to the Company to the extent that they are applicable to private limited companies except for regulations numbered 3,4, 46 and 70: and except in so far as the same are expressly excluded or modified by these Articles.

INTERPRETATION

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

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

"Company" or **"this Company"** means MORO POWER COMPANY (PRIVATE) LIMITED

"Director" or **"Directors"** means the Directors and Alternate Directors for the time being of the Company or, as the case may be, the Directors and Alternate Directors assembled at a board.

"Dividend" includes Bonus shares;

"In writing" means written or printed or party written and partly printed or lighographed or typewritten or other substitute for writing;

"Month" means a calendar month;

"Office" means the Registered Office for the time being of the Company;

"Ordinance" means the Companies Ordinance 1984;

"Persons" includes corporations as well as individuals;

"Register" means the Register of Members to be kept pursuant to the Ordinance;

"Seal" in relation to a Company, means the common seal of the Company;

"Section" means Section of the Ordinance;

Unless the context otherwise requires, words or expressions contained in these Articles shall have the same meaning as in the Ordinance.

PRIVATE COMPANY

3. The company is a "PRIVATE COMPANY" within the meaning or Section 2 (1) (28) of Company Ordinance 1984 accordingly.

(i) The right to transfer the shares of the company shall be restricted in the manner and to the extent herein provided;

(ii) The number of members of the company shall be limited to Fifty (50) number including persons who are in the employment of the Company provided that, where two or more persons hold one or more shares in the Company jointly, they shall, for the purpose of this definition, be treated as a single member and

(iii) The Company shall not invite the public to subscribe for its debentures.

SHARES

4. **Capital:** The authorized share capital of the Company is Rs. 500,000/- (Rupees Five Hundred Thousand only) divided into 50,000 (Fifty Thousand) ordinary shares of Rs. 10/- (Rupees One Ten) each.

5. **Full Nominal Amount:** The amount payable on application for subscription to shares shall be the full amount of the nominal amount of the shares.

6. **Shares at the Disposal of Director:** The shares shall be under the control of the Directors who may allot or otherwise dispose of the same to such persons, on such terms and conditions and at such time, as the Directors think fit.

7. **Trust not recognized:** The Company shall not be bound to recognize any equitable, contingent, future or partial claim to or interest in a share on the part of any person other than the registered shareholder, save as herein provided or save as ordered by some Court or competent jurisdiction.

8. **Certificate:** The certificate of title to shares shall be issued under the Seal and shall be signed by two of the Directors.

9. The certificate of share registered in the name of two or more persons shall be delivered to the person first named on the Register.

10. Only fully paid share shall be issued to each subscriber in the first instance.

TRANSFER AND TRTANSMISSION OF SHARE

11. **When Directors may Decline to Register Transfers.** Save and except as hereinafter provided, the Directors may in their absolute and uncontrolled discretion decline to register or acknowledge any transfer of shares and shall not be bound to give any reason for such refusal.

12. **Disposal only to Members:** Any member proposing to transfer share shall be bound to offer his entire holdings in the Company in the manner hereinafter provided and no member shall be entitled to dispose off his share to a person who is not a member of the Company.

13. **New Member:** If Directors may be unanimously decision admit any person not already a member to become a member by issue of new shares or by transfer of existing shares, if it is in the interest of the Company.

14. **Transfer Notice:** If any person desire to transfer all or any part of his shares (hereinafter called the "Proposing Transferor"), then he shall through written notice (hereinafter called the "Transfer Notice") inform the Company that he desires to transfer shares held by him in the Company to a member or members or a person (hereinafter called " The Purchaser") at a price to be agreed upon between the proposing Transferor and the Purchaser, and in default of Agreement at the fair value mentioned in Article 16 hereof. Such Transfer Notice shall constitute the Company as the Proposing Transferor's Agent for the sale of all his shares to the Purchaser. The Transfer Notice shall not be revocable except with the sanction of majority of the Directors.

15. **Notice to Proposing Transferor:** The right to sell the shares vest with the Company for thirty (30) days from the receipt of the Transfer Notice. If the Company within this period of thirty (30) days finds the Purchaser willing to purchase the shares, then the Company shall give notice to the Proposing Transferor, who shall be bound upon the payment of the agreed price or fair value, as the case may be, transfer the shares to the Purchaser. All other members of the Company shall be sent copies of the Transfer Notice within three (3) days of the receipt of the Transfer Notice to ascertain if they are interested in purchasing the offered shares. Any such member, upon receipt of such notice from the Company may inform the Company that he will not exercise his right to purchase. If a member desires to purchase all or any part of the shares offered by the Proposing Transferor then he shall inform the Company of the same not later than the expiration of the above thirty (30) days stipulated period. Such notice shall set forth the number of shares which the party elects to purchase and the place and time at which the purchase price shall be paid.

16. **Fair Market Value.** The fair value aforesaid shall be ascertained as follows:

    (a) The Company in general meeting may from time to time by resolution passed by majority of not less than three-fourth in value of the holders of shares present and entitled to vote declares the fair value of a share.
    (b) Such resolution shall remain in force until the expiration of one year after the passing thereof for such fewer periods as shall be specified therein.

(c) If at the time when a Transfer Notice is given as aforesaid any such resolution fixing the fair value is in force, the fair value fixed thereby shall be deemed to be the fair value of the shares comprised in such Transfer Notice.

(d) If at the time a Transfer Notice is given as above no such resolution is in force and Proposing Transferor and the Purchaser are unable to agree as to the fair value of shares, then the break up value of said share shall be deemed to be its fair value.

17. **Default in Transferring Shares.** If in any case the Proposing Transferor, having become bound as aforesaid, makes default in transferring the shares, the Company may received the purchase money and shall thereupon cause the name of the purchaser to be entered in the Register as the holder of the share and shall hold the purchase money in trust for the Proposing Transferor. The receipt of the Company for the purchased money shall be a good discharge to the purchaser, and after his name has been entered in the Register shall not be questioned by any person.

18. **Liberty to Sell After One Month.** If the Company does not, within the period of one month after being served with the Transfer Notice, find a member or person selected as aforesaid, willing to purchase the shares and give notice in a manner aforesaid, the Proposing Transferor shall at any time within three months afterwards be at liberty to sell and transfer the shares to any person at any price.

19. **Proportionate Offering.** Every share specified in any Transfer Notice to the Company pursuant to Article 14 hereof shall be offered to the members in such proportion as they may unanimously agree upon or in the proportion to their respective holding or as near hereto as possible if there is no unanimous agreement.

20. **Bound By Notice.** Every person who, by operation of law, transfer or other means whatsoever shall become entitled to any shares shall be bound by every notice in respect of such share which previous to his name and address and title to the share notified to the previous to his name and address and title to the share notified to the Company. shall be duly given to the person from whom he derives his title.

21. **Transfer Instrument Lost.** Where it is provided to the satisfaction of the Directors that an instrument of transfer signed by the transferor and transferee has been lost, the Company may if the Directors think fit, by any application in writing made by the transferee and bearing the stamp required by an instrument of transfer, register the transfer on such terms of indemnity as the Directors may think fit.

BORROWING POWERS

22. Subject to the provisions of the ordinance, the Directors may exercise all the powers of the Company to borrow money on such terms and conditions as may be acceptable to the Directors, debenture stock, and other securities, whether outright or as security for any debt, liability or obligation of the Company or of any third party; and to obtain finance for the purpose of the Company from banks, financial institutions or from any other institution set up by the Federal Government or by any principal government and may secure such finance by the issue of any kind of security or obligation.

VOTES OF MEMBERS

23. No person shall be appointed a proxy who is not a member of the a proxy who is not a member of the Company and qualified to vote save that a corporation being a member of the Company may appoint as its representative any person whether a member of the Company or not. An attorney of a member need not himself be a member.

24. **Number of Directors:** The number of Directors shall not be than two and more than nine. The following persons shall be the first Directors of the Company.

1. Mustafa Abdullah
2. Syed Fayaz Ali Shah Sheerazi
3. Myra Abdullah
4. Syed Israr Ali Shah
5. Capt (Retd) Syed Ghulam Mohiuddin
6. Syed Ahsan Raza Zaidi

25. **Election:** Election of the Directors will be according to the procedures laid down in Section 178.

26. **Nominated Directors:** Subject to the provisions of an agreement made with a bank, financial institution or any other institutions in respects of any loan, advance or credit in foreign and or local currency, in addition to the elected Directors, each of the above mentioned bank, financial institution or other institutions shall have the right from time to time to appoint a person as Director of the Company and to remove such persons from office and, on a vacancy being caused in such office for any reason whether by registration, removal, death or otherwise, to appoint another person to fill the vacancy. The Director (s) so appointed shall be called "Nominated Director (s), such Directors shall not be required to hold any qualification shares and shall have such other rights and privileges as the elected Directors of the Company. The provisions of these Articles and other regulations or rules relating to the election, retirement, qualifications or disqualification of the elected Directors shall not applied to the Nominated Directors.

27. **Chief Executive.** The Directors may from time to time entrust to and confer upon Chief Executive for the time being such of the powers exercisable under these present by the Directors as they think fit, and may confer such powers for such time, and to exercise for such objects and purposes, and upon such terms and conditions and with such restriction, as they think expedient, and they may confer such powers either collaterally with or to the exclusion of and in substitution for all or any of the powers of the Directors in that behalf, and may from time to time revoke, withdraw, alter or vary all or any of such powers.

28. **Remuneration.** If any Director, being willing, shall be called upon to perform extra services or to make any special exertions in going or temporarily residing out of Pakistan or otherwise

for any of the purposes of the Company, the Company shall remunerate such Director all charges and traveling expenses as may be determined by the Directors, the remuneration paid to the Directors, however, in no event, shall exceed the limit fixed by the Controller of Capital Issues.

29. **Vacancy**. The Directors may act as notwithstanding any vacancy in their body, but if the number fall below two, the Directors shall not except for the purpose of filling vacancies, act so long as the number remains below two.

30. **Alternate Director**. Directors may with the approval of the board appoint an alternate Director to act for him during his absence for a period of not less than three months from Pakistan and such appointment shall have effect and such appointee while he holds office as alternate Director shall be entitled no Notice of meetings and vacate office, if any, when the appointer returns to Pakistan, or vacates office as Director, or removes the appointee from office, and any appointment and removal under this Article shall be effected by notice in writing under the hand of Director making the same. The assignment of office by Director other than the foregoing shall be subject to approval by a special resolution of the Company.

31. **Removal**. The Company may be in general meeting resolution remove any Director, provided that a resolutions for removing a Director, shall not be deemed to have been passed, unless the requirements of section 181 have been complied with.

POWER OF DIRECTORS

32. Without prejudice to the general powers conferred by the Ordinance, Table "A" in the First Schedule to the Ordinance, the Memorandum and these Articles, and the other powers conferred by Section 196, the Directors shall have the following powers:

(a) To do an perform any and all acts in the name and on behalf of the Company that may be necessary or appropriate in connection with the conduct of the Companies business within and without the country of Pakistan including, but not limited to the authority to represent and commit the Company in its business activities with any and all authority to execute in the name and on behalf of the Company an and all agreements, documents and other instruments relating to the business of the Company and acquisition of rights and the assumption of obligations relating thereto;

(b) To validate in writing, specific portion of the foregoing authority conferred under Article 34 (a) to any person or persons whomsoever and to revoke or resign at any time any such delegation of authority.

(c) To take on lease, purchase or otherwise acquire for the Company any property, rights or privileges which the Company is authorized to acquire at such price and generally on such terms and conditions as they think fit.

(d) To appoint any person or persons to hold interest for the Company any property, belonging to the Company or in which it in interested or for any other purposes and execute and do all such instruments and things as may be requisite in relation to any such trust;

(e) To sell, rent, exchange or otherwise dispose off absolutely or conditionally all or any part of the property, privileges and undertaking of the Company upon set terms and conditions and for such consideration as they may think fit;

(f) To buy or procure to supply of all plant's machinery, material stores, fuel, implements and other moveable property required for the purposes of the Company;

(g) To sell and to dispose of all articles and goods manufactured or dealt in by the Company;

(h) To engage, fix and pay the remuneration of dismiss or discharge manager, employees, agents, secretaries, servants, workmen and other persons employed or to be employed in or in connection with the Company's business;

(i) To appoint any person or persons to be attorneys of the Company for such purposes and with powers, authorities and discretion, not exceeding those vested in or exercisable by the Directors and subject to such conditions, as the Directors may from time to time deem fit;

(j) To enter into, carry out, rescind or vary all financial agreement with any banks, persons or corporations for and in connection with the Company's business or affairs and pursuant to or in connection with such arrangements to deposit, pledge or hypothecate any property of the Company or the documents representing or relating to the same;

(k) To make and give receipts, releases and other discharges for moneys payable to the Company and for the claims and demands of the Company;

(l) To compound and allow time for the payment or satisfaction of any debts due to or by the Company and any claims and demands by or against the Company and to refer any claim or demand by or against the Company to arbitration and observe and perform the awards;

(m) To draw, accept, endorse and negotiate for and on behalf of the Company, all such cheques, bill of exchange, promissory notes, hundies, drafts, government and other securities as shall be necessary in or for carrying on the affairs of the Company.

(n) To institute, prosecute, defend, compromise, withdraw or abandon any legal proceedings by or against the Company or its officers or otherwise concerning the affairs of the Company;

(o) To invest any of the moneys of the Company not immediately required for the purposes thereof upon such securities or investments and in such manner as they may think fit and from time to time vary or realize such securities and investments;

(p) To enter into such negotiations and contracts and rescind or vary all such contracts and execute and to all such acts, deeds and things in the name and on behalf of the

Company as they may consider expedient for or in relation to any of the matter aforesaid or otherwise for the purposes of the Company;

(q) To pay for any property or rights acquired by or services rendered to the Company or the premiums payable in respect of any leases taken by the Company whether wholly or partially in cash or in shares, by the Company whether wholly or partially in cash or in shares, bonds, debentures, debenture stocks, or other securities of the Company and any such bonds, debentures, debenture stocks or securities to be either specifically charges upon all or any part of the property of the Company;

(r) To insure against fire or other loss or accident all or any of the properties of the Company as the Directors may from time to time think fit;

(s) To open accounts with any bank or bankers or with any Company, firm or individual and to pay money into and draw money from any such account from time to time as the Directors may think fit;

DIVIDENDS AND RESERVE

33. **Declaration of Dividends.** The Company in general meeting may declare a dividend to be paid to the members according to the rights and interests in the profits and may fix the time of payment, not exceeding thirty (30) days from declaration of dividend but not longer dividends shall be declared until these are recommended by the Directors.

34. **Transfer must Registered to pass Dividend.** A transfer of shares shall not pass the right to any dividend declared thereon before the registration of the transfer.

35. **How dividends remitted.** Unless otherwise directed, dividend shall be paid by warrant sent through the post to the address of the member entitled thereof and in case of joint-holders to the address of that one whose name stands first on the Register in respect of the Joint-holding and every check or warrant so sent shall be made payable to the order of the person to who it is sent.

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

37. **Dividends in Specie.** Any general meeting declaring a dividend may direct payment of such dividends wholly or in part by the distribution of specific assets, and in particular of paid up shares or debentures of the Company, or paid shares or debentures of any other company, or in any one or more of such ways. The Directors shall give effect to such resolution. Where any difficulty arises in regard to the distribution they may settle the same as they think expedient; and may fix the value for distribution of such specific assets, or any part thereof, and may determine that cash payments shall be made to any member upon the footing of the value so fixed in order to adjust the rights of all parties; or may vest any such specific assets in trustee upon trusts for the persons entitled to the dividends as may seem expedient to the Directors.

RECONSTRUCTION

38. On any sale of the undertaking of the Company, the Directors or the liquidators on a winding up may, if authorized by a special resolution, accept fully paid shares, debentures, or securities of any other company, either then existing, or to be formed for the purchase in whole, or in part of the property of the Company. The Directors (if the profits of the Company permit), or the liquidators (in a winding up) may distribute such shares or securities, or any other properties of the Company amongst the members without realizing, or vest the same in trustees for them. Any special resolution may provide for the distribution or appropriation of the cash, share or other securities, benefits or property, otherwise than in accordance with the strict legal rights of the members of contributors of the Company. All holders of the shares shall be bound to accept, and shall be bound by any such authorized valuation or distribution relating to the valuation of any securities, or property at such price, and in such manner as the meeting may approve; and they shall waive all rights in relation thereto, save only such statutory right (if any) as are, in case the Company is proposed to be or is in the course of being wound up, incapable of being varied or excluded by these presents.

WINDING UP

39. If the Company is wound up, the liquidator may with the sanction of a special resolution of the Company and other sanction required by law, divided amongst the member in specie or kind the whole or any part of the assets of the Company (whether they shall consist of property of same kind or not) and may, for such purpose, set such value as he deems fair upon any property to be divided as aforesaid and may determine how such division shall be carried out as between the members or different classes of members. The liquidator may, with the like sanction, vest the whole or any part of the such assets in trustees upon such trust for the benefit of the contributors, as the liquidator with the like sanction, shall think fit, so that no member shall be compelled to accept any shares or other securities whereon there is any liability.

INDEMNITY

40. No Director, or any other officer of the Company shall be liable for the acts, receipts, neglect, or default of any other Director, or officer, or for joining in any receipt, or other act for conformity, or for any loss, or expenses happening to the Company or for the insufficiency or deficiency of any security of investment in or upon which any of the Company shall be invested, or for any loss or damage arising from the bankruptcy, insolvency or tortuous act of any person with whom any moneys, securities or effects shall be deposited, or for any loss occasioned by any error of judgment or oversight on his part; or for any other loss, damage or misfortune whatever which shall happen in the execution of the duties of his office or in relation hereto unless the same happens through his dishonesty.

ARBITRATION

41. Whenever any difference arises between the Company on the one hand and any of the members, their executors, administrators or assignees on the other hand touching the intent or

construction of the incidence or consequences of these presents, or of the status or touching anything then or thereafter done, executed, omitted or suffered in pursuance of these presents or of the statues or touching any breach or alleged breach or otherwise relating to the premises, or to any statue affecting the Company or to any of the fair value of the shares of the Company, then every such difference shall, as a condition precedent to any other action at law, be referred, in conformity with the Arbitration Act 1940, or any statutory modification thereof and any rules made there under, to the decision of an arbitrator to be appointed by the parties in difference or if they can not agree upon on a single arbitrator to the decision of two arbitrators, of whom one shall be appointed by each of the parties in difference, or in the event of the two arbitrators not agreeing, then an empire to be appointed by the two arbitrators in writing before proceeding on the reference. If any party refuses or neglects to appoint his arbitrator within ten (10) days after the other party appointed his arbitrator, served the party making default, with notice to make appointment, the former party shall be entitled to appoint that arbitrator to act as sole arbitrator in the reference.

SECRECY CLAUSE

42. Every Director, manager, employee, member of the committee, officer, servant, accountant or other person employed in the business of the Company shall if so required by the Directors before entering upon his duties, sign a declaration pledging to observe a strict secrecy respecting all transactions of the Company with the customers, and the state of accounts with individuals, matter relating thereto, and shall by such declaration pledge himself not to reveal any of the matter which come to his knowledge in the discharge of his duties, except when required so to do by the Directors, or by a court of law, and except so far as may be necessary in order to comply with any of the provisions herein contained.

[redacted] ...ose[redacted]s ad[redacted]s, an[redacted]criptions are subscribed ... are ... ous o... fo... into .. company
[redacted] ...suan... thi... moral ... of a... tion ... e respectively agree to take the number of shares ... ie capital of the company set opposite our respective names.

S.No.	Names and Sub Name	Father's /Husband's Name	Nationality with Former nationality	Occupations	No. of shares Taken by each Subscriber	Addresss	Signature
1.	Mustafa Abdullah 42301-7944934-1	Ahmed Abdullah	Pakistani	Business	700	House No 83/2, Street No 25, Khayaban-e Sahar, DHA Phase-6 Karachi	Sd/-
2.	Syed Fayaz Ali Shah Sheerazi 41409-1933102-7	Syed Aijaz Ali Shah Sheerazi	Pakistani	Business	150	Sheerazi Street, Ward1, Talka Municipal Committee District Thatta	Sd/-
3.	Myra Abdullah 42301-2716257-4	Mustafa Abdullah	Pakistani	Business	80	House No 23/1, Street No 19, Khayaban-e Tanzeem, DHA Phase-5 Karachi	Sd/-
4.	Syed Israr Ali Shah 41306-3189848-5	Syed Ali Murtaza Shah	Pakistani	Business	50	House No C1-2-3, Street Gulistan Sajad Taluka Qasimabad, Hyderabad	Sd/-
5.	Syed Ghulam Mohiuddin 42101-8616437-1	Syed Aleemuddin	Pakistani	Business	10	A-396, Block-1, North Nazimabad, Karachi	Sd/-
6.	Syed Ahsan Raza Zaidi 61101-9242528-7	Syed Sagheer Hussain Zaidi	Pakistani	Business	10	House no 7, street 87, Embassy Road, G-6/3, Islamabad	Sd/-
					Total 1000		

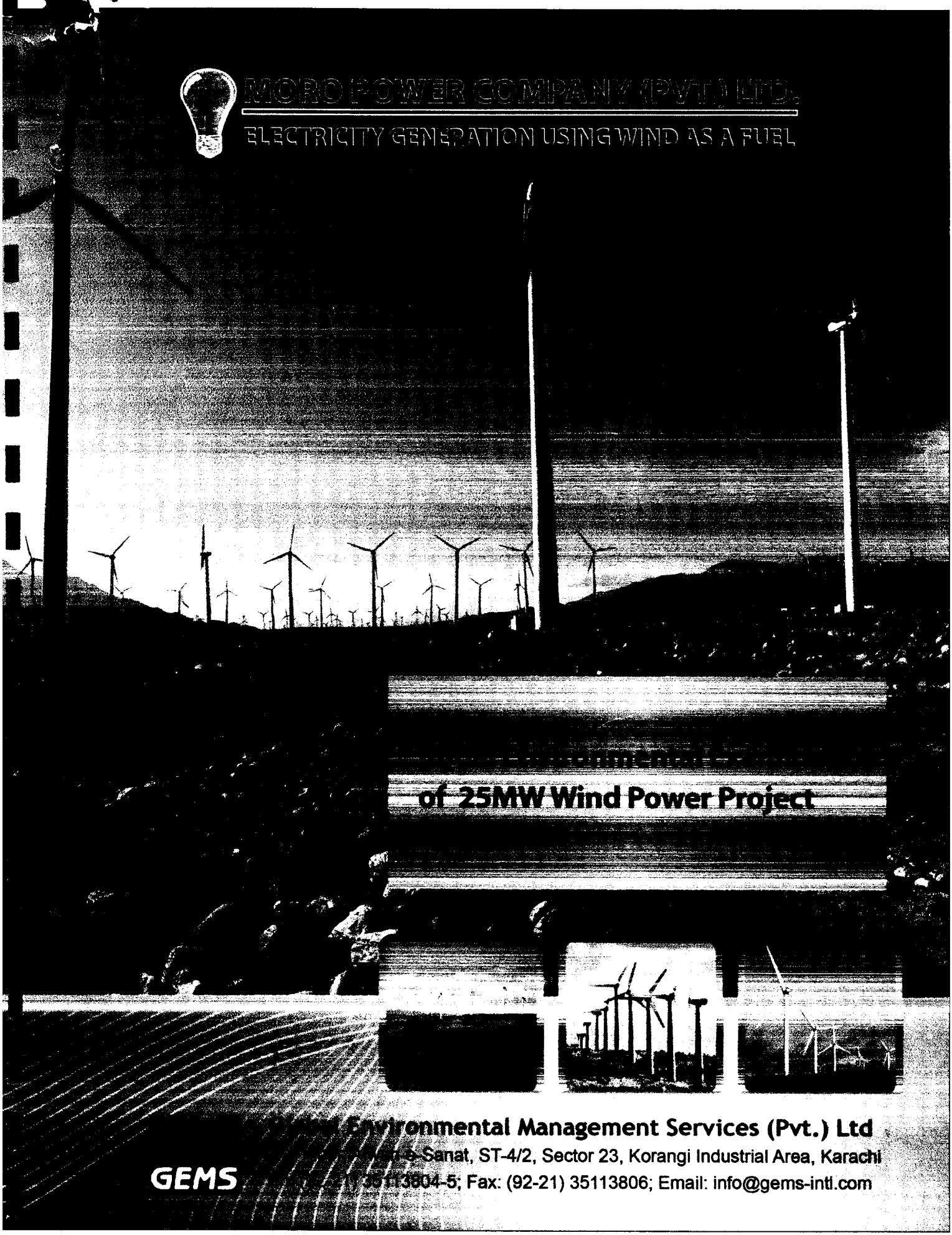
Certified to be True Copy
Deputy Registrar of Companies

Joint Registrar of Companies
Company Registration Office,
Karachi

Date: The 9th Day of January - 2015

Witness to above Signatures:

Full Name	Father's Name	Occupation:	Nationality:	Full Address:	Signature:
Syed Saad Hasan	S.F Hasan	Chartered Accountant	Pakistani	12-A Bl-6 PECHS, KHI.	Sd/-


MORO POWER COMPANY (PVT) LTD.
ELECTRICITY GENERATION USING WIND AS A FUEL
of 25MW Wind Power Project
Environmental Management Services (Pvt.) Ltd
Sanat, ST-4/2, Sector 23, Korangi Industrial Area, Karachi
35113804-5; Fax: (92-21) 35113806; Email: info@gems-intl.com
GEMS

EXECUTIVE SUMMARY

Global Environmental Management Services (Pvt.) Ltd. (GEMS) have conducted the Initial Environmental Examination for the proposed project titled as "IEE of 25 MW Wind Power Project". The Initial Environmental Examination has been prepared in compliance with the requirement under Section 17 of Sindh Environmental Protection Act, 2014. The major connecting roads are National Highway and Superhighway. The intend of the proposed project is to meet the electricity demand of Pakistan's economy through a viable and environmental friendly alternative as the current major sources of electricity are thermal and hydro generation.

The proposed project, "IEE of 25 MW Wind Power Project", falls under Schedule-I of EIA/IEE Regulation 2014 requiring an IEE at planning stage. Categorization of the project into **Schedule-I under Category B i.e. Wind Projects.**

PROPONENT ADDRESS & LOCATION MAP

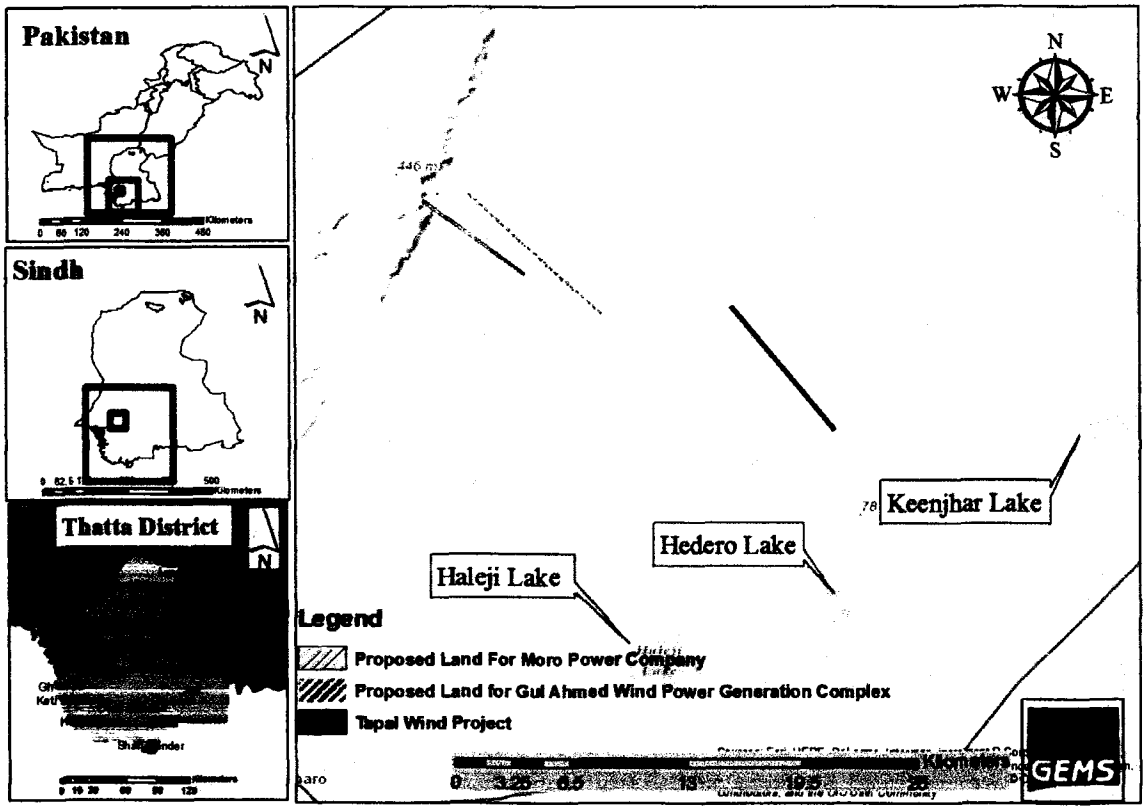
The proposed project site is located in District Thatta, Tehsil Jhampir. The direct distance of the MPC Project site from center of Karachi City is approximately 100 km and almost 80 km from Hyderabad City, The latitude and longitude of the proposed project is tabulated in table below. Respective Approach to the project site is through Karachi Hyderabad Super highway, after 20 km from the Nooriabad industrial area, towards Jhampir, adjacent to proposed Gul Ahmed wind power generation complex Deh Kohistan.

Latitude and longitude of the proposed wind power generation project

Boundary	Latitude	Longitude
M1	25° 2'24.40"N	67°39'26.623"E
M2	25° 2'20.527"N	67°39'23.37"E
M3	25° 0'5.19"N	67°42'27.69"E
M4	25° 0'9.19.31"N	67°42'30.50"E

Project Location Map

Moro Wind Power Company Project Site



PROPOSED PROJECT ACTIVITIES

- Supply of Logistics
- Setting of Wind Farm
- Siting the Wind Turbine
- Wind Turbine
- Electrical Collection System
- Substations
- Vehicle and Heavy Traffic
- Civil Construction
- Supplies during Construction Phase
- Electricity
- Waste Management

SALIENT FEATURES OF THE PROPOSED PROJECT

(A). General Information

i.	Wind Turbine Type, Make & Model	Sany, China
ii.	Installed Capacity of Wind Farm (MW)	25 MW
iii.	Number of Wind Turbine Units/Size of each Unit (KW)	13 X 2.0 MW

The main purpose of this Initial Environmental Examinations IEE study is to ensure:

- All major and minor positive and negative impacts on the environment (physical, biological, social and ecological) during the different stages inception as well as pre-construction, construction, and operation of proposed project are identified.
- Appropriate and adequate mitigation measures are suggested to reduce or eradicate the adverse impacts and practical procedures for their implementation are provided.
- Environmental Management Plan (EMP) for sustainable operation of the project forms an essential part of the IEE document.

The assessment has focused on the construction and operational activities. The major areas covered in the impact analysis included solid waste, occupational safety and socio-economic factors as well as Land acquisition. Since the project area is located within the rural environment, hence the air and noise pollution is not going to be a major issue.

PHYSICAL ENVIRONMENT OF THE PROJECT AREA

The topographical elevation of the proposed project area is about 140 to 160 meters approximately. The available surface water resources within the proposed project vicinity are in the forms of rivers, canals, and streams. Additionally it is important to note that these water resources are not located in close proximity of the proposed project area. Hydrological investigations carried out by Water and Power Development Authority (WAPDA) on the western side of Indus River reveals that fresh water is available at shallow depths in Hyderabad and Thatta districts up to 60ft.During the survey specifically carried out for this IEE study it was observed that the air quality of the project surrounding is relatively much cleaner than other parts of the country, one of the reason of clean air is high wind speed which is about more than 5m/s during 8 months, from February to September, and the highest wind speed of 11.5 m/s is observed during July.

SOCIOECONOMIC ENVIRONMENT OF THE PROJECT AREA

The major entry exit road into the proposed project area is Hyderabad Super highway, after 20 km from the Nooriabad industrial area. The project area has no linkages with railway line. According to the 1998 census of Pakistan, it had a population of 1,113,194. Jhimpir is a union council in Thatta District, Sindh, Pakistan. It is situated 114 km away from Karachi. It is the site of Pakistan's first wind power project. It is the only place in Pakistan where dolomite is found. Thatta District is administratively sub divided into 5 talukas and 94% of the sindh language is being spoken. The bazaars of Thatta are known for hand-printed fabrics, glass bangles and Sindhi embroidery work in lay with tinny mirrors, one of the more world known handicrafts of Pakistan. Thatta appears to have scarcely moved out of the 18th century and is only slowly catching up with the modern world. District Thatta formerly considered as an under developed district of Sindh. It does not have their own resources to enhance the value and improve the quality of life of its people. Proposed Project site was surveyed to see the surrounding settlements of the area. Total area was surveyed in close vicinity of the proposed project site. Two villages was found near the project area with small population.

The findings of impact study and visual inspections of the existing environment of the project area in the present scenario, indicates following main impacts for ***the construction phase*** and ***after Construction phase*** along with simultaneous relevant and appropriate measures, however during operational phase there will be no major impacts on environment.

Checklist of Actions Affecting Environment and Significance of their Impact

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
			None	Small	Medium	Major
A. Environmental Problems due to Project Location						
1. Changes in hydrology affecting existing property values of land	Damages to land due to erosion and/or accretion	Consider geology of the site	x			
2. Encroachment into precious ecological zones	Loss of precious ecology	Qualitative and quantitative analysis of ecology	x			
3. Displacement of population/Resettlement	Social inequities/inadequate compensation	Adequate attention to problem	x			
4. Historical/monuments /cultural values	Loss of precious values	Identify and secure any important cultural site	x			
5. Environmental aesthetics	Loss of environmental aesthetics	Careful planning & Monitoring		x		

Actions Affecting Environment Resources & Value	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
			None	Small	Medium	Major
B. Environmental Problems due to Inadequate Design						
1. Unrealistic assumptions on available construction skills	Unnecessary damages because construction requirements too high	Realistic construction assumptions		x		
2. Pollution Control Equipment Selection	Assumed pollution removals not realized	Appropriate equipment selection		x		
3. Environmental pollution control operations	Possible loss in overall regional welfare	Careful planning/designing/monitoring and use of appropriate standards		x		
3a. Water	Impairment of beneficial water uses	Analysis of consumption and resource availability		x		
3b. Air	Impairment of air quality	Careful planning & monitoring		x		
3c. Noise	Environmental Degradation & Health hazard	Selective noise abatement technique		x		
4. Occupational health & Safety hazards	Hazards to workers health & safety	Careful planning to prevent and secure an offset problem			x	
5. Hazards due to Spills/fires/explosions	Hazards to workers health & safety	Careful planning & management of pollution control		x		
6. Area sanitation	Sanitation/disease hazards	Sanitation management planning according to work criteria		x		
7. Hauling routes in/out areas	Traffic congestion and nuisances along access routes	Traffic management plan according to current traffic movement			x	
C. Environmental Problems During Construction Stage						
1. Problems due to uncontrolled construction practices e.g. scarring	Problems of Environmental Degradation	Careful Planning and Implementation such as ILO safety regulations		x		
a) Run off erosion	Soil degradation	Pitching of trench and containment of runoff for reuse		x		

Action Affecting Environment Resource & Value	Damage to Environment	Recommended Mitigation Measures	Significance of Impact			
			Low	Med	Medium	High
b) Worker accidents	Occupational Health & Safety	Careful planning to prevent and secure an offset problem		x		
c) Sanitation disease hazards	Occupational Health & Safety	Training of contractor staff, Sanitation management planning according to work criteria		x		
d) Hazardous material handling	Health and environmental hazards	Training of contractor staff, hazardous material will be segregated in labeled containers		x		
e) Dust/odors/ fume	Air pollution and health hazards	Sprinkling of water at intervals/ use less gas emitting technology for work		x		
f) Explosion/fire hazards/hazard ous materials spills	Problems of Environmental Degradation	Careful planning to prevent and secure an offset problem		x		
g) Noise/vibration hazards	Problems of Environmental Degradation	Selective noise abatement technique			x	
h) Machinery & Equipment mobilization	Occupational Health and Safety Issues	Careful Planning with technology assessment and Implementation			x	
i) Water pollution hazards	Problems of Environmental Degradation	Careful Planning of passage, containment and Implementation		x		
2. Uncovered cut & fill trenches/areas	Soil erosion, consequent damage to properties & environment, besides trapping of fauna	Pitching of trench and monitoring required		x		
D. Critical Environmental Review Criteria						
1. Loss of irreplaceable resources	Long-term national environmental and economic losses	Planning required to be consistent with government policies; Sustainable use of resources according to need basis of operation		x		
2. Accelerated use of resources for short term gain	Long-term national environmental and economic losses	Planning required to be consistent with policies; Compensate at later stages of operation with less use		x		
Overall Significance of Impact of Different Activities				**x**		

The proposed project developers will provide job opportunities to local community during construction and local communities will be benefited by this project in terms of employment and other opportunities etc. Regardless of all development and business initiatives, there is a need of Environmental Management Plan (EMP) to execute the mitigation measures at its actual sense. Therefore, an EMP has been developed and compiled for the assistance of the project developers, which shall supervise and monitor all the mitigation measures and their effectiveness. It explains and assigns roles & responsibilities of work to the individuals of management and makes it easy to handle the issues with care. Procedures to work on EMP shall be further developed by the developers of the project. The main aspects covered in the EMP guidelines for management approach, organizational structure indicting roles & responsibilities and implementation stages of EMP such as planning & design considerations, monitoring and mitigation plans during construction and needs of training.

Global Environmental Management Services (Pvt.) Ltd. (GEMS) have concluded:

"If the activities are undertaken as proposed and described in this report, and the recommended mitigation measures and environmental management plan is adopted, the project will not result in any long-term or significant impacts on the local community as well as on the physical, biological and socio economic environment of the project area."

LIST OF CONTENTS

3.0 INSTITUTIONAL, LEGISLATION AND POLICY FRAMEWORK

4.0 ENVIRONMENTAL BASELINE: PHYSICAL ENVIRONMENT

7.0 ENVIRONMENTAL IMPACTS AND MITIGATIONS MEASURES

8.0 ENVIRONMENTAL MANAGEMENT PLAN

9.0 CONCLUSION

LIST OF EXHIBITS

CHAPTER

1 INTRODUCTION

1.1 BACKGROUND INFORMATION

This report discusses the Initial Environmental Examination (IEE) of the proposed 25 MW wind power project for MPC. The intend of the proposed project is to meet the electricity demand of Pakistan's economy through a viable and environmental friendly alternative as the current major sources of electricity are thermal and hydro generation. The development of wind generation projects could reduce dependence on oil-based thermal power generation and decrease the greenhouse gas emissions. This potential renewable resource of power generation will contribute towards projecting a positive image of Pakistan within the international community.

1.2 PROJECT AREA AND LOCATION MAP

The proposed project site of MPC has about 240 acres of leased land for 30 years from Government of Sindh the proposed project will be established at deh Kohistan 7/1, Tapo Jhimpir and Deh Kohistan 7/3 Tapo Jungshahi Taluka Thatta at a distance of 24 km from super highway and at a distance of 64 km from National Highway in Deh Kharyo at Jhampir Noori Abad road in District Thatta, Sindh Pakistan.

The site location map of the proposed project has been presented below as **Exhibit 1.1, 1.2** and **1.3.**

Exhibit 1.1: Site Location Map

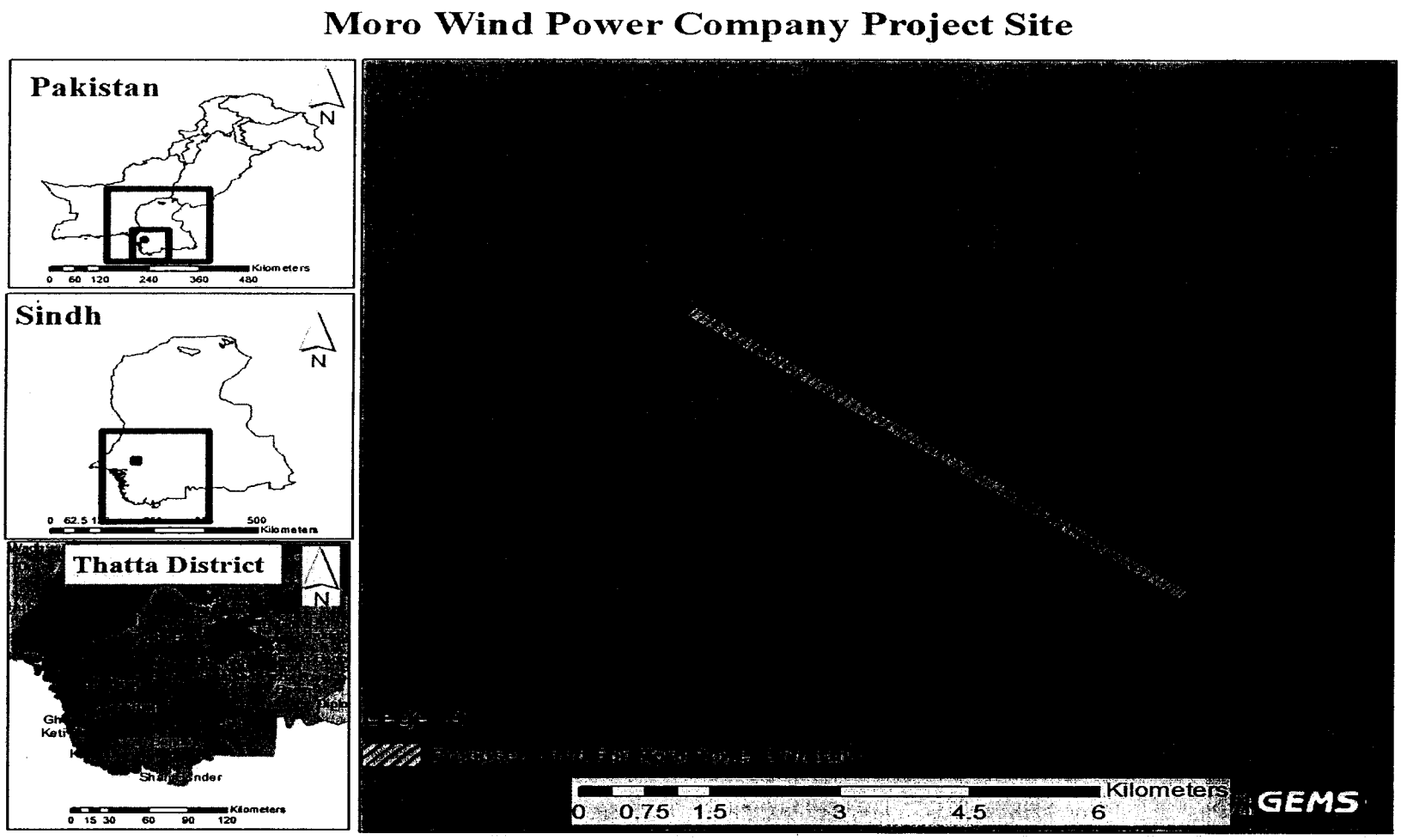


Exhibit 1.2: Site Location Map

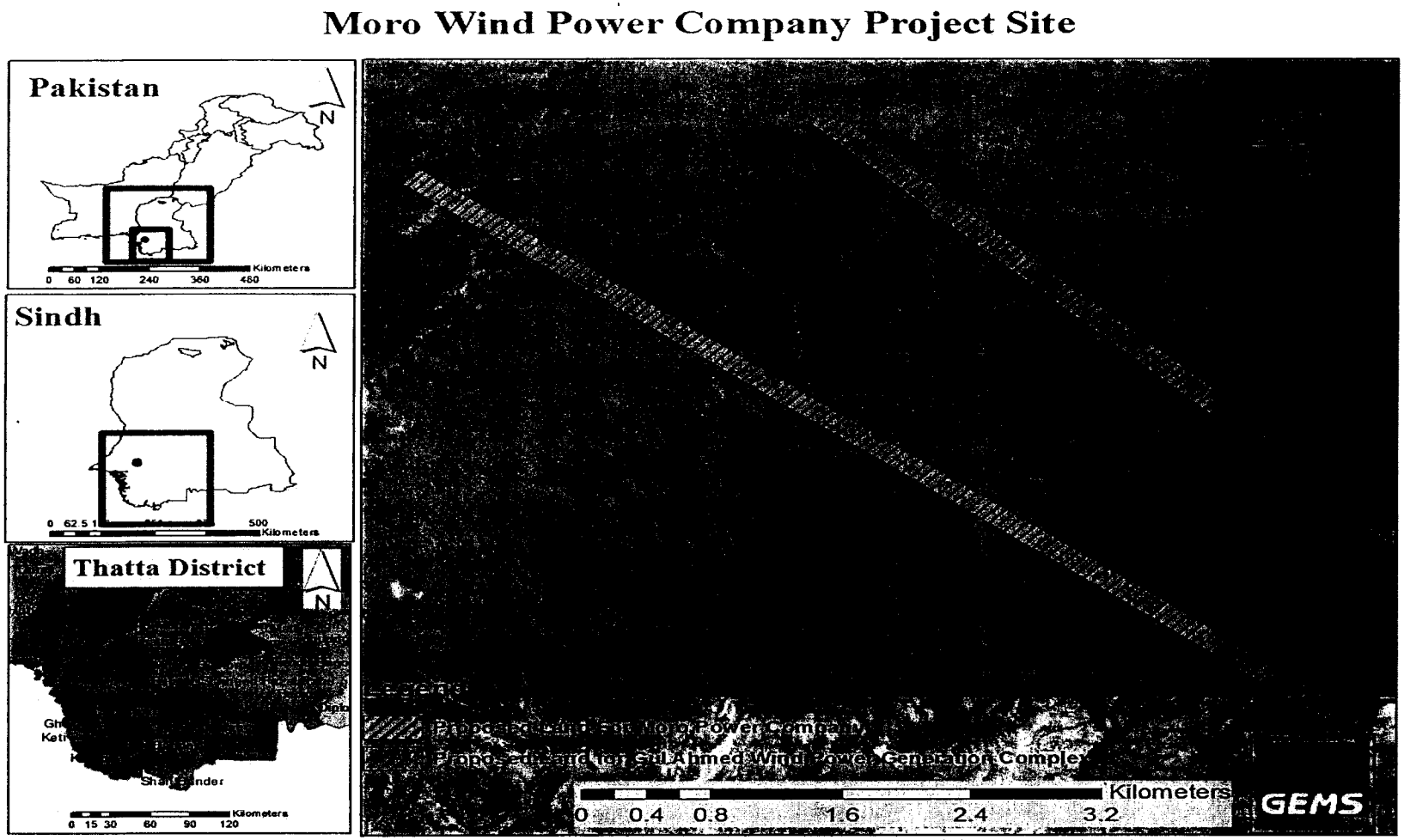
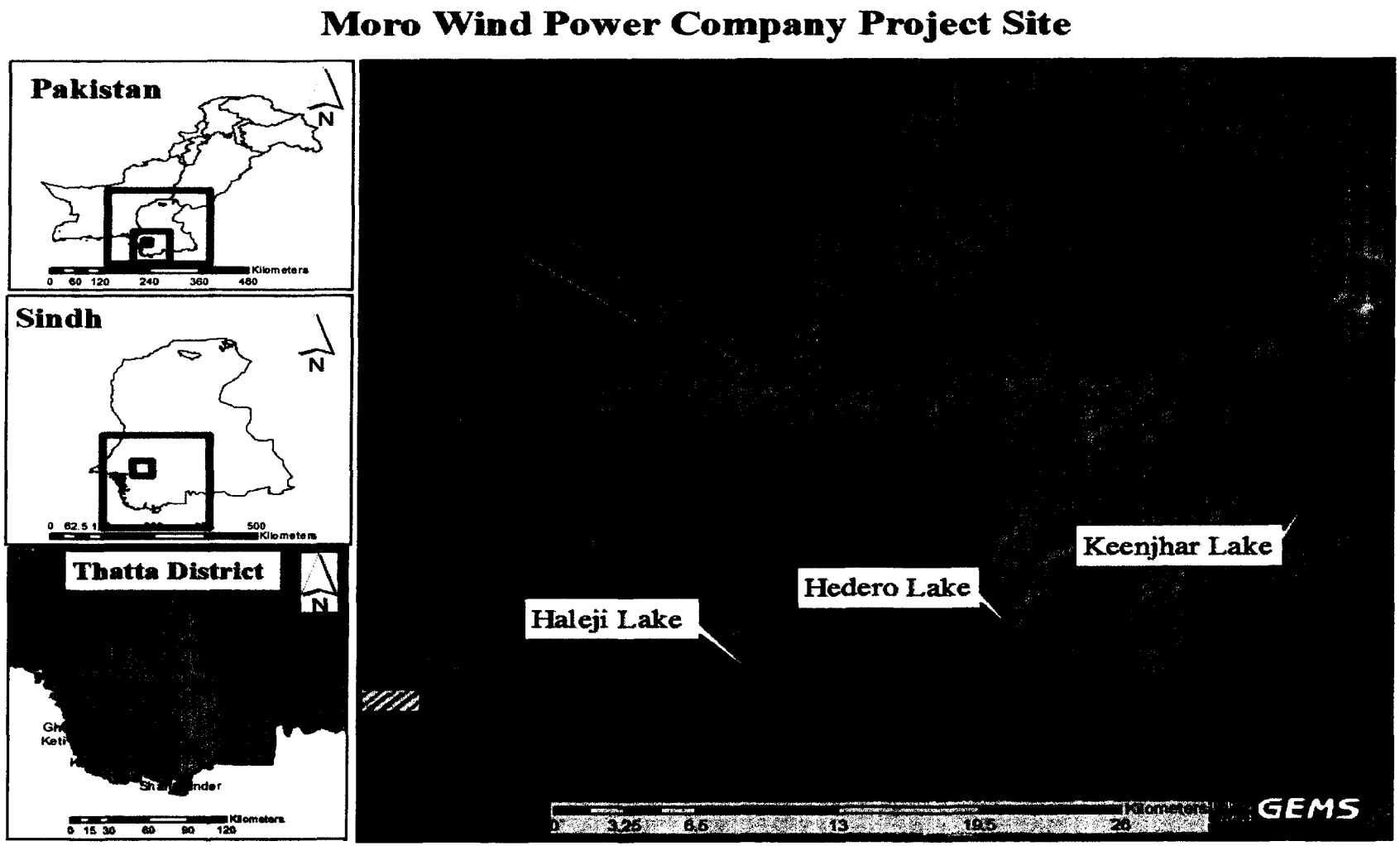


Exhibit 1.3: Site Location Map



1.3 CATEGORIZATION OF THE PROPOSED PROJECT

The proposed project falls under the project Schedule I of category B: **"Wind projects"** as per the guidelines issued by the Sindh Environmental Protection Agency (Review of IEE/EIA) Regulations 2014 and Section 17 of Sindh Environmental Protection Agency (SEPA) under the SEPA ACT, 2014. According to these guidelines, project under this category require an IEE to be conducted at planning stage.

1.4 PROPONENT INTRODUCTION

MPC is a newly established independent power production company wants to provide uninterrupted low-cost and environmental friendly electrical energy. MPC decided to enter in Pakistani market of wind power by taking opportunity of Pakistan's present energy demand and supply situation and the investment friendly initiatives taken by Alternative Energy Development Board (AEDB). MPC is going to install wind power project of 25 MW at wind corridor of Jahmpir, Thatta. It is the first project of MPC.

MORO POWER COMPANY PVT. LTD has engaged the services of M/S Global Environmental Management Services (Pvt.) Limited (GEMS) Pakistan to conduct an Initial Environmental Examination (IEE), of the proposed 25 MW Wind Power Project. This report documents the IEE process and presents its findings.

MORO POWER COMPANY (PVT.) LTD.

ELECTRICITY GENERATION USING WIND AS AFUEL

1.5 PURPOSE OF PROJECT

The project conforms to the government policy that promotes development of renewable energy technology and contributes to lowering dependence on fossil fuel for generating electricity. It is expected to help alleviate the huge energy deficit in Pakistan.

Contribution to Sustainable Development

The project will make significant contribution to sustainable development in the area such as:

- **Environmental Well-being**

The project not only replaces equivalent thermal generation with all the associated environmental benefits but it also promotes an overall environmental wellbeing

since the project will help avoid all associated pollution caused by extraction, processing, storage and transportation of conventional fuels required for thermal generation.

- **Social Well-being**

There will be reduction in poverty in an economically depressed region with very little industry and high unemployment as opportunities will be created during installation as well as operation for both unskilled and skilled workers. The skill sets of locals will be improved through training and capacity building for employment in the project contributing to technical advancement.

1.6 THE IEE STUDY

Need of the IEE Study

IEE was carried out by GEMS, for MPC as per legislative requirement under Sindh Environmental Protection Agency (SEPA) Act 2014. This IEE report is consolidation of the finding and assessment carried out during the IEE process. This IEE was guided by best international practices and conducted accordingly for wind power project of MPC.

As stated earlier that this IEE study has been undertaken to conform to the requirements of the SEPA Act 2014; the Pakistan Initial Environmental Examination; Environmental Impact Assessment Review Regulations 2014. Furthermore, this IEE being an important social and environmental governance tool has gone beyond the legislative requirements. It has incorporated the international best practices, the company's social and environmental policies and compliance and contextual realities to integrate the philosophy and processes of sustainable development.

Purpose of the IEE Study

The purpose of this IEE study is to environmentally evaluate the proposed project activities against the SEPA standards, and against international environmental guidelines.

The specific objectives of this IEE are to:

- Study Sustainable Project infrastructure development and production activities, delivery, and use of energy;
- Identify and evaluate the baseline environmental and social conditions of the proposed project area, including identification of environmentally sensitive areas, receptors and concerned stakeholders;
- Assess protection of human health, cultural properties and biodiversity, including endangered species and sensitive ecosystem.

- Propose appropriate mitigation measures that can be incorporated into the rehabilitation plans of the project to minimize damaging effects or lasting negative consequences if identified during the study;
- Assess the proposed activities and determine whether they comply with relevant environmental regulation in Pakistan
- Prepare IEE Report for submit to the SEPA

Scope of IEE Study

For this IEE study, the scope of work is as under:

- Organization of physical, biological socioeconomic and cultural baseline of the proposed project area;
- Stakeholder consultations/scoping meetings
- Project impact identification, prediction, and significance based on project activities.
- Identification and assessment of the workability of mitigation measures to offset or minimize negative project impacts on environment.

Report Structure of IEE Study

This IEE report has mapped its structure within nine chapters. Chapter 1, introduction, Chapter 2 of the report describes the proposed project in detail. Chapter 3 provides an overview of the national and international legislative tools, instruments and guidelines that are relevant to the proposed project; while Chapter 4, 5, 6 describes the project area's existing environmental conditions, including the physical, biological and socio-economic environments. The social, physical and environmental assessment of potential project impacts associated with project related activities have been discussed in Chapter 7. Chapter 8 provides a set of environmental actions, instruments and guidelines to minimize the impacts discussed in earlier sections in the form of environmental management plan. Chapter 9 presents the conclusion of the IEE.

1.7 APPROACH AND METHODOLOGY

The IEE was performed in four main phases, which are described below.

1.7.1 Scoping

The key activities of this phase included:

- ***Project Data Compilation:*** A generic description of the proposed activities within the proposed project area, relevant to environmental assessment was compiled.

- ***Published Literature Review:*** Secondary data on weather, soil, water resources, wildlife, and vegetation was reviewed and compiled;
- ***Legislative Review:*** Information on relevant legislation, regulations, guidelines, and standards was reviewed and compiled;
- ***Identification of Potential Impacts:*** The information collected in the previous steps was reviewed, and potential environmental issues were identified.

1.7.2 Baseline Studies

Following the scoping exercise, the proposed project area was surveyed to collect primary data. During the field visits, information was collected on;

- Ecologically important areas
- Ambient air quality
- Surface and groundwater resources
- Existing infrastructure
- Local communities
- Public services
- Sites of archaeological or cultural importance.

The following specific studies were conducted as part of the IEE.

Biodiversity Study: Biodiversity experts conducted the biodiversity study, which consisted of a thorough literature review and field data collection. As part of the floral and faunal study, random sampling was conducted and the area's floral and faunal species were documented. The diversity of avian, large and small mammals, and reptile species was determined. Information was collected on the species found in the area.

Physical Environment: Environmental Assessment Specialists conducted physical environmental study including, ambient air, noise, water sampling, surface water resources and the groundwater resources of the areas.

Socioeconomic Study: A Socioeconomic experts conducted socioeconomic and cultural study in the proposed project area. The study team through participatory technique collected data from the locals of the proposed project area. The profile included livelihood, culture, leadership, gender issues, spiritual and temporal leadership, demographic information based on field data and published sources, the existing use of land resources, community structure, employment, distribution of income, goods and services, public health, local religious and cultural values, and local customs, aspirations, and attitudes.

1.7.3 Impact Assessment

The environmental, socioeconomic and cultural, gender and project information collected in previous phases was used to assess the potential impacts of the proposed activities. The issues studied included potential project impacts on:

- Groundwater and surface water quality;
- Ecology of the area, including flora and fauna;
- Wild life
- Local communities;
- Socioeconomic and gender environment.

Wherever possible and applicable, the discussion covered the following aspects:

- The present baseline conditions;
- The change in environmental parameters likely to be affected by proposed project related activities;
- Identification of potential impacts;
- Mitigation measures to reduce impacts to as low as possible;
- Prediction of impacts;
- Evaluation of the importance or significance of impacts;
- Implementation of mitigation measures (i.e. Environmental management).

1.7.4 Documentation

At the end of the assessment, a report was prepared according to the relevant guidelines of the Pakistan Environmental Protection Agency (PEPA). This report includes the findings of the assessment, project impacts, and mitigation measures to be implemented during the execution of the proposed activities.

CHAPTER

2

PROJECT DESCRIPTION

2.1 INTRODUCTION

Moro Power Company (Pvt) Ltd, the proponent intends to establish a 25 MW wind farm in Jhimpir wind corridor. The project site has about 240 acres of leased land for 30 years from Government of Sindh. The proposed project will be established in deh Kohistan 7/1, Tapo Jhimpir and Deh Kohistan 7/3 Tapo Jungshahi Taluka Thatta at a distance of 24 km from super highway and at a distance of 64 km from National Highway in Deh Kharyo off Jhampir-Noori Abad road in District Thatta, Sindh Pakistan.

The project includes designing, testing, manufacturing and operation as well as maintenance of its wind farm comprising of 13 wind turbines. The subject land is located in vicinity of other under construction or under planning stage wind projects with elevation ranging from 140 to 160 meter above mean sea level. Total wind farm occupies an area of approximately 240 acres on a single strip 130 meter wide & 5.5 km length. The minimum distance to the boundaries of adjacent wind farm is one km.

The Project 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). Moro Wind Power Company Pakistan (Pvt.) Ltd. has acquired the details of the proposed project site data such quality and speed of wind throughout the year and the annual energy availability at the Project 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 Moro Wind Power Company (Pvt) Ltd through an Energy Purchase Agreement signed by the company.

2.2 PROPONENT ADDRESS & LOCATION MAP

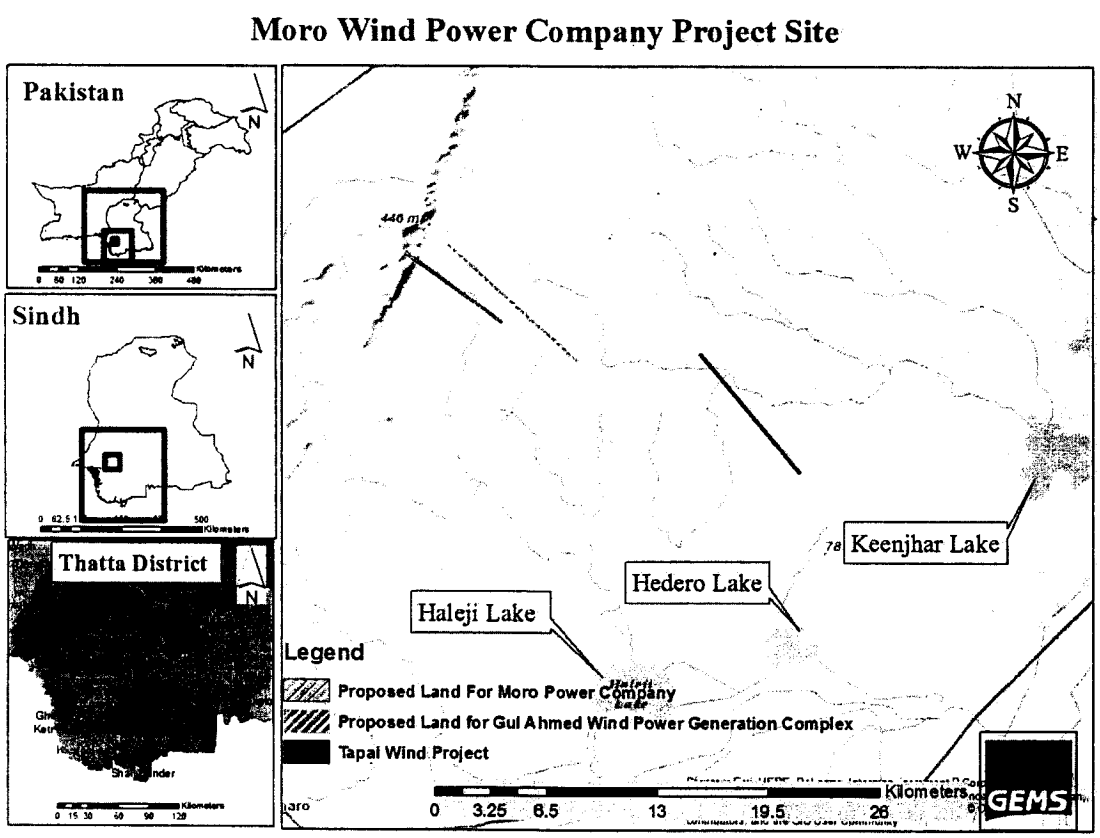
The proposed project is 50% owned by main sponsor Mustafa Abdullah & his associates and 50% shares are rested with M/S RMG Group of Companies. The proposed project site is located in District Thatta, Tehsil Jhampir. The direct distance of the MPC Project site from center of Karachi City is approximately 100 km and almost 80 km from Hyderabad City, The latitude and longitude of the proposed project is tabulated in **Exhibit 2.1** below. Respective Approach to the project site is through Karachi Hyderabad Super highway, after 20 km from the Nooriabad industrial area, towards Jhampir, adjacent to proposed Gul Ahmed wind

power generation complex Deh Kohistan. Location map is presented below as **Exhibit 2.2.**

Exhibit 2.1: Latitude and longitude of the proposed wind power generation project

Boundary	Latitude	Longitude
M1	25° 2'24.40"N	67°39'26.623"E
M2	25° 2'20.527"N	67°39'23.37"E
M3	25° 0'5.19"N	67°42'27.69"E
M4	25° 0'9.19.31"N	67°42'30.50"E

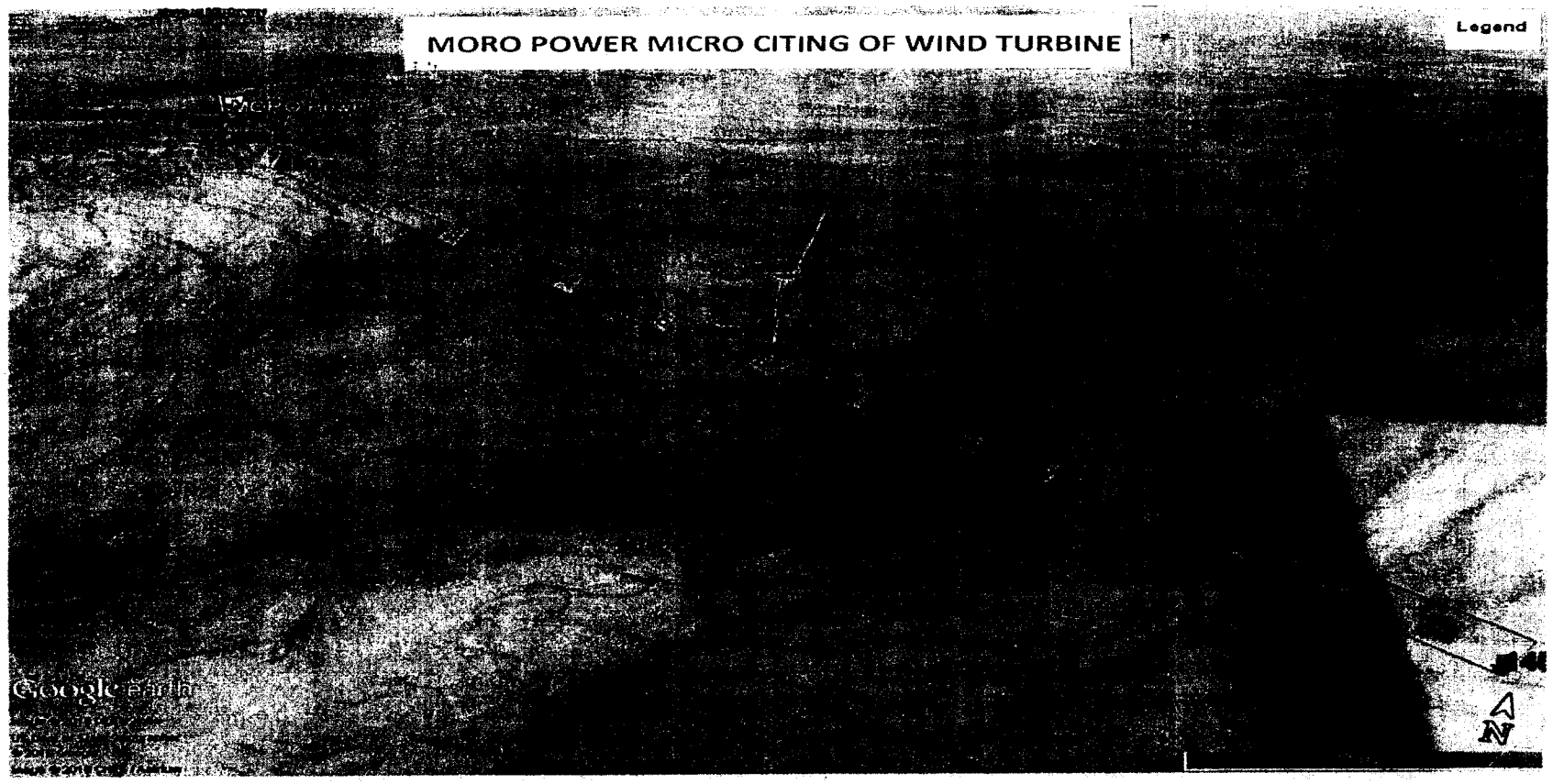
Exhibit 2.2: Project Location Map



2.3 LAYOUT MAP OF THE FACILITY

The layout map of Moro Wind Power Project is provided below as **Exhibit 2.3.**

Exhibit 2.3: Layout Map



2.4 PROJECT SCHEDULE

The project will be executed in phases but in parallel:

Phase 1: The first phase includes three to six months for obtaining permits and approval as well as project financing from Chinese and international banks for arrangement of project debt is in progress to provide the project finance.

Phase 2: Second Phase will involve construction and installation of the Wind Turbines which includes;

- Construction of link roads
- Site clearance
- building of office area
- Piling
- excavation for turbine foundation formations
- Erection of towers
- Installation of electrical collection system
- Installation of underground and overhead electrical lines
- Installation of substations
- construction of turbine base foundations and crane pads

Work on the proposed project is expected after receiving NOC from Sindh Environmental Protection Agency (SEPA). The construction phase is expected to take 18-20 months and the construction work is expected to start from January 2017.

2.5 PROPOSED PROJECT ACTIVITIES

The proposed project includes construction, pavement, concreting, commissioning and installation works. Contract for construction will be awarded to an Engineering firm to undertake the installation of turbines while installation of sub-station would be done by subcontractor.

2.6 SUPPLY OF LOGISTICS

The project site is linked with Karachi, All the deliverable of the proposed project such as wind turbines, generators, motors, poles etc. will be shipped from Karachi to the proposed project site through the superhighway M-9.

The supplies of the proposed project will move in and out from the proposed project site through the Nooriabad – Jhampir Road and the super highway M-9.

Heavy vehicles which will be used to ship the logistics which will load the goods from Port Qasim and will move on National Highway N-5 after N-5 the transporters

will use M-9 and after M-9, Nooriabad-Jhampir road will be used which has been upgraded for heavy loads.

2.6.1 Siting of Wind Farm

The purchased barren land which can be classified as stony rocky land mass has at least half the area studded with cobbles and stones while the rest is covered with alluvial soil. The area is very short of ground water and people rely mostly on the scanty of rainfall. Orography and terrain conditions are normal, the surface is plain but modestly hilly. There, is a seasonal rainfall and the drain in the area receives surface flow of water during monsoon season. 13 turbines will be placed in one row on the leased land which has a height between 70m and 100 m above the sea level.

The grounds and soil conditions are stable for laying the turbine foundations and locating the crane pads for launching the towers. The bearing capacity of the soil may have to be verified by specific geo-technical study of the area because of the Location of the site on the anticline of the Baran River and the Surjan Fault in the vicinity.

2.6.2 Siting the Wind Turbine

Design standards for siting the wind turbines include spatial configuration, lighting, density of turbines, tower visibility and tower design.

It is very necessary before sitting the wind turbine that each turbine unit and each row of the turbine will slow down the wind behind it as it pulls energy out of the wind and converts it to electric power, the space allocated such as to place each turbine apart approximately 350-350 meters. As a rule of thumb turbines in wind parks are spaced somewhere between 5, and 9 RD apart from each other in the prevailing wind direction, and between 3 and 5 RD apart in, the direction perpendicular to the prevailing winds. For the proposed MPC Wind Farm; as an example 13 turbine comprising 2.0 MW in one row spaced 5 RD or 350 meters apart in the prevailing wind direction.

2.6.3 Wind Turbine

The Project site will use the wind, which falls in class 3 at 80 m height. When wind blows past a turbine, the blades capture the energy and rotate. This rotation triggers an internal shaft to spin, which is connected to a gearbox increasing the speed of rotation, which is connect to a generator that ultimately produces electricity.

Turbine subsystems include:

- Rotor component which includes the blades that convert the wind's energy into rotational shaft energy with a rotor speed of 9.8-18.7 revolution per meter.

- Nacelle (enclosure) containing a drive train, usually including gearbox" and a generator includes the electrical generator, the control electronics for converting the low speed rotation to high speed rotation.
- Tower to support the rotor and drive train
- Electronic equipment such as controls, electrical cables, ground support equipment and interconnection equipment.

MPC Project turbines will use three-blade turbines that are pointed into the wind by computer-controlled motors. They have high tip speeds of over 320 km/hour or 88 m/sec, high efficiency and low torque ripple, all of which contribute to reliability. The blades are usually colored light gray to blend in with the clouds. The length of the blade is 40.3 meters which is made up of fiberglass polyester resin. The tubular steel towers will be 80 m in height. The blades will rotate with a speed of 3-20 revolutions per minute. At 22 rotations per minute the tip speed exceeds 90 m/sec. A gear box is used for stepping up the speed of the generator, but direct drive of an annular generator is also common, since more energy can be collected by variable-speed turbines which use a solid-state power converter to interface with the transmission system. All turbines are equipped with protective features to avoid damage at high wind speeds, by feathering the blades into the wind which ceases their rotation, supplemented by brakes. Wind farms being developed currently use large wind turbines for sites in class 3 and above.

In view of the MPC Wind Power Project Site at Jhimpir being placed in class 3 to 5 at 80m height, and also in consideration of large swept area is required. And available at Project site for large turbines, the Project can opt for Wind Turbines with generating capacity of 2.0 MW and over with rotor diameter of 80 to 85 m mounted at the hub height of about 80 m.

2.6.4 Electrical Collection System

The wind turbines will generate about 690 volts of power in each phase. The power will run through a step-up transformer, which steps up the voltage to 33 kilovolts (KVA), the power will then be fed into underground cables that will provide electrical connection among groups of wind turbines. The underground collection cables will feed the larger feeder lines that will run to the project substation.

At the power substation the electrical power from the entire wind power plant will be converted to 132 kv and will be transferred to the interconnection substation at Nooriabad located at a distance of 10 km from the proposed power plant and further the electricity will be transmitted to the national grid.

The power produced by the 13 turbines will be looped in two segment and it will be fed to Moro power grid station, the grid station equipment includes transformers will convert it into 132 kva and will be transmitted to the national grid.

2.6.5 Substations

The main function of the substations is to step-up the voltage so that electricity can be reliably interconnected to the designated power grid. The basic elements of the substations are a control house, two main transformers, outdoor breakers, relaying equipment, high-voltage bus work, steel support structures, and overhead lightning suppression conductors. These elements will be installed on concrete foundations. Each substation will consist of a graveled footprint area of approximately two to four acres, a chain link perimeter fence, and an outdoor lighting system. Direct strike lightning protections will be provided by the use of overhead shield wires and lightning masts Connected to the switchyard ground grid. Overhead shield wires will be high strength Steel wires arranged to provide protection.

2.6.6 Vehicle and Heavy Traffic

Heavy vehicular traffic will operate mainly for delivery of turbines and for transportation of the batching plant and ancillaries. The latter process will require four flatbed trailers of 40-feet size with a load carrying capacity of 30-35 tons. The movement of the turbines and towers takes approximately two months and is expected to be from Port Qasim National Highway N5 M-9, the Super Highway Jhampir Link Road Project site. Movement of vehicles for transportation of turbines and for other "needs during construction typically requires.

2.6.7 Civil Construction

Civil works will include construction of the Sub-station and campsite preparation. The following steps will be taken in site preparation:

- Clearing of vegetation from identified areas
- Filling and compaction
- Construction of auxiliary facilities such as site camp, equipment and supplies storage areas
- Water tank and water pits, fuel storage areas and waste pits.
- Construction of turbine foundations and crane pad

The turbine foundation shall, where necessary, be built on pile foundations, with appropriate number of piles per location, built on detailed design, using standard piling practices. The construction at site will take into account that rotor assembly (blades and hub) weighing;"22 tons; the nacelle containing the generator and weighing 52 tons may need a concrete base for the tower whose construction may require 26 tons of reinforcing steel and contain ~ 190 cubic meters of concrete. The base may be 15 m in diameter and ~ 2.4 m thick near the center.

Campsite facilities will include supply of safe drinking water; drainage, sewerage, and septic tanks. Standard Operation Procedures will be followed to provide safe working environment compatible with human hygienic requirements and to maintain conditions necessary for storage of medicines, materials and equipment.

The construction campsite will cover an area of approximately 10,000 m^2 which will includes equipment storage area, parking area and area office.

Water tank will be established on the construction site for the storage and usage of water during the construction work.

Sewage Septic tank will be established at the site which will be used for collection and transportation of wastewater from the proposed project site to the nearest wastewater treatment facility.

Campsite for the workers and for the engineering unit would be established at a safe distance from the proposed project site which will be decided after receiving NOC from SEPA and the camp site may accommodate 250-300 personals.

Keeping in view the health of the workers proper sanitation system would be established at the camping site such as availability of safe water and availability of toilets would be mandatory.

Proper pits will be established with engineering design with a depth of 12 feet to dump the organics waste both of the kitchen as well as of human origin. Keeping in view that no liquid effluent is left untreated to the ground.

Temporary health facility will be established on the project site for the workers, in case of any emergency first aid will be provided.

2.6.8 Supplies during Construction Phase

All supplies such as towers, fans, transformers, concrete, wires and all other equipment's and utilities both for construction and for the camp site will be transported by trucks from Karachi and Hyderabad. This will include all fuels and oils, drilling requirements, spare parts for construction machinery and food and supplies for the camp. All the goods will be unloaded in designated areas such as food items in the camp site while the construction material on the other sites as decided. A catering company will be contracted to supply the requirements of the campsite while the engineering company will be contracted for the construction work.

Construction materials such as Aggregate/sand will be procured from the designated crusher area. A cement mixing plant will be set up on site to prepare and mix the cement for the construction work.

Fuel requirement during construction may be approximately 2 million liters which shall be met by transportation by oil tanker trucks from Karachi. An onsite storage tank of 20,000 liters on storage wheels will be provided under due safety and security conditions for the Daily ongoing activities.

2.6.9 Electricity

The expected maximum requirement of electricity for construction and the campsite is estimated at 1500 KVA. Diesel generators will be used for power

generation which will be functional throughout the construction phase, this generator will also fulfill the demand of the camp site. In case of any shortage the EPC contractor will acquire temporary electricity connection from the nearest grid to decrease the use of diesel generators.

2.6.10 Waste Management

The solid waste generated by the project will consist of campsite waste, garage waste, metal scraps, and excess construction materials. All efforts will be made to minimize waste generated during the construction phase.

The main types of waste that will be generated are:

- Fuels, grease and oils
- Garage waste includes tires and other automobiles parts.
- Sewage will include kitchen and toilets of the camp site
- Campsite waste may include rappers, toilet papers, bottles and other daily usage items

The piling operation is not likely to generate any waste as it involves concrete for piling. As bulk concreting will be done using concrete, pump wastage of concrete will be minimal. Fuels and oils will, if stored at site, despite security reasons, be stored in containers in areas with impervious floors and surrounded by dyke walls.

Recyclable materials .will be periodically transported out of the site and sold / given to contractors. Non-recyclable material will be collected and .disposed of by the contractor at designated landfill sites. Most garage waste, such as used spare parts, is recycled in Pakistan. All such waste will be collected and sold / given to approve contractors for disposal off-site.

As part of the site preparation stage, a drainage and sewerage system will be constructed for the camp. The sewerage system will consist of soak pits for the collection of waste water from the camp kitchen and washing / ablution areas. Sewage from the toilets will go into lined septic tanks. Sewage and solid waste disposal trucks will be used to periodically remove the sludge, sewage and solid

Waste from the site. All combustible domestic waste will be collected and burned in a garbage pit, suitably fenced to prevent from being blown away. Non-combustible and non- biodegradable waste, such as glass, metal and plastic, will be separated and transported for being sold or given to a contractor for suitable disposal.

2.6.11 Conservation of Water

The company will keep the scarcity of fresh water in view during the construction phase, and will adopt recommended methods to reduce the usage of water and will use treated water for drinking purpose. Detailed design of the Project may consider diversion of the surface water flow through the natural drainage system into the field for vegetation of the otherwise barren land.

2.6.12 Water Supply and Consumption

5000 liters per day of potable water will be required. This will be transported from Nooriabad and will be stored in a water tank for daily use. The water storage tank will be constructed on the site with a capacity of 12,000 liter.

2.6.13 Staff Requirement during Construction Phase

It is estimated that direct manpower required during the construction phase will be about 350. About 100 support staff will be present in addition to the above. Expatriate workers are expected to be on site. Jobs will be offered mainly to the local people during the construction phase.

2.6.14 Shift Staff

Reasonable accommodation will be maintained at Nooriabad for shift staff. Wind farm would need a maximum of 25 persons per shift in addition to the security staff. Security issues shall be outsourced and the level will be as per requirement at the site. An average of 4 staff vans and SUVs will be kept at the site to meet the transportation and. emergency needs.

2.7 HEALTH SAFETY AND ENVIRONMENT

Accordingly all the policy, procedures, and SOPs specific to HSE will be applicable to the contractors to be engaged for construction work. The contractors will have to follow the HSE policy;

- HSE Policy of MPC (Pvt.) Ltd.
- Emergency rescue plan pertaining to safety and accidents including fall, will be established before start of construction activity according to the safety and protection rules of Pakistan.
- Trained persons will be appointed on the posts relating to implementation of emergency and rescue plan.
- Trained technicians and safety equipment's will be installed for technical measures during construction and production

2.8 FIRE PROTECTION SYSTEM

Appropriate fire detection and firefighting system and equipment shall be designed and provide throughout the wind farm. According to the regulations of the authorities in charge of public security and firefighting and the rescue procedure of emergency treatment, the facilities of an independent rescue brigade at Nooriabad Industrial Area will be availed. A dedicated ambulance will be stationed at site for emergency needs.

2.9 SALIENT FEATURES OF THE PROPOSED PROJECT

(A). General Information

i.	Name of Company	Moro Power Company (Pvt.) Ltd
ii.	Registered Business Office	4C,M-1,Lane#12, ITTEHAD, Phase II Ext, DHA, Karachi, Pakistan
iii.	Plant location	Jhimpir, near Nooriabad, District Thatta, in the Province of Sindh
iv.	Type of Generation Facility	Wind power.

(B). Wind Farm Capacity & Configuration

i.	Wind Turbine Type, Make & Model	Sany, China
ii.	Installed Capacity of Wind Farm (MW)	25 MW
iii.	Number of Wind Turbine Units/Size of each Unit (KW)	13 X 2.0 MW

(C). Wind Turbine Details

(a).	**Rotor**	
i.	Number of blades	3
ii.	Rotor speed	9.8 - 18.7 rpm
iii.	Rotor diameter	82.5 m
iv.	Swept area	5346 m^2
v.	Power regulation	Combination of blade pitch angle adjustment, and generator/converter torque control.
vi.	Cut-In wind speed	3m/s
vii.	Cut-In Wind Speed	25 m/s
viii.	Survival wind speed	40 m/s, 3s average
ix.	Pitch regulation	Electric motor drives a ring gear mounted to the inner race of the blade pitch bearing.
(b).	**Blades**	
i.	Blade length	40.3 m
ii.	Material	Fiberglass polyester resin

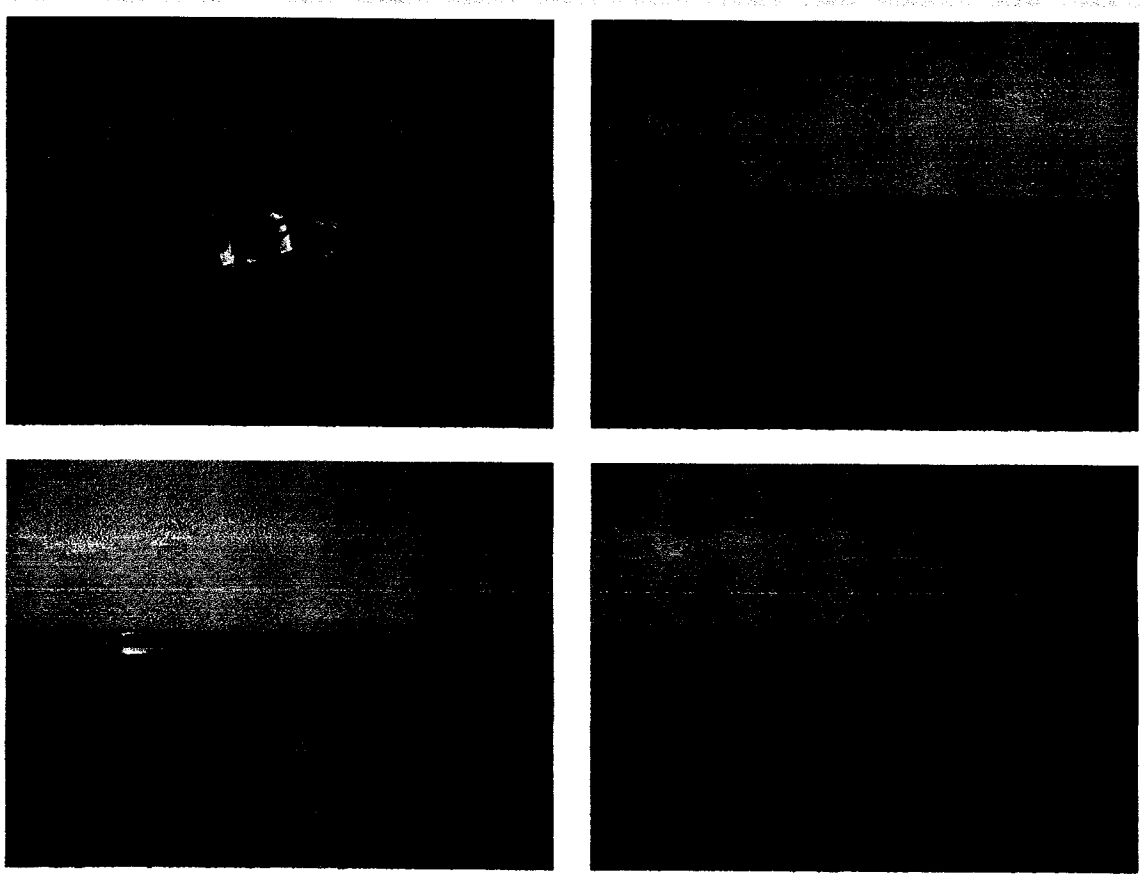
(c). Gearbox		
i.	Type	Multi-stage planetary/helical gear design
ii.	Gear ratio	1:107:1
iii.	Main shaft bearing	Roller bearing mounted in a pillow-block housing arrangement.
(d). Generator		
i.	Power	1600 kw - 2000 Kw
ii.	Voltage	690 V
iii.	Type	Doubly-fed induction type
iv.	Enclosure class	IP 54
v.	Coupling	Flexible coupling
vi.	Power factor	0.95 Lagging – 0.95 Leading
(e). Yaw System		
i.	Yaw bearing	Roller bearing
ii.	Brake	Planetary yaw
iii.	Yaw drive	4 planetary yaw drives
iv.	Speed	0.5 degrees/s
(f). Control System		
i.	Type	Automatic or manually controlled
ii.	Scope of monitoring	Remote monitoring of different parameters, e.g. temperature sensors, pitch parameters, speed generator torque, wind speed and direction, etc.
iii.	Recording	Production data, event list, long and short-term trends
(g). Brake		
i.	Design	Three independent systems, fail safe (individual pitch)
ii.	Operational brake	Aerodynamic brake achieved by feathering blades.
iii.	Secondary brake	Mechanical brake on (high speed) shaft of gearbox.

(h).	**Tower**	
i.	Type	Tubular steel tower
ii.	Hub heights	80 m

(D). Other Details

i.	Project commissioning date (Anticipated)	**June'2018**
ii.	Expected life of the project from Commercial Operation Date (COD)	20 Years

Exhibit 2.4: Pictorial Profile of MPC Site



CHAPTER 3

INSTITUTIONAL, LEGISLATION AND POLICY FRAMEWORK

The IEE of the Wind Power Project at Jhampir wind corridor will be subjected to the legislative and regulatory requirements of the Government of Pakistan including State laws. This chapter presents briefly the existing laws and regulations regarding environmental policies, legislation and other guidelines that have relevance to the proposed project.

3.1 NATIONAL ENVIRONMENTAL POLICY, LEGISLATION AND GUIDELINES

The enactment of comprehensive legislation on the environment, covering multiple areas of concern, is a relatively new and ongoing phenomenon in Pakistan. Whereas, a basic policy and legislative framework for the protection of the environment and overall biodiversity in the country is now in place, detailed rules, regulations and guidelines required for the implementation of the policies and enforcement of legislation are still in various stages of formulation and discussion. The following section presents a brief overview of the existing national policies, legislation and guidelines.

3.1.1 National Conservation Strategy (NCS)

The National Conservation Strategy (NCS) is the primary Policy document of the Government of Pakistan on national environmental issues. The Policy was approved by the Federal Cabinet in March 1992. The Strategy also attained recognition by international donor agencies, principally the World Bank. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas in order to preserve the country's environment.

A midterm review of the achievements of the NCS in 2000 concluded that achievements under the NCS have been primarily awareness raising and institutional building rather than actual improvement to environment and natural resources and that the NCS was not designed and is not adequately focused as a national sustainable development strategy (GoP, November 2000). The need therefore arose for a more focused National Environmental Action Plan (NEAP) required to bring about actual improvements in the state of the national environment with greater emphasis on poverty reduction and economic development in addition to environmental sustainability.

The National Environmental Action Plan was approved by the Pakistan Environmental Protection Council under the chairmanship of the President/ Chief Executive of Pakistan in February 2001. NEAP now constitutes the national environmental agenda and its core objective is to initiate actions that safeguard public health, promote sustainable livelihoods, and enhance the quality of life of the people of Pakistan.

A National Environmental Policy has been approved by the Federal Cabinet in its meeting held during June 2005. This policy has already been endorsed by the Pakistan Environmental Protection Council during 2004. The new policy has total 171 guidelines on sectoral and cross-sectoral issues. The objectives of new policy include assurance of sustainable development and safeguard of the natural wealth of country. The following are the approved Sectoral Guidelines;

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

3.1.2 Sindh Environmental Protection Act 2014

The Sindh Environmental Protection Act, 2014 (SEPA 2014) is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The SEPA 2014 is broadly applicable to air, water, soil, marine and noise pollution. Penalties have been prescribed for those contravening the provisions of the Act.

The two primary deliberations of the Act are the conduct of projects only after approval of environmental assessments from the SEPA and adherence with Sindh Environmental Quality Standards (SEQS).

3.1.3 Approval from Sindh Environment Protection Agency

As per the 2014 Regulations, Proponent will submit an IEE report for their project activities to SEPA and will seek approval on the same from the agency. Ten hard copies and 2 soft copies of the IEE report will be need to be submitted to SEPA. It will then grant its decision on the IEE as per the rules and procedures set out in the 2014 Regulations. The following rules will apply:

- A fee is payable to SEPA for review of the IEE;
- The IEE submission is to be accompanied by an application in the format prescribed in Schedule V of the 2014 Regulations;
- SEPA is bound to conduct a preliminary scrutiny and reply within 10 days of the submission of the report a) confirming completeness, or b) asking for additional information, if needed;
- In the review process SEPA may consult a Committee of Experts, which maybe constituted on the request of the DG SEPA;
- On completion of the review process, the decision of SEPA will be communicated to the proponent in the form prescribed in Schedule V;
- Where an IEE is approved, SEPA can impose additional controls as part of the conditions of approval;
- SEPA is required to make every effort to complete the IEE review process within 90 days of the issue of confirmation of completeness. However, SEPA can take up to 4 months for communication of final decision;
- The approval will remain valid for the project duration mentioned in the IEE but on the condition that the project commences within a period of three years from the date of approval. If the project is initiated after three years from approval date, the proponent will have to apply for an extension in the validity period. The SEPA on receiving such request grant extension (not exceeding 3 years at a time) or require the proponent to submit a fresh IEE if in the opinion of SEPA changes in baseline conditions or the project so warrant;
- After receiving approval from SEPA the proponent will acknowledge acceptance of the conditions of approval by executing an undertaking in the form prescribed in Schedule VI of the 2014 Regulations;
- The 2014 Regulations also require proponents to obtain from SEPA, after completion of the project, a confirmation that the requirements of the IEE and the conditions of approval have been duly complied with;
- The SEPA in granting the confirmation of compliance may impose any additional control regarding the environmental management of the project or the operation, as it deems necessary.

3.1.4 Sindh Environmental Protection Agency Review of IEE and EIA Regulations, 2014

The SEPA Review of IEE and EIA Regulations, 2014 (The 2014 Regulations) promulgated under SEPA 2014 were enforced on December, 2014. The 2014 Regulations define the applicability and procedures for preparation, submission and review of IEEs and EIAs. These Regulations also give legal status to the Pakistan Environmental Assessment Procedures prepared by the SEPA in 2014.

The Regulation classifies projects on the basis of expected degree of adverse environmental impacts and lists them in two separate schedules. Schedule I lists projects that may not have significant environmental impacts and therefore require an IEE. Schedule II lists projects of potentially significant environmental impacts requiring preparation of an EIA. The Regulations also require that all projects located in environmentally sensitive areas require preparation of an EIA.

This project falls under the following category:

Schedule I (IEE):

Category B (Energy)

- Wind Project

3.1.5 Land Acquisition Act, 1894

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

3.1.6 Acquisition of Land for Companies

The procedure taken for the acquisition of land for Companies is very simple. The first step to be taken by a Company desiring to acquire land under the Land Acquisition Act is to apply to the Collector giving particulars of the lands it needs and the work which it proposes to do on it, explaining that it is one which will be useful to the public. If, on the report of the Collector, the Provincial Government is satisfied that the work is apparently so, a notification including invitation of objections would be published; or, the Provincial Government may direct that an enquiry should be made according to the special procedure laid down for it.

The Company should satisfy the Provincial Government that

i. The acquisition is needed for the construction of some work; such work is likely to prove useful to the public;

ii. That the purpose of acquisition is to obtain land for the erection of dwelling houses for workmen employed by the Company or for the provision of amenities directly connected therewith. Industrial concerns employing not less than 100 employees shall be considered as Company for the purposes of acquisition.

The enquiry shall be held by the officer (who is appointed by the Provincial Government to conduct enquiry) at such time and place as the Provincial Government shall appoint and will make a report on it and if the Provincial Government is satisfied after considering the report, if any, of the Collector that the purpose of the proposed acquisition is the same as mentioned in the Notification then it will require the Company to enter into an agreement with the Provincial Government for the following matters:

1) The payment to the Provincial Government of the cost of acquisition;

2) The transfer, on such payment, of the land to the Company;

3) The terms on which the land shall be held by the Company;

4) where the acquisition is for the purpose of erecting dwelling houses or provision of amenities connected therewith, the time, within which, the conditions on which and the manner in which the dwelling houses or amenities shall be erected or provided; and

5) The time within which and the conditions on which the work shall be executed and maintained, and the terms on which the public will be entitled to use the work.

3.1.7 Compensation in Case of Damage to Lands

According to Land Acquisition Law, there are certain matters to be taken into consideration by Collector / Revenue Officer in determining the amount of compensation to be awarded for land acquired under the Law. These are as follows:

1) The market value of the land at the date of publication of the notification;

2) The damage sustained by the person interested by reason of the taking of any standing crops or trees which may be on the land at the time of the Collector's taking possession thereof;

3) the damage (if any) sustained by the person interested, at the time of the Collector's taking possession of land, by reason of severing such land from his other land;

4) The damage (if any) sustained by the person interested, at the time of the Collector's taking possession of the land, by reason of the acquisition injuriously affecting his other property, movable or immovable, in any other manner, or his earnings;

5) If in consequence of the acquisition of the land by the Collector, the person interested is compelled to change his residence or place of business, the reasonable expenses (if any) incidental to such change; and

1) b. Captive cum grid spill over power projects (i.e. for self-use and sale to utility)

1) c. Captive power projects (i.e. for self or dedicated use)

1)d. Isolated grid power projects (i.e. small, stand-alone)

2) Except for Category (a) above, these projects will not require any Letter of Intent (LOI), Letter of Support (LOS), or Implementation Agreement (IA) from the Government.

3) Electricity purchase by NTDC/CPPA from qualifying renewable resources at one location and receive an equivalent amount for own use elsewhere on the grid at the investor's own cost of generation plus transmission charges (wheeling)

4) Net metering and billing allowed enabling a producer to sell surplus electricity at one time and receive electricity from the grid at another time and settle accounts on net basis. This will directly benefit the economics of small scale, dispersed generation and optimize capacity utilization of installed systems.

5) De-licensing and deregulation of small scale power production through renewable resources (up to 5 MW for hydro and 1 MW for net metered sales) to reduce the transaction costs for such investments. This will be particularly beneficial from micro, mini and small hydro as well as solar-based electricity production.

6) Simplified and transparent principles of tariff determination

7) Insulating the investor from resource variability risk, which is allocated to the power purchaser

8) Facilitating project proponents in obtaining carbon credits for avoided greenhouse gas emissions, Helping improve financial returns and reducing per unit costs for the purchaser

These guidelines are in line with the Government's open door policy for inviting private investment into the country.

3.1.11 Electricity Act, 1910

The Act provides a legal base for power distribution. A licensee under this Act is enabled to operate supply of electricity. This Act obligate licensee to pay compensation for any damages caused during the constructions and maintenance of any power distribution facilities.

6) The damage (if any) bona fide resulting from diminution of the profits of the land between the time of the publication of the declaration and the time of the Collector's taking possession of the land.

3.1.8 Pakistan Penal Code, 1860

The Pakistan Penal Code (1860) authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.

3.1.9 The Antiquities Act, 1975

The Antiquities Act of 1975 ensures the protection of cultural resources of Pakistan. The Act is designed to protect 'antiquities' from destruction, theft, negligence, unlawful excavation, trade, and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain articles of archaeological significance.

Under the Act, the project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of a protected antiquity;
- Report to the Department of Archeology, Government of Pakistan, any archeological discovery made during the course of a project.

3.1.10 Policy for Development of Renewable Energy for Power Generation, GOP 2006

In December 2006 the Government of Pakistan published the first national package of measures aimed at promoting renewable sources of energy. The provisions apply to hydropower plants with a capacity of up to 50MW, solar thermal, photovoltaic's and wind energy. Over the short term, i.e. to mid-2008, technologies that are already in commercial use internationally are to be trialed through the mechanism of attractive power purchase contracts and partial risk coverage. In the medium term, i.e. to 2030, it is hoped to have installed at least 9700 MW of capacity for renewable electricity in this way.

SALIENT FEATURES OF THE POLICY

The Policy invites investment from the private sector for following categories of projects:

1) a. Independent power projects of IPPs (for sale of power to the grid only)

3.1.12 Electricity Act, 1910

The Act provides a legal base for power distribution. A licensee under this Act is enabled to operate supply of electricity. This Act obligate licensee to pay compensation for any damages caused during the constructions and maintenance of any power distribution facilities

3.1.13 Sindh Wildlife Protection Ordinance 1972

The Sindh Wildlife Ordinance 1972 empowers the government to declare certain areas reserved for the protection of wildlife and to control activities within these areas. It also provides protection to endangered species of wildlife. The Project area does not lie in or near any protected area;

3.1.14 Sindh Forest Act (1927)

The act empowers the provincial forest departments to declare any forest area as reserved or protected. The act also empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce; quarrying and felling, lopping and topping of trees, branches in reserved and protected forests. The project area is located outside any reserved or protected forest area therefore the project will not contravene with any provisions of the Act.

3.1.15 Cutting of Trees (Prohibition) Act, 1975

This Act prohibits cutting or chopping of trees without permission of the Forest Department.

3.1.16 Highways Safety Ordinance, 2000

This ordinance includes provisions for the licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control, offences, penalties and procedures; and the establishment of a police force for motorways and national highways charged with regulating and controlling traffic on the national highways, and keeping the highways clear of encroachments.

3.2 NATIONAL AND INTERNATIONAL GUIDELINES OR STANDARDS

3.2.1 The Pakistan Environmental Assessment Procedures, 1997

The Pakistan Environmental Protection Agency prepared the Pakistan Environmental Assessment Procedures in 1997. They are based on much of the

existing work done by international donor agencies and Non-Governmental Organizations (NGO's). The package of regulations prepared by PEPA includes:

- Policy and Procedures for Filing, Review and Approval of Environmental Assessments;
- Guidelines for the Preparation and Review of Environmental Reports;
- Guidelines for Public Consultation;
- Guidelines for Sensitive and Critical Areas; and
- Sectoral Guidelines for various types of projects.

The Sourcebook identifies a number of areas of concern, which should be addressed during impact assessment. It sets out guidelines for the determination of impacts, provides a checklist of tools to identify possible biodiversity issues and suggests possible mitigation measures. Possible development project impacts on wild lands, wetlands, forests etc. are also identified and mitigation measures suggested.

The World Bank Guidelines for noise are provided in **Exhibit 3.5**. The indicative IFC guideline values applicable to sanitary wastewater discharges are shown in **Exhibit 3.6**.

3.2.2 Multilateral Environmental Agreements (MEA's)

The MEAs have been developed for trans-national environmental protection where countries have signed to take responsibility as a whole for improving the state of environment of the world. Some agreements that are relevant to the project are related as follows.

3.2.3 The Convention on Biological Diversity (CBD) (1992)

The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity, and to integrate these plans into national development programmes and policies. Parties are also required to identify components of biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

3.2.4 The Convention on Conservation of Migratory Species of Wild Animals (CMS) (1979)

The Convention requires countries to take action to avoid endangering migratory species. The term "Migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or

more national jurisdictional boundaries. The parties are also required to promote or cooperate with other countries in matters of research on migratory species.

3.2.5 The Convention on Wetlands of International Importance, Ramsar (1971)

The Convention entitled the countries to protect wetlands of which Pakistan became a signatory too. It obligates countries to identify and protect wetlands in the country. So far 18 sites in Pakistan have been declared as wetlands of International Importance or Ramsar Sites.

3.2.6 The IUCN Red List

Some animal species are already extinct in Pakistan, and many are internationally threatened. The IUCN Red List 1996 of threatened animals classifies 37 species and 14 sub-species of mammals that occur in Pakistan as internationally threatened or near threatened.

The Red List is based on field data that is more than 10 to 15 years old and needs to be re-assessed. The country also provides critical habitat to 25 internationally threatened bird species and 10 internationally threatened reptiles.

3.2.7 Civil Safe Employee: Australian Health and Safety Handbook

This guideline contains some basic information and guidance that may help to ensure own safety at work and help to ensure the safety of others. Work related injuries and illnesses clearly impact on the whole country so it is in everybody's interest to improve our health and safety performance.

The first part of this booklet contains general information about occupational health and safety and rights and responsibilities. The second part describes some hazards that are common to the civil construction industry and what to do about them.

3.2.8 OSHA Standards Health Safety

The Occupational Safety and Health Administration (OSHA) are issuing safety and health program management guidelines for use by employers to prevent occupational injuries and illnesses. The Occupational Safety and Health Act of 1970 (OSHA) representatives have noted a strong correlation between the application of sound management practices in the operation of safety and health programs and a low incidence of occupational injuries and illnesses. Where effective safety and health management is practiced, injury and illness rates are significantly less than rates at comparable worksites where safety and health management is weak or non-existent.

The Occupational Safety and Health Administration (OSHA) have concluded that effective management of worker safety and health protection is a decisive factor in reducing the extent and the severity of work-related injuries and illnesses. Effective management addresses all work-related hazards, including those potential hazards which could result from a change in worksite conditions or practices. It addresses hazards whether or not they are regulated by government standards.

CHAPTER

4

ENVIRONMENTAL BASELINE: PHYSICAL ENVIRONMENT

The existing physical environmental conditions of the proposed project area are described in this section. Information for this section was collected from a variety of sources including published literature surveys conducted for other studies in the area and those that were conducted specifically for this study. Much of the information on topography and land use geophysical climate and water resources came from published literature and previously conducted studies. The information given in the section on air sound soil and water quality is the result of detailed field surveys conducted specifically for this IEE.

4.1 TOPOGRAPHY AND LAND USE

As discussed in previous chapters the proposed project will be established in deh Kohistan 7/1, Tapo Jhimpir and Deh Kohistan 7/3 Tapo Jungshahi Taluka Thatta at a distance of 24 km from super highway and at a distance of 64 km from National Highway in Deh Kharyo at Jhampir Noori Abad road in District Thatta, Sindh Pakistan.

The Moro Wind Project site has about 240 acres of leased land for 30 years from Government of Sindh. The proposed project site is located approximately 100 km and 80 km away from Karachi and Hyderabad respectively. Karachi Hyderabad Superhighway connects the proposed project site with Karachi and Hyderabad. Karachi Hyderabad Superhighway is present at 24 km in the North-West of the proposed project site. The topographical elevation of the proposed project area is about 140 to 160 meters approximately. The topographical elevation map is presented below as **Exhibit 4.1.**

Exhibit 4.1: Topographical elevation map of the proposed project's area

Moreover, it is important to note that the proposed project area sustains majority of area occupied by barren, flat to mildly hilly tracts, which consists of outlying spurs of the Kirthar Range. Additionally if people of the project area plan to carry out cultivation activities, they need to look forward for alluvial soil, which exists near or along the numerous depressions where rainwater carried by hill streams (nallas) can be stored. The major land available in the project area is barren, few small pockets are available for cultivation which are being utilized by the locals of the project area.

4.2 GEOLOGY

According to AH Kazmi[1] the region belongs structurally to Lyari embayment zone bordering the Kirthar fold in the southwestern part of the Thano Bulla Khan Jhimpir area. A thick sequence of tertiary sedimentary rocks is found within the proposed project area, which mainly includes rocks of limestone, shale, mudstone and sandstone. These stones ranges in from Eocene to Pleistocene underlie or are exposed throughout the area. The deposition of sequence was in the remnant of the shallow Tethys seaway, which was gradually eclipsed because of the northward drafting of the Indian plate and its ultimate collision with the Eurasian plate to the north.

Geological investigations of the area, according to Kazmi as well as DeJong[2], suggest the presence of (Shallow marine Early to Middle Eocene Laki limestone and Late Eocene Tyon Formation) only Middle and Tertiary rock formations comprising fresh and slightly weathered recent and sub-recent shoreline deposits. Principal constituents of these deposits are the interblended sandstone and shale together with subordinate amounts of large size gravels or conglomerate.

4.3 SOIL CONDITION

Soil cover in Deh Kohistan area is very thin due to severe wind erosion on land in the drainage basin. Natural vegetation has almost disappeared from the surface plain. The soils of the area in this region are hallow, strongly calcareous silt loam with weak structure. The slope of the stony wasteland and the hilly region is towards the syncline of Baran Nai. The hills either comprise of bare rocks or have very shallow soils. The lower parts of hills and higher parts of the plains have gravel soils with a strong zone of lime accumulation at 30 to 40 cm depth. Moreover, it is important to note that the soil within the proposed project area is mostly saline due to water logging and for the reason about 1.43 Mha cultural able wasteland including about 0.685 Mha under forest cover and 0.302 Mha that has been lost due to water logging and salinity[3].

[1] Geology of the Indus Delta, AH Kazmi, in Marine and Oceanography of Arabian Sea and Coastal Pakistan, ed BU Haq, JD Milliman , Van Nostrand Rienhold Company, New York 1984
[2] A. Farah and KA DeJong, Geodynamics of Pakistan, 1979
[3] Environmental Impact Assessment of 250 MW Wind Project, NBT Wind Power Pakistan iii (Pvt.) Ltd.

4.4 SURFACE WATER RESOURCES

It has been observed that within the vicinity of the jhampir, kenjhar lake and other forms of surface water resources area available which is situated on the right bank of the Mighty Indus in Thatta district. The available surface water resources within the proposed project vicinity are in the forms of rivers, canals, and streams. Additionally it is important to note that these water resources are not located in close proximity of the proposed project area. Even after availability of freshwater resources the accessibility to freshwater is limited to the rural population residents near the canals and even in that case it is restricted to perennial canals.

4.5 GROUND WATER HYDROLOGY

Ground water generally becomes saline from Hyderabad down south. This is attributed to the shift of the Arabian Sea in geological times. There are credible evidences to the effect that the Kirthar Mountains were witness to the last ice age some 15,000 years from the wisent and that the seashore was at the present site of Hyderabad some 12,000 years ago[4]. The areas with saline ground water show higher concentration of chlorides compared with carbonates and bicarbonates and sulphate which suggests that some millennia ago the area was submerged in the sea. Although melting of Himalaya's glaciers and water flow from downstream the Indus and the saraswati had diluted the salinity, yet the saline water in the deep down strata could not be displaced by fresh water flow from rivers. The sediments transported by rivers ultimately trapped the salinity in its fold. Hydrological investigations carried out by Water and Power Development Authority (WAPDA) on the western side of Indus River reveals that fresh water is available at shallow depths in Hyderabad and Thatta districts up to 60m. It becomes saline to highly saline as one move southwards to coastal areas. Ground water occurs under water table condition at depth varying from 3m to 10m. Ground water depth in the proposed project site is about 30m. Quality of ground water is reasonable and is potable as reported by locals.

4.6 CLIMATIC CONDITION

4.6.1 Rainfall

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

[4] Climate Change Environmental Degradation & Poverty Nexus In Coastal Region Of Thatta District Part-1 Dhabeji – Gharo Coastal Area By Dr. Mirza Arshad Ali Beg

Exhibit 4.2: Monthly rainfall data from 2003-2013 (MM)[5]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2003	6.4	21.8	0	0	0	16.3	270.4	9.8	0	0	0.2	0	324.9
2004	13.7	0	0	0	0	0	3	5.6	0	39.3	0	4.3	65.9
2005	10.8	12.8	Trace	0	0	Trace	1.3	0.3	54.9	0	0	17.1	97.2
2006	Trace	0	Trace	0	0	0	66.2	148.6	21.9	0	3.1	61.3	301.1
2007	0	13.2	33.4	0	0	110.2	41	250.4	0	0	0	17.4	465.6
2008	8	Trace	1.1	0	0	0	54	37.5	Trace	0	0	21	121.6
2009	3	Trace	0	Trace	0	2.6	159.9	44	68.9	0	0	1.5	279.9
2010	Trace	0.5	Trace	Trace	Trace	97.4	120.4	111.5	42.7	0.4	Trace	Trace	372.9
2011	8.5	8.5	1.6	Trace	Trace	Trace	7.2	61.1	212.9	Trace	Trace	Trace	291.3
2012	0.2	0.0	0.0	0.0	0.0	Trace	Trace	8.1	121.0	0.0	0.0	22.8	152.1
Average	4.2	4.7	3.0	0	0	18.8	60.2	56.4	43.5	3.3	0.2	12.1	206.4
Max	13.7	21.8	33.4	0	0	110.2	270.4	250.4	212.9	39.3	3.1	61.3	465.6
Min	0	0	0	0	0	0	0.3	0.3	0	0	0	0	55.8

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

Monsoon in the arid area of Deh Kohistan is characterized by low and high variable rainfall both in time and space. The rainfall has a specific trend and pattern that is below medium rainfall, which may come once in three years, whereas drought once in 8- 10 years[6]. Annual rainfall increases from less than 100 mm in the north to 350 mm in the southeast. Nearly 14 per cent of the desert receives 350 mm rainfall, 25 per cent gets 250 mm, and 4.5 per cent receives less than 150 mm, and remaining 52.5 percent receives 150- 25 mm rainfall almost all the rain is received during monsoon from mid-June to mid-September, but July and August are the months of heavy rainfall. During remaining period of the year there are drought-like conditions for continuous period of six to nine months. Although, rainfall is in heavy showers yet there is generally little runoff. The rainwater is usually absorbed in the sandy grounds, however the village folks have constructed channels to divert the surface

[5] *Data Processing Centre, Pakistan Metrological Department*
[6] IUCN: Status Paper on Situation of Arid Zones in Sindh, 2000

run-off into land area enclosed by dykes for storage in tanks or bandats, and also into fields for irrigation.

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

4.6.2 Temperature

The yearly average temperature varies between minimum 16.4°C and maximum 35.8°C. The monthly average temperature ranges between 8.7°C in January and 39.8°C reaching a maximum of 43.8 °C in May. The temperatures start falling from October each year to January and dry and hot weather prevails from April to September[7].

In Kohistan extreme temperatures of up to 38-45°C in summer and 6-8°C in winter prevail during the two seasons. Due to high temperatures in summer, the plant species with low vigor and shallow root system die away. Maximum temperature is high in these regions, especially in the dry season when there is little cloud or moisture in the atmosphere to absorb solar radiation. Under conditions of high temperatures life and work become difficult. Not only is lack of moisture in the form of rain, the chief factor causing arid conditions, but low air humidity in itself has an adverse effect upon plants and animals, because the rate of evaporation is very high at these temperatures. Meteorological Parameters of the proposed project site are given below as an **Exhibit 4.3**,

Exhibit 4.3: Meteorological Parameters for Jhimpir Area

Months	Temperature °C		Rainfall mm	Relative Humidity%
	Maximum	Minimum		
January	25.78	8.73	0.96	50.38
February	28.59	11.60	3.60	48.81
March	34.02	16.80	2.30	48.36
April	38.40	21.80	2.49	48.67
May	39.85	25.47	0.69	53.10
June	38.02	27.46	10.76	60.70
July	35.11	27.04	70.49	69.61
August	33.61	26.06	89.88	72.55
September	34.36	24.87	34.43	68.78
October	35.80	21.70	3.72	58.15
November	31.87	15.86	1.67	53.88
December	26.68	10.10	1.11	52.46
Annual	33.48	19.76	221.64	57.56

[7] *Data Processing Centre, Pakistan Metrological Department*

Loss of moisture from the ground and from vegetation is an indicator of rate of "evapo- transpiration" which is very high in semi- arid and arid regions of Kohistan. The incidence of high temperature causes heat damage. Maximum temperatures are high in Kohistan especially in dry season when there is little cloud or moisture to absorb solar radiation. Accordingly the rate of evapo-transpiration is very high.

4.6.3 Wind Speed & Variation

Geological survey of Pakistan along with the USA's NREL and US-AID has collected the information on wind speeds, wind rose and wind turbulence and other wind characteristics by installing wind mast/towers for collecting actual wind speeds/data. Many years of reliable wind data is available and based on this information, the wind corridor of 50 km width (Gharo-Keti Bander) and 100 km in length (up to Jamshoro) has been identified as having potential to produce at least 10,000 MW of electricity. In comparison China has installed capacity of 150,000 MW (Wind) & India's Wind installed capacity is 25,000 MW.

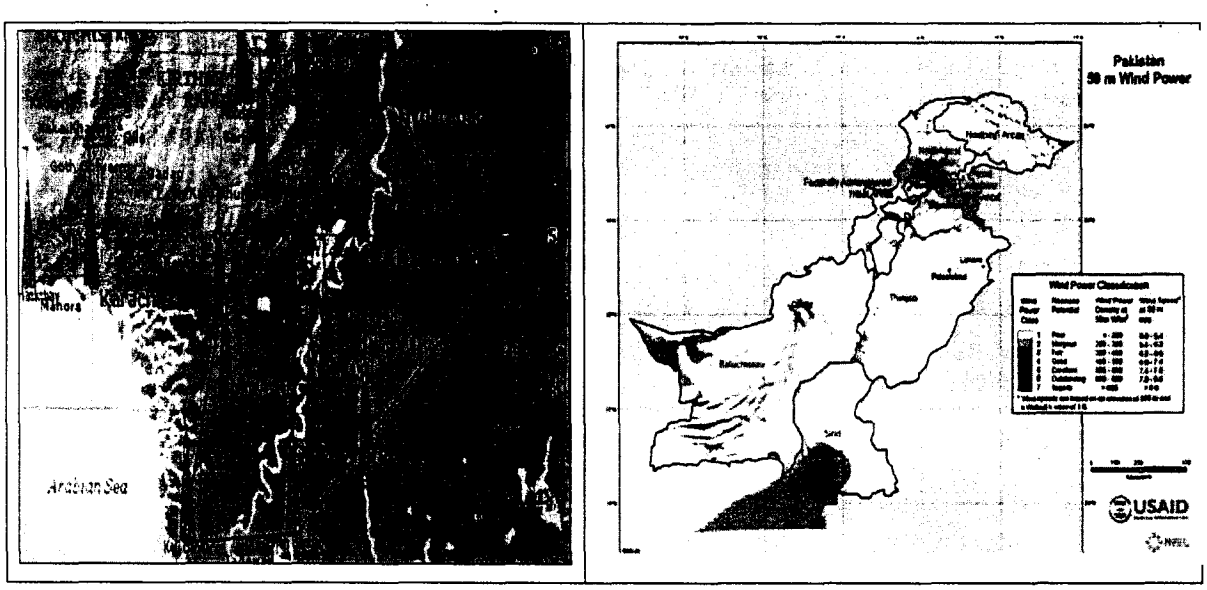
4.6.3.1 Wind Potential Area of Sindh

Total Area of Sindh suitable for wind farms = 9749 km²

Average Capacity Factor of this area in Sindh = 25%

Gross Potential of the area corresponding to 25%
Capacity Factor = 9749 x 4.5 =43,871 MW

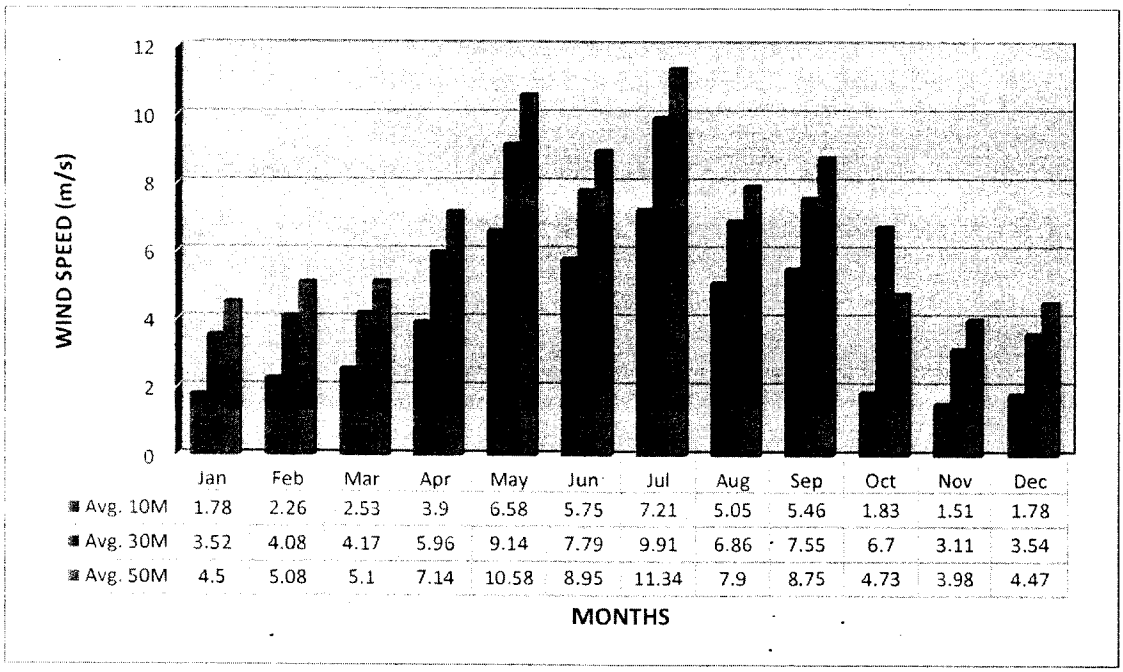
Exploitable Potential (25% of the area) = 11,000 MW



4.6.3.2 Average Wind Speed:

The wind speed at height of 10 meter, 30 meter and 50 meter have been computed and monthly average of these wind speed at three levels have been given below as an **Exhibit 4.4**. At 50 meters the average wind speed of more than 5m/s during 8 months, from February to September, and the highest wind speed of 11.5 m/s is observed during July.

Exhibit 4.4: Monthly average wind speed at height of 10 meter, 30 meter and 50



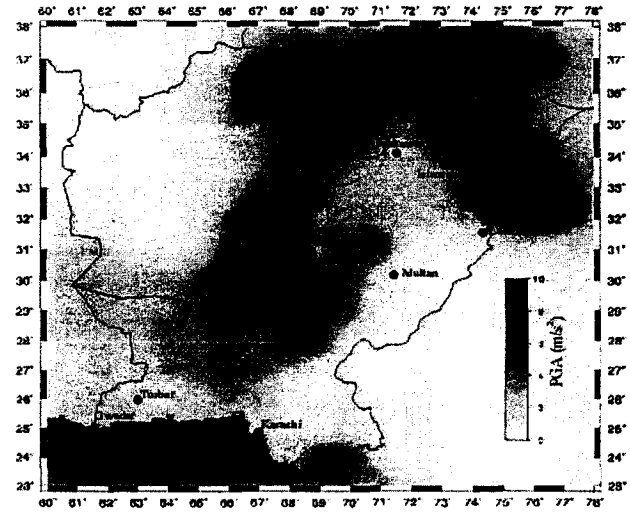
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. 10M	1.78	2.26	2.53	3.9	6.58	5.75	7.21	5.05	5.46	1.83	1.51	1.78
Avg. 30M	3.52	4.08	4.17	5.96	9.14	7.79	9.91	6.86	7.55	6.7	3.11	3.54
Avg. 50M	4.5	5.08	5.1	7.14	10.58	8.95	11.34	7.9	8.75	4.73	3.98	4.47

4.6.3.3 Monthly Average Wind Speed (m/s) at Jhimpir

At 50 meter height even during the month of January, October and December the wind speed is close to 5m/s, it means that average wind speed data at 50 meters height indicate that there is a good wind power potential during at least eleven months of a year at Jhimpir, Hence wind quality is such that an year round generation of electricity can be in range of 33-37%.

4.7 SEISMICITY

Movement of active Karachi triple junction of three major tectonic plates viz the Indian Plate, Arabian plate and the Eurasian Plat of the earth's crust, may result in Seismic activity in the proposed project site. Seismic activity in the region is the result of movement on one or more faults and mainly from intra-plate active faults, including the Karachi-Jati, Allah Bund-Rann of Kutch, Surjan-Jhimpir and Pab.



Jhimpir Fault: A number of epicenters are located on this N-W trending fault. The fault has produced an earthquake of M 5.6 Richter Scale. Global Seismic Hazard map of Pakistan is given below[8]:

The seismic hazard, in view of the historical data, has been estimated for Deh Kohistan 7/1 as "moderate to major". This suggests the "possibility" of earthquakes of intensity V to VII on (MM) scale and "probability" of those above VII. The seismic risk factor of g/20 must therefore be incorporated in the design factor for the construction of Wind Towers and Turbines. Moreover in view of the Rock Quality Designation (RQD) values being lower than 30% and showing poor Rock Quality and low load bearing capacity, the risk of liquefaction during major (> 7 on Richter Scale) earthquakes will have to be taken into account. The appropriate mitigation measures would be to provide bored reinforced concrete piles to minimize the risk to the liquefaction threat during major (> 7 on Richter Scale) earthquake[9].

4.8 TECTONICS

Pakistan is located at hub of three seismic plate boundaries as, Indian Plate (east), Eurasian Plate (West) and Arabian Plate (South). First two are continental plates while third is an oceanic plate.

The proposed project site is about 200 km on the NEE, while Karachi lies approximately 160 km east of the triple junction. The western and north-trending arms of the triple junction sustain convergent and trans-current rates of 28-33 mm/yr respectively[10].

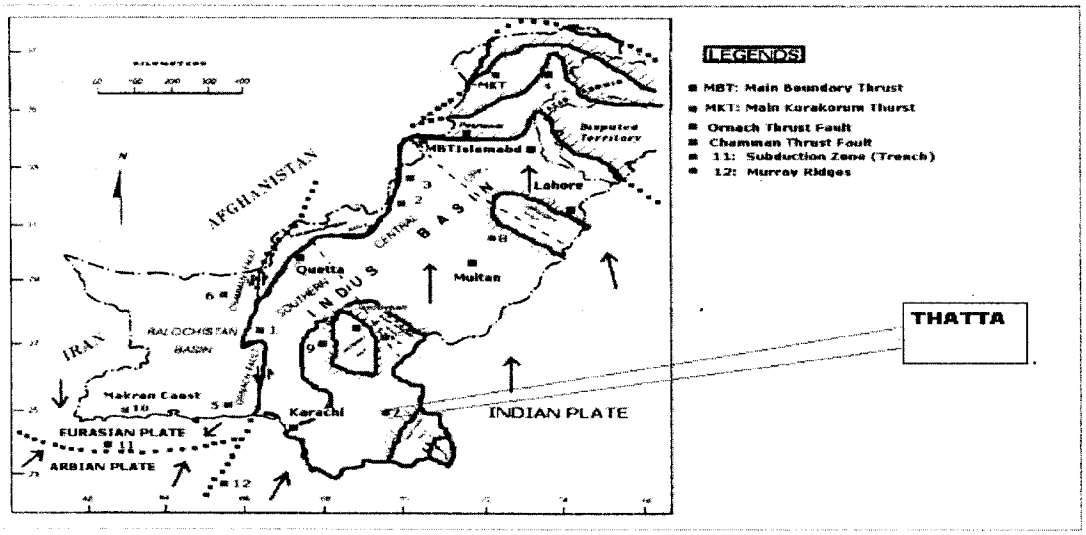
Indian plate activates and subduction into north of Pakistan caused formation of Himalayan and Karakoram mountain range along subduction boundary MBT (Main Boundary Thrust). Arabian plate subduction into Eurasian plate along coastal line of Markan, Baluchistan. **Exhibit 4.5:** displays Tectonic plate configuration of Pakistan.

[8] Giardini, D., G. Grunthal, K. Shedlock, and P. Zheng (1999). The GSHAP Global Seismic Hazard Map. *Annali di Geofisica* 42, 1,225 – 1,230.[GeoRef]

[9] *Initial Environmental Examination Of 50 Mw GAWPL-WPGC At Deh Kohistan Thatta*

[10] "Geodetically constrained Indian plate motion and implications for plate boundary deformation", Apel, E, R., Bürgmann, P. Bannerjee, and B. Nagarajan, 2006, *EOS, Transactions, American Geophysical Union* 85,52 T51B-1524 Fall meeting supplement

Exhibit 4.5: Tectonic plate configuration of Pakistan



4.9 AIR QUALITY

Pakistan lacks a comprehensive and effective air quality monitoring system that can be used to track and address specific instances of air pollution and air quality degradation. At present, monitoring of urban air pollution in Pakistan is limited to isolated instances where air pollutants are measured for brief periods at selected locations. Urban locality, city, region, or countrywide continuous or repeated air quality monitoring data does not exist. Similarly, there is no formal system of air quality data storage and reporting.

On 31st of August 2016 Ambient Air quality was sampled from different points at proposed project site. To evaluate the air quality of the proposed project site, all the calculated values were compared with SEQS for air quality assessment. All the values of air monitoring parameters where found under the limits of Sindh Environmental Quality Standards for air quality. The results of air sampling parameters are given below as an **Exhibit 4.6.**

Exhibit 4.6: Location: Proposed Project Site

S. No	Parameter	Units	SEQS Limits	Concentration	Method/ Instrument
1	Carbon monoxide	ppm	5	<1	EVM7
2	Carbon dioxide	ppm	*	324	EVM7
3	Sulphur dioxide (SO_2)	$\mu g/m^3$	120	<100	VRAE PGM-7840
4	Particulate matter (PM_{10})	$\mu g/m^3$	150	44	EVM7

*: Limits are not available in SEQS

CHAPTER

5

ENVIRONMENTAL BASELINE: BIOLOGICAL ENVIRONMENT

5.1 SURVEY METHODOLOGY

The proposed project area was visited and data regarding the biodiversity i.e. Mammals, Birds, Reptiles and Plants was collected.

To record the occurrence and individuals of various species present there, observations were made from vantage points suitable for viewing the habitat. For the confirmation of various species, field guides and checklists were used for floral and faunal species.

5.2 PROJECT AREA

The proposed project area is in Jhampir, district Thatta, at the right side of Karachi-Hyderabad Motorway which links Karachi to Hyderabad.

Proposed project site is covered with natural wild vegetation.

5.3 BIODIVERSITY

6 species of Mammals, 20 species of Birds 4 species of Reptiles and 11 species of plants have been spotted and recorded from the area. Details are provided in **Exhibit 5.1 to 5.4**, whereas the pictorial profile of the biological environment of the area is shown in **Exhibit 5.5** and **Exhibit 5.6**.

The area falls in the arid climatic zone and habitat only support a few number of plants and animals as well as due to scarcity of water, the floral and faunal species are low in the proposed project area.

5.4 FAUNA

5.4.1 Mammals

Active burrows in windrows within the proposed project location indicate a sizable population of small mammals in the area. Other common mammals found here include the Asiatic jackal, the Indian hare, the Indian gerbil, the five-striped palm squirrel, the Long-eared Desert Hedgehog, and the Indian Porcupine. No

mammalian species are listed under any category of the IUCN Red List (2000) was found during the field survey. However Asiatic jackal in the project area has been included in **Appendix III** of CITES.

Reported Mammals of the proposed project site includes: Ratel (Honey Badger) (*Mellivora capensis*); Small Indian Mongoose (*Herpestes javanicus*); Black-naped Hare (*Lepus nigricollis dayanus*); Grey Spiny Mouse (*Mus saxicola*)

5.4.2 Birds

Soreley's Gazetteer of Sindh lists 426 bird species, out of which about 22 species were observed at the proposed project area and its surroundings. All above mentioned 426 species are winter visitors and summer breeders[1]. Resident bird species that are commonly found in the area include Bank Myna, sparrows, robins and doves. Characteristic bird species that have adapted to the environment and are still to be found in the area, include the Indian grey partridge *(francolinus pondicertanis)*, chest-nut-bellied sand grouse (*pterocles exustus*), rock dove (*Columbia livia*), Indian little button quail (*turnix sylvatica*) and Eurasian roller (*coracias garrulous*). Kites, vultures, and falcons the highflying birds were not spotted during the survey and the several visits to the area. They were reported by the locals to be only occasional visitors. Other birds found here include the Houbara bustard (*Clamydotis undulate*) ,in IUCN Red List as low risk, near threatened), Grey Parttridge (Francolinus pondiceranus), Indian Sand grouse (*Pterocles exustes*), Painted Sand grouse (*Pterocles indicus*), Saker Falcon (*Falco biarmicus cherrug*), Indian Griffon Vulture (*Gyps fulvus fulvescens*); Partridge (*Ammoperdix griseogularis*); Common Quail (*Coturnix coturnix*); Eurasian Wryneck (*Jynx torquilla*); Sindh Woodpecker (*Dendrocopos assimilis*) Sindhi; Common Hoopoe (*Upupa epops*); Indian Roller (*Coracias benghalensis*); Asian Koel (*Eudynamys scolopacea*); Rose-ringed Parakeet (*Psittacula krameri*); Spotted Owlet (*Athene brama*); Rock Pigeon (*Columba livia*); Indian Collared Dove (*Streptopelia decaocto*); Common Crane (Grus grus); Tawny Eagle (*Aquila rapax*), Common Myna (*Acridotheres tristis*); Pale Crag-martin (*Hirundo obsoleta*); House Sparrow (*Passer domesticus*)[2]. The proposed project area also hosts many species of migratory birds for limited duration of time.

5.4.3 Reptiles

The proposed project area provides a good habitat for a variety of reptiles. Monitor lizard *(Varanus bengalensis)* was observed at the proposed project area, the largest lizards in the area. The preferred habitat of the desert monitor *(Varanus griseus)* is sandy, while the Indian monitor *(Varanus bengalensis)* prefers water bodies. This rare species of lizard has been included in **Appendix II** of the CITES, but its

[1] Sorley's Gazetteer of Sindh, 1968
[2] Initial Environmental Examination Of 50 Mw GAWPL-WPGC At Deh Kohistan, Jhimpir, Thatta

population was found less in the proposed project area due to increase in human population.

The population of the Indian sandy boa *(Eryx johni)* is very low. Black Cobra presence is also reported in the proposed project area, which has also been included in **Appendix III** of CITES. The most prominent snake in the area is the saw-scaled viper *(Echis carinatus).* This is a highly poisonous snake and is distributed throughout Pakistan. The size reached by this species in the project area is larger than in other parts of Pakistan.

The populations of other species of snakes and lizards found in the project area is satisfactory and no other species thereof is included in CITES.

Other reptiles reported in the proposed project area includes: Yellow-headed Agama (*Stellio Agama nupta fusca*), Indian Garden Lizard (*Calotes versicolor*), Long-tailed Desert Lacerta (*Eremias guttulata watsonana*) reported but not spotted, Sindh Sand Gecko (*Crossobamon orientalis*) reported but not spotted[3].

5.5 FLORA

Most of the area near and along the proposed project site is covered with wild vegetation. The level of anthropogenic activity is very low; specifically communities in nearby villages used the place to cut the woods (*Prosopis juliflora)* for their livelihood and fuel. This has resulted in loss of natural habitat into barren land. The quality of soil is also poor with little organic matter, sandy loam and poor texture to support large-scale vegetation.

Samplings were carried out in the surrounding of the proposed project location, along the earthen access track towards the project area.

A total of 11 species of plants were observed within the vicinity of the proposed project site. Most of the species are of minor ecological importance and only four of them are dominant and wide spread. The plant species dominating the project area include *Prosopis juliflora, Capparis decidua, Euphorbia hirta* and *calotropis procera.* The plant species within the vicinity of the proposed project location is mainly dominated with *Acacia nilotica* and *Salvadora persic.* The vegetation cover is less than 10% at the plant site. The area falls in zone, with common, less important species.

5.5.1 Trees

Reported Trees from the proposed project site includes:

Acacia nilotica, Acacia Senegal, Calotropis procera, Salvadora oleoides (khabar) Prosopsis senegal, Acacia arabica, Capparis aphylla, Commiphora wrighti,

[3] Initial Environmental Examination Of 50 Mw GAWPL-WPGC At Deh Kohistan, Jhimpir, Thatta

Commiphora stocksiana, Prosopis cenraria, Tamarix gallica, tamarix aphylla, Euphorbia cauducifolia, Lasiurus sindicus, populus euphratica, Rhazya stricta, capparis aphyila, acacia lebbek, Prosopis cineraria, Eleusine flagelliforia, Salsola foetidia; Baleria acanthoides, Lasiurus sindicus, Aristida sp. Ziziphus nummularia, Cordia gharaf, Grewiavillosa, Leptodenia pyrotecneca, Lyssium depressum, Pterophyllum oliveri, Tecoma undulate [4].

5.5.2 Grasses

The following grass species have been reported at the site but most of them were found to have succumbed to aridity compounded by overgrazing:

Arisdita adscensionis, A. Mutabilis, Cenchrus ciliaris, Cenchrus biflorus, Cenchrus, Cenchrus pennisetformis, Cynodon dacdylan, Cymbopogon jawarancusa, Digitaria sp, Eleucine flagellifera, Lasiarus sindicus, Saccharum spontaneum, Sporobolus marginantus.

5.5.3 Forbs

Aerva tomentosa, Cassia holoserica, Convolvulus glomeratus, Crotolaria bifolia, Fagonia cratica, Helotropium ophioglossum, Indigofera oblongifloia, Rynccosia minima.

5.5.4 Bush

Predominant bush species found in the area include Devi, Chali, Damral and Darathi (local names). No special medicinal value is associated with these bush species by the locals.

5.6 CONCLUSION

The construction and installation activities will be taken place within the barren land of the proposed project area which will not produce any significant impact upon the biodiversity. The removal of vegetation will not take place because the land being used for the construction purpose is already free from any vegetation.

[4] Initial Environmental Examination Of 50 Mw GAWPL-WPGC At Deh Kohistan, Jhimpir, Thatta

Exhibit 5.1: Mammals Recorded at the Proposed Project Area

S. No	Common Name	Scientific Name	Occurrence				Status		
			Common	Abundant	L. Common	Rare	SWPO	Red list	Appendix /CITES
1	Asiatic Jackal	*Canis aureus*			x				III
2	Five striped palm squirrel	*Funambulus pennantii*	x						
3	Indian Gerbil	*Tatera indica*	x						
4	Indian hare	*Lepus nigricollis*	x						
5	Indian Porcupine	*Hystrix indica*	x						
6	Long-eared Desert Hedgehog	*Hemiechinus collaris*	x						

Exhibit 5.2: Reptiles Recorded on the Proposed Project Area

S. No	Common Name	Scientific Name	Occurrence				Status		
			Common	Abundant	L. Common	Rare	SWPO	Red list	Appendix /CITES
1	Indian Monitor lizard	*Varanus bengalensis*			x		x		I
2	Indian Fringed- toed Lizard	*Acanthodactylus cantoris cantoris*	x						
3	Indian sand boa	*Eryx johni*	x						
4	Saw scaled viper	*Echis carinatus*	x		x				

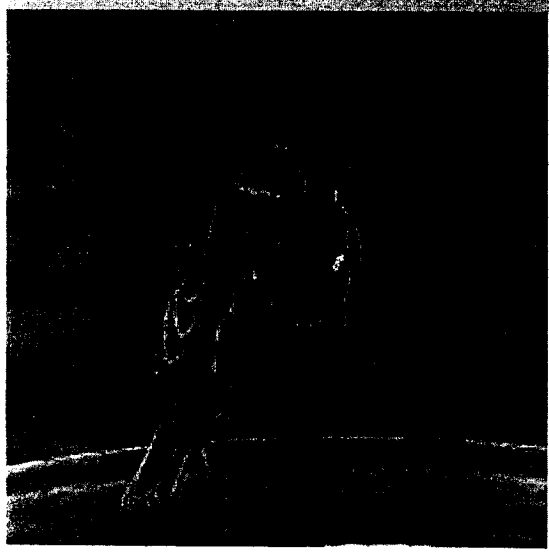
Exhibit 5.3: Birds recorded at the proposed project area

S. No	English Name	Scientific Name
1	Grey Partridge	*Pondicerianus mecranesis*
2	Grey Quail	*Coturnix coturnix*
3	Redwattled Lapwing	*Vanellus indicus*
4	Painted Sandgrouse	*Pterocles indicus*
5	Indian Ring dove	*Streptopelia decaocto*
6	Desert Lark	*Ammomanes deserti*
7	Indian red turtle dove	*Streptopelia tranquebarica*
8	Rose ringed parakeet	*Psittacula krameri*
9	Cuckoo	*Cuculus canorus*
10	Sind-tailed Bee-eater	*Merops orientalis*
11	Hoopoe	*Upupa epops*
12	Indian crested Lark	*Galerida cristata*
13	Indian grey Shrike	*Lanius excubator*
14	Rosy Starling	*Sturnus roseus*
15	Indian Myna	*Acridotheres tristis*
16	Sindh House Crow	*Corvus splendens*
17	White eared Bulbul	*Pycnonotus leucogenys*
18	Red vented Bulbul	*Pycnonotus cafer*
19	Common babbler	*Turdoides caudatus*
20	Sindh Jungle babbler	*Turdoides striatus*

Exhibit 5.4: Flora of the proposed Project Area

S.No	Plant Species	Local Name	Life Form			
			Herb	Shrub	Grass	Tree
1	*Acacia jacquemontii*	Banwar		x		
2	*Acacia nilotica*	Sindhi Babur				x
3	*Avicena merina*	Mangrove				x
4	*Calotropis procera*	Ak		x		
5	*Capparis decidua*	Kirar				x
6	*Euphorbia hirta*	Kheer wal				x
7	*Prosopis juliflora*	Devi		x		
8	*Salsola imbricate*	Lano		x		
9	*Salvadora persica*	Khabbar		x		
10	*Saveda fruticosa*	Lani		x		
11	*Zizyphus nummularia*	Ber		x		

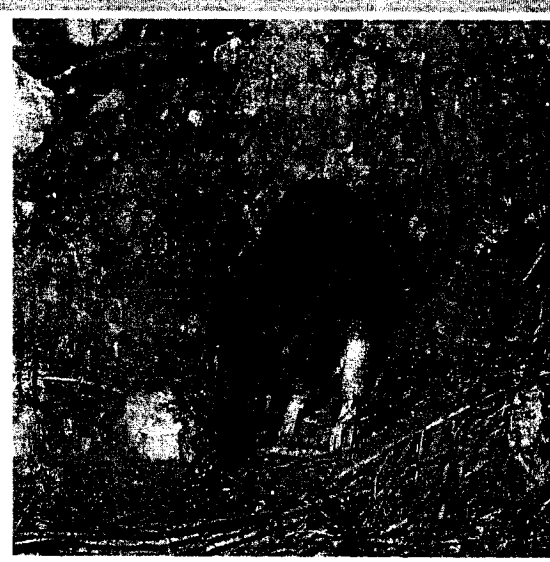
Exhibit 5.5: Pictorial profile of Birds Found at project site



Sparrow at Project

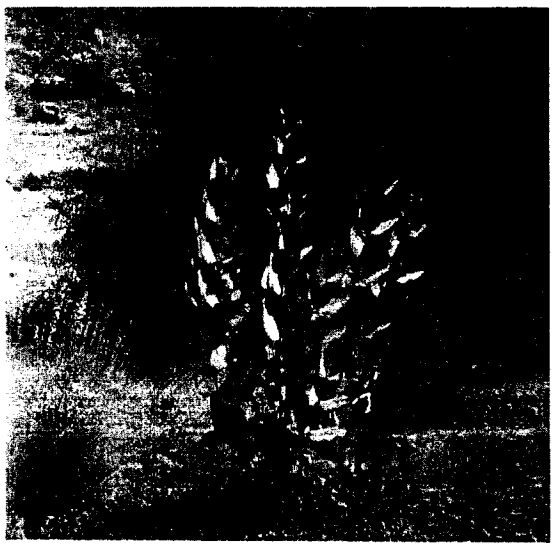
Crow at Project

Desert Lark



Common mouse at project site

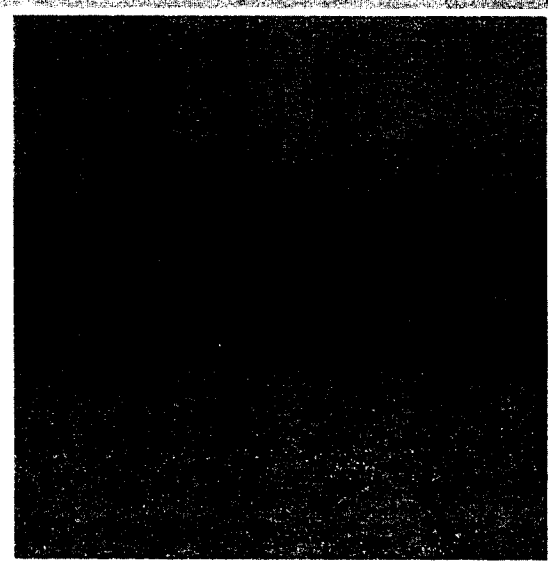
Exhibit 5.6: Pictorial profile of flora at project site



Calotropis procera

Parkinsonia aceulata

Grass

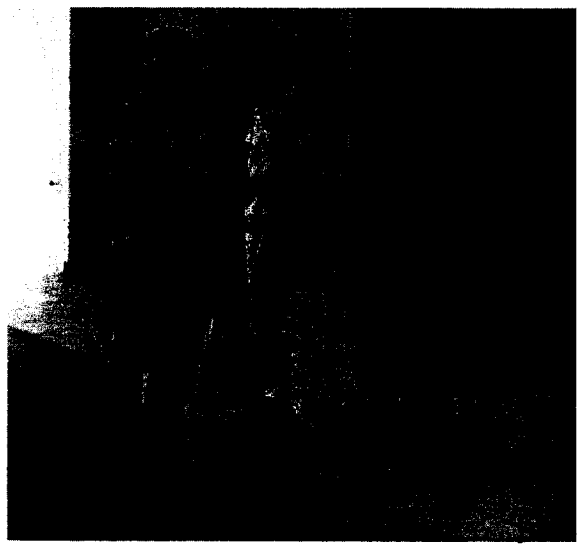


Zizyphus nummularia

CHAPTER

6 SOCIO-ECONOMIC CULTURAL ENVIRONMENT

One of the necessary sections in the development of IEE report is providing a complete data on socio-economic cultural environment of the project area.



It presents information on the proposed project area's location, population as well as the description of socio-economic indicators such as education, health, economy and lifestyle. The purpose of the socio economic survey was to gather firsthand information about the generic characteristics of people living in the vicinity of proposed project areas, their social lifestyle, their economic activities and living culture. Information was specifically collected regarding the conditions of health, education, potable water, transport and communication network, housing units etc. Special attention was given on gathering an insight about the daily life traditions and values of the inhabitants of surrounding area. A detailed description of major findings is presented in this section.

6.1 STUDY METHODOLOGY

A team comprising of sociologist and gender specialist carried out the study of socio economic cultural environment of the proposed project area. The approach methodology for specific survey was a combination of qualitative and quantitative data techniques. A qualitative research approach was combined with the quantitative data collection of socio-economic cultural data through short structured questionnaires focus group discussions with communities. These included men, women key informants of the thirty key villages in the surroundings (05 kms radius) of the proposed project area. Relevant accurate information was obtained efficiently in terms of time village coverage by rapid cycles of interaction among the team members, community's village elders.

6.1.1 Data Collection Tools

Specific tools were used for data collection which includes: direct observation, short questionnaire, focus group discussions informal interviews, etc. Various stakeholders including the local communities, local leaders, and representatives of local government, NGOs and others were also consulted in detail about the proponent's likely activities in the area. Data from other published literature sources the district census report have also been used.

6.2 PROJECT LOCATION

The Moro Wind Power Pvt. Ltd. proposed project site is located in District Thatta, Tehsil Jhampir at Jhampir Nooriabad Road, Sindh. The direct distance of the MPC Project site from center of Karachi City is about 100 km and 80 km from Hyderabad City. Total purchase area of Project is 240 acres.

6.3 ENTRY EXIT POINTS

The major entry exit road into the proposed project area is Hyderabad Super highway, after 20 km from the Nooriabad industrial area. The project area has no linkages with railway line.

6.4 DEMOGRAPHICS

Thatta District is located in the southern area, locally called Laar, of province of Sindh, Pakistan. Its capital is Thatta. It had great importance in history and today is famous for its archeological sites and centuries old monuments, which are great tourist attractions. According to the 1998 census of Pakistan, it had a population of 1,113,194. Jhampir is a union council in Thatta District, Sindh, Pakistan. It is situated 114 km away from Karachi. It is the site of Pakistan's first wind power project. It is the only place in Pakistan where dolomite is found. Thatta District is administratively sub divided into 5 talukas and 94% of the Sindhi language is being spoken. The bazaars of Thatta are known for hand-printed fabrics, glass bangles and Sindhi embroidery work in lay with tinny mirrors, one of the more world known handicrafts of Pakistan. Thatta appears to have scarcely moved out of the 18th century and is only slowly catching up with the modern world.

There are archeological sites in the city and on its outskirts. The most famous of these sites is the Makli Hill, which is the biggest necropolis in the world and about three kilometers from Thatta. Thatta played an important role in the history of Sindh and the city was constantly renovated from the 14 to 18 century. But in 1739, when the province of Sindh was taken over by Nadir Shah of Persia, Thatta entered into a period of decline. However the four centuries that comprise the golden age of Thatta have left their traces on the form of monuments in the region.

6.5 NETWORKING COMMUNICATION

Proposed Project site is located in the under developed areas of Thatta, and Thatta itself is the major town of the proposed project area and also the district Headquarter. Furthermore District Thatta formerly considered as an under developed district of Sindh. It does not have their own resources to enhance the value and improve the quality of life of its people. Proposed Project site was surveyed to see the surrounding settlements of the area. Total area was surveyed in close vicinity of the proposed project site. Two villages was found near the project area with small population.

6.6 LEADERSHIP DYNAMICS

The village leader, spiritual leader is normally the most influential person of the village/town in terms of land. The people of this area are peaceful and polite. Therefore minor conflicts are resolved at village level. However, if the conflicts are big and complex then the community leader resolves the conflict through listening to both the parties' point of views. Mostly conflicts occur due to disputes on land and Irrigation water etc.

6.7 LIVELIHOOD

The proposed project is located in the arid stony land with low rainfall. According to a survey conducted in the vicinity of proposed project area, the only source of livelihood for the people is keeping livestock as a major supplement for household consumption needs and as a store of value. Livestock is important source of income for the locals and most of them have own cows, goats, sheep, camels, ass, mule, hens and buffalo's. About 35% are involved in rearing livestock. People grow maize and fodder for livestock. Good breeds of buffalo and cow are found in Thatta Districts. Due to the overall scarcity of water the livestock in the district suffers from shortage of feed and fodder crops and the numbers of livestock is decreasing tremendously. Another source of livelihood is wood cutting that enabled household to meet with their fuel needs and source of income as well. It is difficult to grow main crops because of aridity and largely sand soil. Maize is the main crop that suits the rain fed area and same is used for fodder. Two-thirds of the village households have their own land of various sizes. Most of the inhabitants of the villages cultivate their own land, but some are too poor to cultivate it themselves, hence few households have rented it out to 'Haris' who invest in cultivating their land, preparing it for crops, irrigate the lands and then collect the harvest to sell it in the markets. The crops grown on their lands are mostly vegetables like Gourd, lady finger, ridge gourd and cluster beans. The **Exhibit 6.1** represent the livestock population in the district.

Exhibit 6.1: Livestock Population in the Thatta District

Livestock	Population	Percentage
Cattle	339,105	31
Buffalo	314,253	29
Sheep	170,031	16
Goat	240,920	22
Camel	11,081	1
Horse	424	0.3
Mule	183	0.1
Ass	23,748	2
Domestic Poultry	510,114	Not Included

** Source: Livestock census: 1996*

6.8 ECONOMY

Income is the main factor/indicator for the development of the community or for the country. Enough income resource stimulates the individual for advancement. Major source of income observed asked from the respondent are small business, livestock, labor and agriculture. A small numbers of persons are engaged in private labor, transportation in small businesses. Local people resources (material, social) are so limited that it excludes them from the minimum acceptable way of life from urban cities of Pakistan. To reduce economic burden children at very tender age are busy in grazing cattle or helping males in fields. For poverty alleviation of the local people Local authorities need to make plan for income generation, credit employment schemes, and promote local handicrafts to increase income.

6.9 PROFESSIONAL AFFILIATION

The people in the proposed project area are working in low level occupation, most of the families are involved in farming, raising livestock and collecting sand and gravel from the river beds. Females are also taking part with the males in the following types of labor.

- Wood collection
- Farming
- Stone excavation, gravel collection
- Water sale by donkey-cart
- Industrial labor

6.10 DRINKING WATER

Supply development of potable water sources are very low. The source of drinking water in all of the villages is underground water drawn through tube wells, hand pumps. The depth of ground water level is approximate 200 ft. Another source of water in the villages is tankers but the water supplied by the tankers is unpotable and its poor quality is not safe for drinking and human consumption. Water supply is not available in any of the villages of the proposed project area.

6.11 EDUCATION

The Universal Declaration of Human Rights (1948) declared primary education as the basic human right of all people of all nations, where strengthening the quality of education has become a concern of paramount importance in discussion on education. The status of education in major cities of Pakistan is not very satisfactory this situation becomes more pathetic in rural areas such as in the proposed project area, education status was found low in the area due to unavailability of school near to area and low income resources. In surveyed area it was found that ratio of boys is more than girls in education. The poor situation of rural area school education system is well reflected in Pakistan National Education Policy 1992 which recognized that the quality of primary education has been compromised required urgent examination of the measures needed for its raising. The policy has mentioned several strategies for the purpose including teachers' training, provision of textbooks etc. To achieve universal primary education goal there is a great need that Government need to re-activate non-functional government schools and provide training to teachers, and upgrade primary schools.

6.12 HEALTH

The health facilities are inadequate and substandard. Major health problems of the area are fever, malaria, cough, skin diseases, typhoid, tuberculosis, child mortality, maternal health, congestion, asthma, blood pressure, sugar hepatitis and kidney stone. Water borne diseases are also common due to the consumption of tankers water. People travel to Thatta, Jamshoro and Hyderabad in case of some serious problem /emergency. The cost of treatment is intolerable for the villagers particularly the travel cost, the fees paid to the doctor and the medicine cost. The situation is worse for females as the basic health unit (BHU) and mother and child Centre (MCH) in all towns are unstaffed and under stocked. To reduce child mortality, improve maternal health and combat diseases, government should need to open Village health clinics, arrange medical camps provide training to female health workers.

6.13 THE STATUS OF WOMEN

The women of this area are very hard working and practical. They play a major role as counterpart to carry out household field activities with their men. Generally the women remain very busy in the project area; women are responsible for cooking food dish-washing, washing of clothes, sewing of clothes, making Rillhies and look after

their children. In addition to all above activities women were also seen working in the agriculture field mostly in harvesting of crops, picking of cotton and feeding milking the livestock. The women of the project area are illiterate have no authority to interfere in domestic decision making, they usually sleep early and they wake-up early in the morning to carry out routine activities.

6.14 NON GOVERNMENTAL ORGANIZATION (NGOs)

Different national and international NGOs are working in the Thatta district with the help of their local partners. Their scope of work ranges from relief operations in coastal areas of the Thatta to social welfare and livelihood improvements initiatives. Some are working on CPI (Community Physical Infrastructure). Some have found their way in providing micro finance to local communities through social collateral. Few of these are also working on awareness and advocacy. Names of different NGOs and institutions like NRSP (National Rural Support Program), Aga Khan planning and Building Services (AKPBS), PPAF (Pakistan Poverty Alleviation Fund), International Union for Conservation of Nature (IUCN), World Wide Fund for Nature (WWF), Strengthening Participatory Organization (SPO) and Pakistan Fisher Folk Forum.

6.15 ARCHAEOLOGICAL AND HISTORICAL SITES

Survey was conducted within and around the proposed project site and no archaeological and historical sites have been identified /seen in the proposed project area.

6.16 RITUALS

Major castes / tribes in the proposed project area are Palari, Shoro, Chandio (Muslim). These tribes mostly speak Sindhi language.

Ceremonies:

Marriages in most families are arranged by parents preferably is their own caste, sometimes the engagement of girl boy is fixed at the time of birth or childhood. On the birth of first boy, marriage and circumcision ceremony playing of drums Shehnai, is quite common. The ritual of wedding/ marriage ceremonies usually lasts for one to two days. To bear the expenses of ceremony usually the poor people borrow the money on credit to celebrate the marriages/circumcision ceremonies. Meat rice is offered at ceremony.

Belief System:

People of the area have respect belief on the saints. They usually visit shrines of saints at the time of trouble, misfortune, pray for birth of sons and when their wishes come true, this reflects their faith upon them. Depending on which sect one belongs to is determined by the fact that whether or not they visit the shrines or how much they revere the saints.

CHAPTER

7

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

After a thorough assessment of the existing environmental and socio-economic conditions and review of technical data, a team of environmental professionals analyzed the environmental impacts and suggested necessary measures for mitigation significant impacts. This Chapter presents the Initial Environmental Examination of the proposed project including its components.

The Wind energy generation project is not an air, water polluting and resource intensive project. However, there may be considerable environmental impacts during the initial construction phase mainly due to civil works such as adjustment of access routes or movement of construction vehicles. Construction phase impacts are usually temporary and localized phenomenon, except the permanent changes that might be introduced in the land use patterns along the Right-of-Way. However, these impacts are given due consideration, wherever applicable.

7.1 SCREENING OF ENVIRONMENTAL IMPACTS

The screening matrix was developed as part of the environmental impact assessment process for the proposed project. The purpose of screening matrix is to identify the potential environmental impacts during the design, construction and operation phases. The interaction of project activities with various components of the environment was observed with the help of these matrix. The impacts were generally categorized as physical, biological and social, and then each of these broad categories further divided into different aspects. The potential impacts thus predicted were characterized in the matrix as follows:

- High negative (adverse) impact
- Low negative impact
- Insignificant impact
- High positive (beneficial) impact
- Low positive impact
- No impact.

The negative impacts predicted by this mean were the "unmitigated" impacts. Appropriate mitigation measures were recommended as part of this IEE, as a result the occurrence, possibility and severity of the potentially adverse impacts could be reduced.

7.2 ASSESSMENT OF RESIDUAL IMPACTS

The mitigation measures cannot always completely eliminate the probable adverse impacts of the proposed project activities; often there are residual impacts even after the implementation of mitigation measures. The final step of the entire impact assessment process is to determine the residual impact. These residual impacts are monitored during the project execution, in order to ensure that these remain within acceptable limits.

7.3 IMPACT CLASSIFICATION

Impacts were characterized when the potentially adverse impacts were identified. The impacts are characterize in numerous parts and it included:

- Nature (direct/indirect)
- Duration of impact (short term, medium term, long term)
- Geographical extent (local, regional)
- Timing (project phase: before, during and after construction)
- Reversibility of impact (reversible/irreversible)
- Likelihood of the impact (certain, likely, unlikely, rare)
- Impact consequence severity (severe, moderate, mild).

The above aspects of environmental and social impact characterization are represented as **Exhibit 7.1.**

Exhibit 7.1: Impact Characterization

CATEGORIES	CHARACTERISTICS
Nature	**Direct:** Environmental parameter is directly changed by the proposed project.
	Indirect: Environmental parameter changes due to change in another parameter.
Duration of Impact	**Short-term:** Lasting after the activity in short time period such as Noise
	Medium-term: Lasting for a period of few months to a year such as loss of vegetation.
	Long-term: Lasting For a long time period such as loss of soil due to soil erosion.
Geographical Extent	Local, regional (spatial dimension)
Timing	Construction phase and Operation phase
Reversibility of Impact	**Reversible:** When a receptor resumes its pre-project condition
	Irreversible: When a receptor does not or cannot resume to its pre-project condition
Likelihood of the Impact	**Certain:** Impact expected to occur under most circumstances
	Likely: Impact will probably occur under most circumstances
	Possibly: Impact may possibly occur at some time
	Unlikely: Impact could occur at some time
	Rare: Impact may occur but only under exceptional circumstances
Impact Consequence Severity	**Major**: Those activities which has irreversible damage to a unique environmental feature; causes a decline in abundance or change its distribution over more than one generation of an entire population of species of flora or fauna or has a long-term effects (period of years) on socioeconomic activities of significance on regional level.
	Moderate: Activities with long-term (period of years), reversible damage to a unique environmental feature; causes reversible damage or change in abundance or distribution over one generation of a population of flora or fauna and has short-term effects (period of months) on socioeconomic activities of significance on regional level.
	Minor: Activities with short-term (period of a few months) reversible damage to an environmental feature; slight reversible damage to a few species of flora or fauna within a population over a short period; has short term (period of months) effects on socioeconomic activities of local significance.
	Negligible: When no measurable damage to physical, socioeconomic, or biological environment above the existing level of impact occurs.
Significance of Impact	Categorized as High, Medium, or Low Based on the consequence, likelihood, reversibility, geographical extent, and duration; level of public concern; and conformance with legislative of statutory requirements.

7.4 ENVIRONMENTAL IMPACTS ASSESSMENT

The proposed project activities will include excavation, foundation works, and construction of building and installation of wind turbines. During the operation phase, most of the construction phase impacts will get stabilized and will be restricted only to the operation and maintenance of the project.

The impacts on the environment from various activities of the proposed project can be categorized as follows:

- Impact on Physical Resources
  - Impact on Topography
  - Impact on Soils and Geology
- Impact on Environmental Resources
  - Impact on Air Quality
  - Impact on Noise Levels
  - Impact on Water Quality
- Impact on Ecological Resources
  - Terrestrial Ecology
  - Wild Life
- Impact on Human Environment
  - Health and Safety
  - Socio-economics
  - Cultural sites
  - Traffic and Transport
- Waste Disposal
  - Solid waste
  - Liquid waste disposal.
- Seismicity

7.4.1 Impact on Physical Resource

7.4.1.1 Impact on Topography

The topographical condition of proposed project site is already discussed in chapter 4. However due to construction & operational activities it is expected that there will be no adverse impact on topography of proposed project site.

7.4.1.2 Impact on Soils and Geology

The quality and stability of the soils on site may be affected by earthworks including dumping of construction and excavation, leveling of the site, and discharge of water from concrete batching and accidental leakage of chemicals to be used. However, the excavation activities for foundations of Wind mills may result in soil erosion due to poor rock quality and low load bearing capacity of soil. Moreover, the resulting impact on soil quality cannot be readily quantifiable. Impact appraisal will be based on a quantitative assessment considering severity and likeliness of the residual impact after taking necessary mitigation measures. The impacts related to soil erosion and contamination are characterized below.

- Nature: Indirect
- Duration: Short term
- Geo extent: Local
- Reversibility: Mostly reversible
- Likelihood: Unlikely
- Consequence: Minor
- Impact significance: Low

During operational phase, no significant impacts are expected on soil quality, provided that good waste management practices are implemented at the site and proper pavements are done for general vehicular movement.

Mitigation Measures

- All works will be limited to the project site
- Topography will be monitored and managed according to need.
- Vegetation top soil will be relocated and grass plantation will be promoted.
- The construction activities will be planned to minimize any contamination to soil.
- Ensure that all the chemicals involved in construction phases such as paints, oils and other lubricants that may or will be used in any operational phase must be placed at a designated area having impermeable floors. This would reduce the probability of leaching of these lubricants to the soil.
- Movement of heavy vehicles, which are expected to carry heavy machinery for the proposed project will be restricted to the parking areas, unnecessary movement of vehicles should be avoided to minimize soils contamination.
- A complete geotech study for each turbine foundation and civil structure foundation will be completed prior to civil construction of the foundations to determine the need for type of foundations.

- Regular inspections should be carried out to detect leakages in construction vehicles, equipment, and storage tanks.
- A spill prevention response team will be available throughout the construction phase.
- All waste material, solid and liquid, will not be stored at any open area and must be contained in impermeable containers and should be labelled clearly. The containers will be constantly checked for their durability.
- Storage of waste material from camp areas should not be allowed for more than two (02) days.
- In case of soil contamination at large scale, the soil would be removed and properly disposed after treating it properly such as incineration, soil remediation technique etc.

Residual Impacts

- By applying appropriate construction practices and management actions recommended in mitigation measures will significantly reduce the adverse effects on soil quality, and soil erosion and contamination could also be minimized. The significance of the residual impacts is thus expected to be 'low'.
- Proper environmental monitoring during the construction and operational phase of proposed project will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

7.4.2 Impact on Environmental Resources

7.4.2.1 Impact on Air Quality

During the construction phase, the activity would involve, movement of transporting vehicles carrying the construction materials etc. To and fro movement of Construction vehicles at the site will generate dust emissions. The major sources of potential impacts on air quality during the construction phase of the Proposed Project are the generation of dust from the earthworks, movement of vehicles on unpaved surfaces, and the release of exhaust emissions (SO2, NOX, Hydrocarbons) from construction equipment and vehicles at the construction sites and the camp site. However, the increase in air pollution is temporary, also the nearest major human habitats at the proposed project site is several kilometers away and it is unlikely to impact the communities. However the construction team and other site staff can be impacted by this air quality deterioration. While during operational phase, there will be no any significant impact on air quality. The impacts related to air quality deterioration are characterized below.

- Nature: Direct
- Duration: Short term

- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Unlikely
- Consequence: Minor
- Impact significance: Low

Mitigation Measures

- Sprinkling of water during excavation and construction will control dust emission to a great extent.
- Emissions from the vehicles will be monitored to ensure that the emissions are within the SEQS limits.
- All the vehicles should be monitored and tuned periodically in order to minimize the exhaust emissions.
- The project vehicles will follow safe driving practice while passing through/near the communities, including reduced speed, which will minimize dust emissions as well.
- Enclosed painting booths and dedicated fabrication areas in favor of wind direction so the fumes may divert away from the site;

Residual Impacts

- By applying appropriate construction practices and management actions recommended in mitigation measures will significantly minimize the adverse effects on air quality. The significance of the residual impacts is thus expected to be 'low'.
- Proper environmental monitoring during the construction and operational phase of proposed project will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

7.4.2.2 Impact of Noise Levels

During the construction phase, the major sources of noise pollution include movement of vehicles, transportation of construction material and equipment to the site and operation of heavy machineries. During Operational phase there will be noise generation due to movement of wind mill blades. Noise that will be generated by construction machinery, equipment and during wind mill operation is calculated & estimated using their sound power levels, which are given below.

Machinery to be used in Construction & Operation Works:

Machine	Sound Power dB(A) (LP)*
Excavator	108
Trucks	102
Loader	112
Dozer	93
Grader	107
Roller Compactor	95
Wind Turbine at 80 meter height	90-105
Wind Turbine at ground surface	55-65

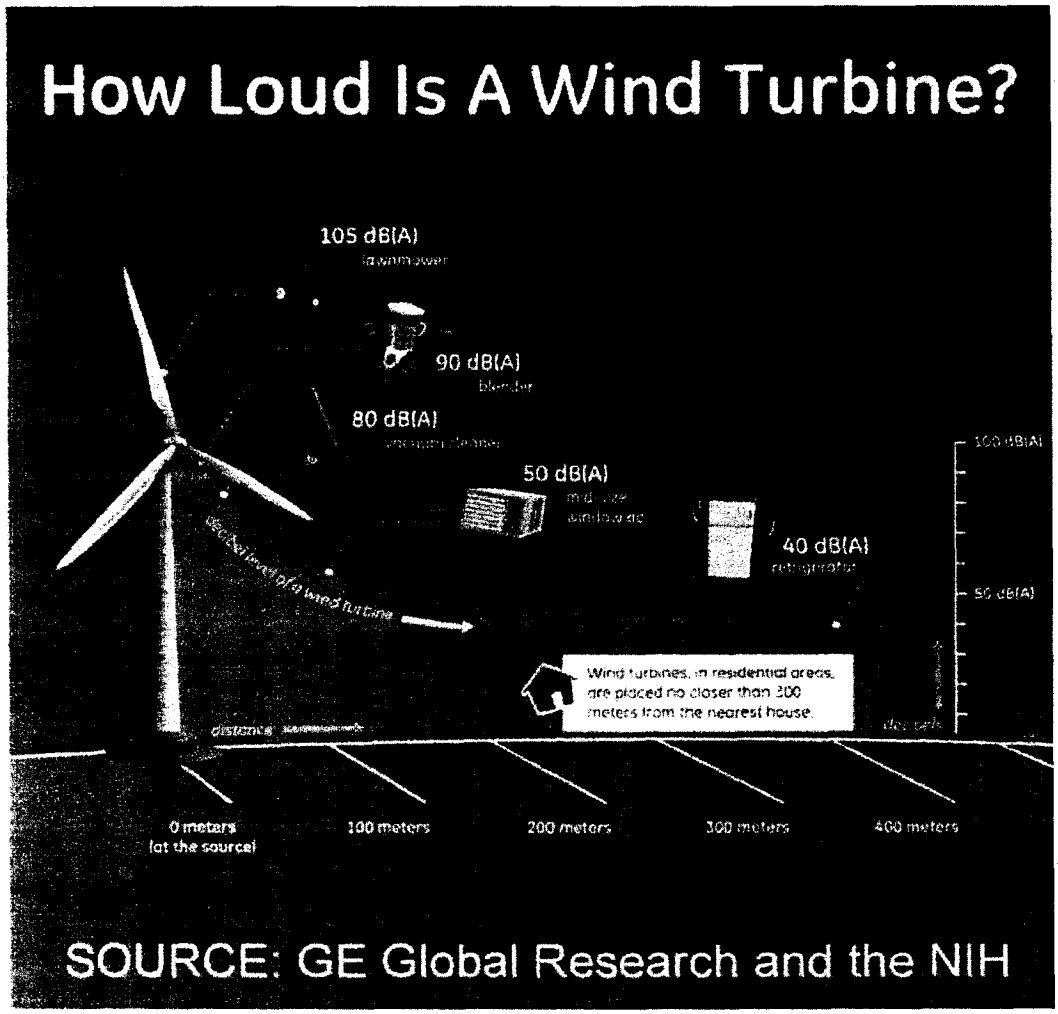
* Lp= Sound Pressure Level
* *Source: http://www.nottinghamcity.gov.uk*

Trucks will make rounds between the site and carrying backfilling material will make rounds within the site between excavation area and the backfill material storage site. The major work of the construction is expected to be carried out during the day time. The impacts related to noise pollution are characterized below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Unlikely
- Consequence: Minor
- Impact significance: Low

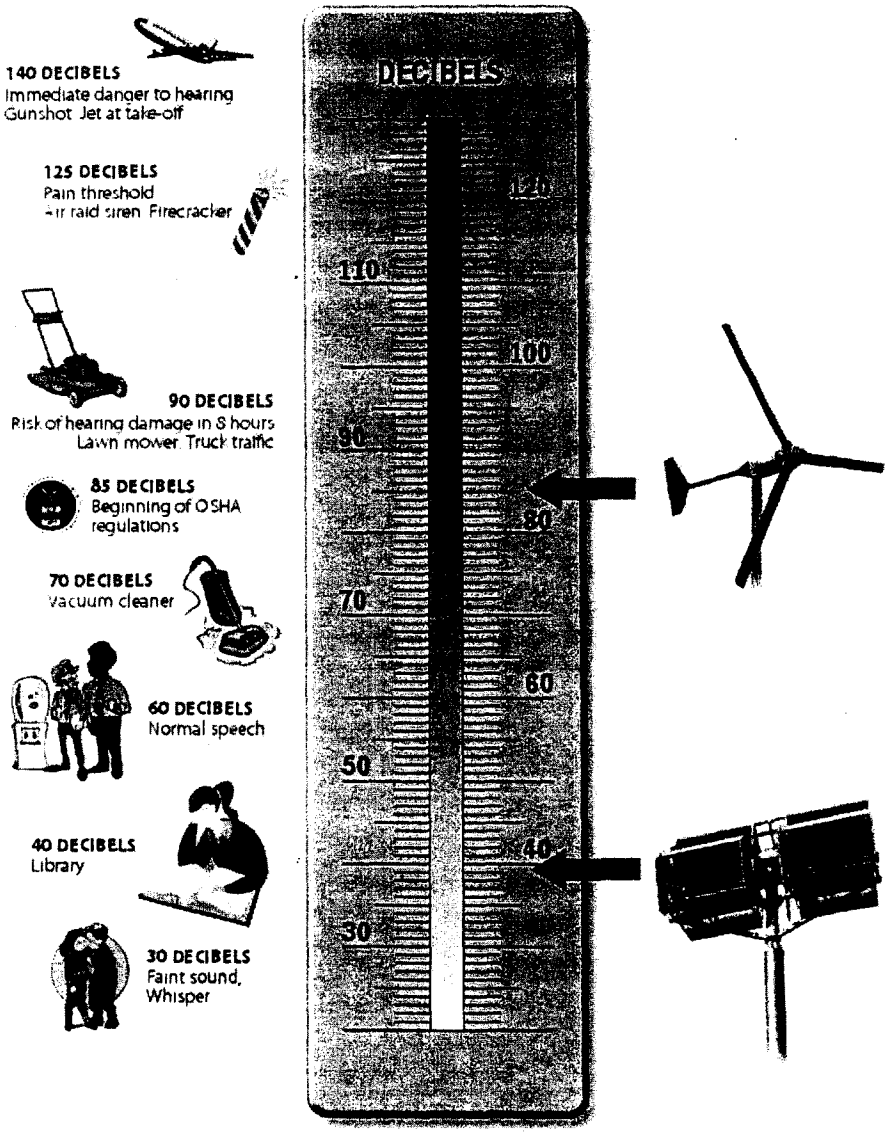
The **Exhibit 7.2** represent the noise level generated by wind turbine and **Exhibit 7.3** represent the comparison of noise level generated by wind turbine.

Exhibit 7.2: Noise Level Generated by Wind Turbine.



**Source:* *http://www.gereports.com/post/92442325225/how-loud-is-a-wind-turbine/*

Exhibit 7.2: Noise Level Comparison



** Source: http://www.vqwind.com/ vq-windjet-vs-propeller-sound-level-pressure.aspx*

Limit values for day-time, evening and night-time environmental noise are mentioned in SEQS for construction sites. Construction might continue during night- time as well upon obtaining necessary permit from the SEPA. There may be nuisance due to construction noise at proposed project site and the nearby public.

On the other hand, noise and vibration impacts due to construction activities in proposed project site will be local. In other words, only immediate surroundings which are currently completely vacant will be affected. Therefore, construction works will not add to the noise impact of the Proposed Project due to its location.

Mitigation Measures

Following measures will help to keep noise and vibration in acceptable level during construction phase:

- Contractor shall equip their heavy construction equipment and plants with exhaust silencers to limit the engine noise so as not to exceed 80 dB (A) (compacters, loaders, vibrators and cranes) and regularly maintain all construction vehicles and machinery in accordance with the SEQS.
- Workers on site will be provided with adequate personnel protective equipment (PPE) so as to alleviate noise levels.
- Also, the construction activities will be scheduled / planned in such a way as to prevent high noise activities during night times and simultaneous operation of multiple high noise equipment will be avoided to the extent feasible.

Residual Impact

- The environmental monitoring during the proposed project execution will ensure noise and vibration impacts are indeed absent.

7.4.2.3 Impact on Water Quality

Water during the construction activity will be required for the concrete mixing and for wetting the fresh concrete structures etc. At the construction site as well as water sprinkling for dust suppression. The proposed project activities that can contaminate soil may also contaminate the surface water. These include:

- Disposal of construction waste
- Warehouse and workshop waste disposal
- Domestic solid waste disposal from construction camp
- Waste effluents disposal
- Equipment/vehicle maintenance
- Spillage/leakage of fuels, oils and chemicals

The construction phase of the proposed unit will not have any major impact on the surface and ground water quality in the area. Due to construction activities grey water is expected to be generated meanwhile domestic waste water may be generated from temporary camp sites.

During operational phase, water will be consumed in toilets and cleaning activities in buildings which have minimal adverse impacts on water resources.

If chemical substances and oily waste get leached by precipitation of water and percolate to the ground water table then there may be a chance of ground water

contamination. For wind mill construction activity, chemical substance or oil is used hence there is chance of adverse impact on ground water quality. The impacts of the proposed project activities on the water quality of the area are characterized below.

- Nature: Indirect
- Duration: Short to medium term
- Geo extent: Local
- Reversibility: Mostly reversible
- Likelihood: Unlikely
- Consequence: Minor
- Impact significance: Low

Mitigation Measures

- Complete record of water consumption during construction & operation phase will be maintained.
- If a water well is to be installed, it will be designed to abstract water preferably from deep aquifer not being used by local communities.
- Care shall be taken to locate the temporary construction worker sheds away from any water bodies.
- Adequate drinking water facilities, sanitary facilities, and drainage in the temporary sheds of the construction workers should be provided to avoid surface water pollution.
- Contractors shall use silt traps and erosion control measures where the construction is carried out in close proximity to the water bodies to avoid entering of cement particles, rock, rubbles and waste water to the surrounding water bodies

Residual Impacts

- By applying appropriate construction practices and management actions recommended in mitigation measures the proposed project activities are unlikely to contaminate the water resources of the area in any significant manner. The residual impacts of the proposed project on the water quality will therefore negligible.
- Proper environmental monitoring during the construction and operational phase of proposed project will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

7.4.3 Impact on Ecological Resources

There is no national wildlife park, bird sanctuary in the vicinity or surrounding of the proposed project site. However, there is wetland site namely keenjhar lake which is about 40 km in the southeast of wind project. The ecological impacts are briefly described in the following sections

7.4.3.1 Effect on Flora and Fauna

It is expected that no any flora and fauna that are rare, endangered, endemic or threatened will be affected. Some small bushes were observed in the proposed project site, but these have very little ecological significance, and most of this vegetation at the site will not be disturbed. However, noise, vibration and emission from construction vehicles, equipment will occur during construction and pre-construction stages in temporary manner which may have adverse impacts on native species.

During operational activities the most significant environmental issue associated with the project could have been the potential for migratory birds' mortalities through collision with the wind turbines and associated infrastructure. Non-collision impacts on birds such as site avoidance and disruption of migratory behavior could also been significant. However since, according to a survey conducted by WWF in 2009, number of birds in and around Keenjhar Lake has reduced drastically in recent years, besides these birds have tendency to fly at an altitude of 400 to 500 meters therefore there is no chance of collision with wind towers at this specific site. However the noise which produce during blades movement may also be threatened to migratory birds. The impacts of the proposed project activities on the floral and faunal resources of the area are characterized below.

- Nature: Direct
- Duration: Short to Medium term
- Geo extent: Local
- Reversibility: Mostly reversible
- Likelihood: Likely
- Consequence: Moderate
- Impact significance: Medium

Mitigation Measures:

- Strict restriction on worker force regarding disturbance to surrounding habitats, flora and fauna including hunting of small mammals like Rabbit or Mongoose and unnecessary cutting of plants shall be ensured.

- The wind towers to be erected minimum at a distance of 300 meters to avoid the avian collision and to give the birds a wider corridor for the access in the proposed project area;
- Regular checking of the vacuums or holes in the towers to avoid nesting facility of any of the birds;
- Wind Turbine towers to be colored identical and are to be equipped with flashing lamp to avoid avian collision at night;

Residual Impact

- The potential impacts of the proposed project on the flora and fauna of the area are expected to be moderate in nature. With the help of the above mentioned mitigation measures, these impacts are expected to reduce further.
- However, the significance of the residual impacts on the faunal resources of the area is therefore expected to be 'low'.

7.4.3.2 Removal of Trees

According to site preparation, trees might be needed to be removed which are discussed in detail in Chapter 5 about floral species quantities as well as their significance.

Mitigation measure:

- It is to be understood that the trees are of wild nature and are indigenous species, however top vegetation soil is recommended for relocation and re-growth of grass and shrubs of the area.

7.4.4 Impact on Human Environment

7.4.4.1 Health and Safety

The risks of any potential health and safety hazard are always there at anywhere in wind farm. The assessment team has identified following few health and safety hazards that may be experienced at any time during the construction and operational phase of wind farm.

There are very remote chances of all these.

- Accidental or controlled fires
- Falling from height
- Falling turbine blade or damaged turbine

- Damage to turbine components due to high winds
- Turbine blade failure
- Vehicle accident
- Exposure to high voltage

The health risks caused by the construction and operational activities are characterized below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely
- Consequence: Moderate
- Impact significance: High

Mitigation Measures:

Project activities may create accidental damage to public as well as the construction workers. Therefore, contractors should take necessary action to enhance personal safety during rehabilitation works through following measures:

- Necessary training on safety aspects to the personnel working at the line will be provided by the contractor.
- Organize awareness programs relevant to personal safety of the workers in particular and public in the area in general.
- Installation of warning signs at particular locations such as transverse points of local road network.
- Provide protective safety belts, footwear, helmets, goggles, eye-shields, and clothes to workers depending on their job specification.
- Arrangement of proper first aid unit and emergency vehicle to take affected personnel to the nearest medical facility.
- Only authorized and trained personals will be allowed to enter into the power generation plant.

Residual Impact

- By applying appropriate construction practices and management actions recommended in mitigation measures, the residual impacts of safety hazards by the proposed project activities will therefore be negligible.

- Proper environmental monitoring during the construction and operational phase of proposed project will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

7.4.4.2 Socio-Economics

Skilled workers will be employed for these works; local people will be engaged for communication of project activities.

7.4.4.3 Cultural Sites

There are no archaeological, historical, or cultural important sites within the proposed project vicinity; and hence, the impacts on these sites are not envisaged.

7.4.4.4 Effect on Local Road Network

In the construction phase, the major impact of the Project on the local traffic will be due to the movement of trucks bringing construction material into site and taking excavated material and demolition debris from the site.

In addition to the surroundings of the Proposed Project Site, an increase in traffic load might be foreseen at the Link Road since heavy vehicles are usually observed on the track for logistics of different material for the city. A waste disposal site will be designated for excavated material from proposed project site. Trucks carrying excavated material will use different main arteries or access routes. Thus, the proposed project will not expected to add up the impacts on traffic. However, all construction material related to the proposed project will be transported through the local road network to the project site. Transporting of large quantities of materials using heavy vehicles could exceed the carrying capacity of the road. The impacts of the proposed project activities on the road network of the area are characterized below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Possible
- Consequence: Moderate
- Impact significance: Low to Medium

Mitigation Measures:

- It should be ensured that employees park their vehicles within the parking area designated for parking within the industry to reduce the probability of traffic congestion and disturbance to the residency.
- To reduce the traffic load facilitate the employees with transportation facility by means of large buses if possible.

Residual Impacts

- By applying appropriate actions recommended in mitigation measures the proposed project activities are unlikely to increase traffic congestion in the area. The residual impacts of the proposed project will therefore be negligible.
- Proper environmental monitoring during the construction and operational phase of proposed project will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

7.4.5 Waste Disposal

7.4.5.1 Solid Waste

Solid waste will be generated during the construction phase. It includes domestic, packaging and recyclable wastes, e.g. steel, plastic and wood, from construction works. However, the quantity of such wastes is not known. The impact of solid waste by the operational activities are characterized below.

- Nature: Indirect
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Unlikely
- Consequence: Minor
- Impact significance: Low

Debris from excavated material from site leveling activities will also be generated.

Mitigation Measures:

- Waste Generated should be disposed of at designated sites and should not be store for longer time so as to avoid the contamination on site.

- Contractor shall provide garbage bins near workers, accommodation and construction sites, for dumping wastes regularly in a hygienic manner.

- Recyclable materials should be handled and disposed of through certified waste disposal contractor.

Residual Impacts

- Residual impacts are foreseen to be negligible / low in this case if recommended mitigation measures are adhered with.

7.4.5.2 Liquid Waste

The labor camps at the site of tower erection will be temporary in nature and the human excreta will not be significant to cause contamination of ground water. Mostly, labors will be staying near hamlets, which shall use the community services for solid waste, water and sanitation. Poor sanitation facilities will lead to pollution of surrounding environment, contamination of water bodies and increase adverse impact to the aquatic, terrestrial lives and general public inhabited in the area. Adequate drinking water facilities, sanitary facilities, and drainage in the temporary sheds of the workers during construction shall be provided to avoid the surface water pollution.

Garbage disposal sites and material storage yards near the labor camps will provide favorable habitats for vectors of diseases such as mosquitoes, rats and flies. Proper disposal of solid waste apart from the vicinity of labor camp will enhance sanitation of workers who stay in camps. The impact of liquid waste by the construction activities are characterized below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Unlikely
- Consequence: Moderate
- Impact significance: Low

Mitigation Measures:

- Provision of adequate washing and toilet facilities shall be made obligatory. This should from an integral component in the planning stage before commencement of construction activity.

- There should be proper solid waste disposal procedure to enhance sanitation of workers who stay in camps. Thus, possibilities of infecting water borne diseases or vector borne diseases (parasitic infections) will be eliminated.
- Provision of the solid waste disposal, sanitation, and sewage facilities at all sites of the construction/labor camps to avoid or minimize health hazards and environmental pollution.
- Adequate supply of water shall be provided in the temporary urinals, toilets, and washrooms of the workers' accommodation.

Residual Impacts

- Residual impacts are foreseen to be negligible / low in this case if recommended mitigation measures are adhered with.

7.4.5.3 Hazardous Wastes

Quantification of hazardous waste including waste oil, waste batteries and accumulators and worn-out tyres is not possible at this stage since there are no typical figures for that However, hazardous waste handlers certified by SEPA will be contracted for handling and disposal of such wastes.

Residual Impacts

Residual impacts are foreseen to be negligible / low in this case if recommended mitigation measures are adhered with.

7.4.6 Seismicity

The area presents a moderate to high hazard potential for earthquake activity. This suggests the "possibility" of earthquakes of intensity V to VII on (MM) scale and "probability" of those above VII. In view of the Rock Quality Designation (RQD) values being lower than 30% showing poor Rock Quality, low load bearing capacity, and high risk of liquefaction during major (> 7 on Richter Scale) earthquakes. The recently developed (after the October 2005 earthquake) seismic zone map of Pakistan has divided the country into 4 seismic zones ranging in term of major, moderate, minor and negligible zones with respect to ground acceleration values.

No appreciable earth quakes have been recorded in the proposed site and the adjoining area in the recent past.

The unmitigated impact of the seismic hazards are characterized below.

- Nature: Indirect
- Duration: Long term

- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Unlikely
- Consequence: Moderate
- Impact significance: Low

The recently developed guidelines for earth quake design of buildings in Karachi have assigned an expected Peak Ground Acceleration (PGA) value of 0.20g for bigger buildings. This would place the proposed site within Uniform Building Code (UBC) Zone 2B.

Mitigation Measures

- Bored reinforced concrete piles to minimize the risk of liquefaction threat during major earthquake.
- No specific mitigation measure other than to construct the building facility in accordance with the UBC Zone 2B.

Exhibit 7.3: Checklist of Actions Affecting Environment and Significance of their Impact

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
			None	Small	Medium	Major
A. Environmental Problems due to Project Location						
1. Changes in hydrology affecting existing property values of land	Damages to land due to erosion and/or accretion	Consider geology of the site	x			
2. Encroachment into precious ecological zones	Loss of precious ecology	Qualitative and quantitative analysis of ecology	x			
3. Historical/monuments /cultural values	Loss of precious values	Identify and secure any important cultural site	x			
4. Environmental aesthetics	Loss of environmental aesthetics	Careful planning & Monitoring	x			
B. Environmental Problems due to Inadequate Design						
1. Unrealistic assumptions on available O & M skills	Unnecessary damages because O & M requirements too high	Realistic O & M assumptions	x			
2. Pollution Control Equipment Selection	Assumed pollution removals not realized	Appropriate equipment selection	x			
3. Environmental pollution control operations	Possible loss in overall regional welfare	Careful planning/designing/ monitoring and use of appropriate standards		x		
3a. Water	Impairment of beneficial water uses	Analysis of consumption and resource availability	x			
3b. Air	Impairment of air quality	Careful planning & monitoring		x		
3c. Noise	Environmental Degradation & Health hazard	Selective noise abatement technique		x		

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
			None	Small	Medium	Major
4. Occupational health & Safety hazards	Hazards to workers health & safety	Careful planning to prevent and secure an offset problem		x		
5. Hazards due to Spills/fires/explosions	Hazards to workers health & safety	Careful planning & management of pollution control		x		
6. Area sanitation	Sanitation/disease hazards	Sanitation management planning according to work criteria		x		
7. Hauling routes in/out areas	Traffic congestion and nuisances along access routes	Traffic management plan according to current traffic movement	x			
C. Environmental Problems During Construction Stage						
1. Problems due to uncontrolled construction practices e.g. scarring	Problems of Environmental Degradation	Careful Planning and Implementation according to relevant applicable laws		x		
a) Run off erosion	Soil degradation	Pitching of trench and containment of runoff for reuse		x		
b) Worker accidents	Occupational Health & Safety	Careful planning to prevent and secure an offset problem		x		
c) Sanitation disease hazards	Occupational Health & Safety	Training of contractor staff, Sanitation management planning according to work criteria		x		
d) Hazardous material handling	Health and environmental hazards	Training of contractor staff, hazardous material will be segregated in labeled containers		x		
e) Dust/odors/fume	Air pollution and health hazards	Sprinkling of water at intervals/ use less gas emitting technology for work		x		

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
			None	Small	Medium	Major
f) Explosion/fire hazards/hazardous materials spills	Problems of Environmental Degradation	Careful planning to prevent and secure an offset problem		x		
g) Noise/vibration hazards	Problems of Environmental Degradation	Selective noise abatement technique		x		
h) Machinery & Equipment mobilization	Occupational Health and Safety Issues	Careful Planning with technology assessment and Implementation		x		
i) Water pollution hazards	Problems of Environmental Degradation	Careful Planning of passage, containment and Implementation		x		
2. Uncovered cut & fill trenches/areas	Soil erosion, consequent damage to properties & environment, besides trapping of fauna	Pitching of trench and monitoring required		x		
D. Environmental Hazards Relating to Operations						
1. Inadequate O & M	Variety of environmental degradation	Adequate O & M		x		
2. Inadequate operations phase/environmental monitoring	Opportunity loss for feedback connections to project design and O & M	Adequate monitoring according to SEQS guidelines		x		
3. Explosion/fire hazards/hazardous materials spills	Problems of Environmental Degradation	Careful planning to prevent and secure an offset problem			x	
4. Occupational Health & Safety Programmes including accidents	Hazards to workers health & safety	Careful O & M including guide lines of OHSAS 18001 guidelines for emergency			x	

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
			None	Small	Medium	Major
E. Critical Environmental Review Criteria						
1. Loss of irreplaceable resources	Long-term national environmental and economic losses	Planning required to be consistent with government policies; Sustainable use of resources according to need basis of operation		x		
2. Accelerated use of resources for short term gain	Long-term national environmental and economic losses	Planning required to be consistent with policies; Compensate at later stages of operation with less use		x		
F. Potential Environmental Problems During Operation						
1. Land Use Changes	Problem at preparation of site, construction, commissioning & during operation	Careful implementation of EMP		x		
G. Impacts from Operation of IMV lines						
1 Environmental health hazard due to Operation Activities	Unnecessary exposure of workers to environmental hazards.	Careful planning, training of workers with least exposure criteria		x		
2. Depreciation of environmental aesthetics	Loss of values	Careful planning with proper rooms and ventilation & implementation		x		
Overall Significance of Impact of Different Activities				x		

*O & M: Operation and Maintenance

CHAPTER

8

ENVIRONMENTAL MANAGEMENT PLAN

8.1 ENVIRONMENTAL MITIGATION PLAN

The Environmental Mitigation Plan is a key component of the IEE. It lists all the potential impacts and associated mitigation measures identified in the IEE. For each expected impact, the EMP identifies the following information:

- A comprehensive listing of mitigation measures (actions).
- The party responsible for ensuring the full implementation of the action.
- The parameters to be monitored in order to ensure effective implementation.
- A time scale for implementation to ensure that the objectives of mitigation are fully met.

A mitigation plan concerning the activities of the proposed development is presented in **Exhibit 8.1**.

8.2 ENVIRONMENTAL MANAGEMENT PLAN OBJECTIVES

EMP provides the provision mechanism to report the adverse environmental as well as social impacts of the proposed project during its implementation, to enhance project benefits, and to introduce standards of good environmental practice for all project works.

The objectives of the EMP are to:

- Define the responsibilities of project coordinators, contractors and other role play and effectively communicate environmental concerns among them.
- Describe monitoring mechanism and identify monitoring parameters to ensure that all mitigation measure are effectively implemented.
- To ensure that after completion of project, restoration of site and rehabilitation work will be carried out.
- Provide the mechanism for taking timely action in the face of unanticipated Environmental or social situations.

8.3 INSTITUTIONAL ARRANGEMENT FOR EMP

The EMP is to be implemented by an Environmental Committee formed by the Proponent. The membership of the Environmental Committee consists of:

- Environment, Health, and Safety Officer;
- Contractor's Representative.

8.4 TERMS OF REFERENCE

The Environmental Committee will ensure:

- Implementation of the EMP.
- Ensure compliance.
- Monitoring.
- Trouble shooting.
- Coordination and reporting to SEPA.

8.5 EMP SCOPE

EMP has provided detailed strategy to be implemented for achieving improved environmental performance in the following areas.

- Use and Disposal of water
- Recycling, Reuse and Waste Management
- Control of Pollution
- Environmental Risk Assessment
- Environmental Management
- Transportation
- Community Responsiveness

8.6 EMP COMPONENTS

The EMP consists of the following:

- Institutional Arrangements
- Mitigation & Monitoring plan
- Organizational Structure and Responsibilities
- Communication and documentation
- Environmental and social trainings,

8.7 INSTITUTIONAL ARRANGEMENTS

This section describes the organizational structure required for managing the Environmental as well as social aspects of the proposed project. Also defined in this section are the roles and responsibilities of the various role players during the project construction and operation.

8.7.1 Management Approach

The management will appoint an Environment, Health and Safety Officer within the Organization, in order to handle the environmental, social, occupational health and safety aspects during different phases of the proposed project. Other essential features of the pre project are:

- The obligatory will be responsible for overseeing and monitoring the entire Implementation of the EMP.
- The contractor(s) will be required to appoint a dedicated field EHS Monitor (EHSM) at the project site.
- During the construction and operation phase of the project, the EHS officer will be responsible for the Environmental, social, safety and occupational health aspects of the site activities.

8.8 MITIGATION PLAN

The mitigation plan is a key component of the EMP. It lists all the potential effects of each activity of the pre project and their associated mitigation measures identified in the IEE. The recommended information is presented in the plan for each project activity:

- A listing of the potential impact associated with that project activity,
- A comprehensive listing of mitigation measures (actions),
- The person(s) responsible for ensuring the full implementation of the action,
- The person(s) responsible for monitoring the action,
- The timing of the implementation of the action to ensure that the objectives of
- Mitigation are fully met.

8.9 MONITORING PLAN

The objective of environmental and social monitoring during the various phases of the proposed project will be as follows:

- Ensuring that the mitigation measures included in the IEE are being implemented completely.

- Ensuring the effectiveness of the mitigation measures in minimizing the project's impacts on social and environmental resources.
- To achieve these objectives the recommended monitoring program will be implemented.

8.9.1 Compliance Monitoring

The compliance monitoring of the pre-project activities is principally a tool to ensure that the environmental and social control measures identified in the IEE are strictly adhered to during the pre-project activities.

Various aspects of the IEE compliance monitoring will be to:

- Systematically observe the activities undertaken by the contractors (and subcontractors) or any other person associated with the pre project.
- Verify that the activities are undertaken in compliance with the IEE and EMP.
- Document and communicate the observations to the concerned person(s).
- Maintain a record of all incidents of environmental and social significance, related actions and corrective measures.
- Maintain contact with the communities, solicit their views and concerns, and discuss them during the fortnightly meetings.

8.9.2 Effects of Monitoring

The IEE predicts the impacts of the proposed project on the basis of information available at the time of conducting the assessment and the natural processes that link various environmental and social parameters. Based on this prediction, mitigation measures are introduced such that the predicted residual effects do not exceed acceptable levels.

Broadly, effects monitoring has the following objectives:

- To verify that the impacts of the proposed project are within acceptable limits, thus establishing credibility (public assurance).
- To immediately warn the project proponents (and the regulatory agencies, if required) of unanticipated adverse impact or sudden changes in impact trends so that corrective actions can be undertaken, which may include modifications in the proposed activities, or the inclusion of modified or additional mitigation measures.
- To provide information to plan and control the timing, location, and level of certain pre-project activities so that the effects are minimized.

- To facilitate research and development by documenting the effects of the proposed project that can be used to validate impact-prediction techniques and provide a basis for more accurate predictions of future projects.
- The effects monitoring plan is provided in **Exhibit 8.2**. The detailed methodologies will be developed during the detailed design phase of the project, when the specific information on field activities will be known.

8.9.3 External Monitoring

The objectives of this external monitoring will be to ensure that:

- The EMP is being adequately implemented,
- Mitigation measures are being implemented,
- The compliance and effects monitoring are being conducted,
- Environmental and social trainings are being conducted, and
- Complete documentation is being maintained

8.10 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

MWPL have their own environmental management system to ensure the implementation of EMP and Health and safety issue during construction and operation.

The environmental management responsibilities will be expected by its project manager and his team member during construction and operation phase.

- Coordinate with relevant government departments
- Identify and report changes in activities and services that may create new environmental aspects.
- Ensure that construction work is carried out in an environmentally sound manner by the contractor by incorporating environmental compliance by appropriate provision in the construction contract.

8.11 COMMUNICATION AND DOCUMENTATION

An effective mechanism for recording, storing and communicating environmental and social information during the pre-project is an essential requirement of an EMP.

The key features of such a mechanism are:

- Recording and maintaining all information generated during the monitoring in a predetermined format.

- Communicating the information to a central location.
- Storing raw information in a central database.
- Implementation Report of all mitigation measures recommended in the IEE report, and will be submitted to the SEPA on quarterly basis.

8.12 ENVIRONMENTAL AND SOCIAL TRAINING

Environmental and social trainings will help to ensure that the requirements of the IEE and EMP are clearly understood and followed by all project personnel throughout the project period. The primary responsibility for providing training to all project personnel will be that of the EHS. The environmental and social training program will be finalized before the commencement of the project, during the detailed design phase. The training will be provided to the MWPL staff, the construction contractors, and other staff engaged for the Pre-project. The scope of the trainings will cover general environmental awareness and the requirements of the IEE and the EMP, with special emphasis on sensitizing the project staff to the environmental and social aspects of the area.

8.13 CHANGE MANAGEMENT

The present IEE has been carried out on the basis of the project information available at this stage. This is however possible that the changes are made in some components of the pre-project, during the design and construction phases. In order to address the environmental and social implications of these changes, a simple framework has been devised, which is described in this section.

The change management framework recognizes the following three broad categories of the changes in the project:

- Category A changes,
- Category B changes,
- Category C changes.

Exhibit 8.1: Environmental Impact and Mitigation Plan

S. No	Impact	Mitigation/Recommendation	Responsibility	Timing
1.	**Impacts on Landform and Soil**	Unnecessary dust generation during construction should be avoided by sprinkling of water at regular interval specifically in windy season and during excavation.	Contractor	DC
		Ensure that excavation and other earth works will be limited to the proposed construction site Pitching of soil will be done.	contractor	DC
		Ensure that lubricants and oils will be stored properly and with impervious lining in labeled containers.	Contractor / MWPL	DC
		Backfilling of the excavated area should be done with the same excavated soil.	Contractor	DC
		Washing of vehicles and machinery which will be used during the construction phase will be done at designated area.	Contractor / MPC	DC / OP
		Waste material generated during the construction activities should be disposed of properly at designated area.	MPC	DC
		Ensure that fuel storage tanks are above the ground level to avoid any type of soil and underground water contamination.	Contractor	DC

S. No	Impact	Mitigation/Recommendation	Responsibility	Timing
2.	**Impacts on Water Resources**	Efficient and less water consuming technologies should be selected for construction.	MPC	DC
		Concrete mixing during construction should not be done above or near water supply lines	Contractor	DC
		Message should be conveyed to all the workers and employees regarding water conservation and special signs should be displayed at particular places for awareness.	MPC / Contractor	DC / OP
		Drainage of any types of lubricant or oils into sewage will be strictly prohibited.	MPC / Contractor	DC / OP
3.	**Impacts on Air Quality**	Fugitive dust emission should be controlled, especially particulate matters such as PM_{10} and $PM_{2.5}$ by sprinkling of water on regular basis.	Contractor	DC
		Construction vehicles and machinery should be well maintained and tuned in order to control emission of CO_2, SOX and NOX.	Contractor	DC
		Proper ventilation should be ensured in the newly constructed building rooms to ensure ventilation.	MPC	OP
4.	**Noise**	Construction vehicles and machinery should be properly lubricated and tuned in order to prevent high level of noise.	Contractor	DC
		Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities.	Contractor	DC
		Ensure that noise produced during operation is within the limits of SEQS.	MPC	OP

S. No	Impact	Mitigation/Recommendation	Responsibility	Timing
5.	**Impacts on Biological Resources** **(wildlife and vegetation)**	The wind towers should be erected at a distance of approximately 350 meters or above to avoid any avian collision and to provide the birds a wider corridor to pass through Regular checking of the towers to avoid nesting of birds and other avian fauna Ensure that no trees will be cut or cleared during the construction or mobilization of machineries. New plants should be planted as much as possible to increase the natural beauty of the proposed project site, keeping in view that the height of the plant will not create any problem during the operational phase.	MPC / Contractor	DC/OP
6.	**Socio-economic**	Unskilled jobs should be provided to local residents of the proposed project site	MPC / Contractor	DC/OP
		Construction vehicles and machineries should not be parked in any public places and roads. Proper area should be allocated for parking in the proposed project site as well as near the camping site.	Contractor	DC
		It is recommended that construction activities should be carried out in day time.	Contractor	DC
7.	**Health and Safety Impacts**	During construction, operation and maintenance all OHSAS 18001 guidelines related to work should be properly followed.	MPC / Contractor	DC/ OP / DM
		During construction and operation, all necessary PPEs should be provided to all the workers and employees i.e. masks, gloves, safety shoes, safety goggles, helmet etc.	MPC / Contractor	DC/ OP/ DM

S. No	Impact	Mitigation/Recommendation	Responsibility	Timing
		MSDS and safety precautions should be communicated to all workers and employees.	MPC	OP
		Trainings should be conducted for safe material handling, use and storage.	MPC	OP
		Only authorized and trained personals will be allowed to enter the power generation plant.	MPC	OP
		Proper clean environment should be maintained.	MPC	DC/OP
		Emergency response training should be given to each employees and drills should be scheduled and conducted.	MPC	OP
		Danger signs and symbols should be installed in the whole assembly area at particular places.	MPC/Contractor	DC/OP

DC= During Construction
OP =Operation Phase
DM= During Maintenance

Exhibit 8.2: Environmental Monitoring and Management Plan

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Monitoring	Frequency of Monitoring	Responsibility
Air	Chronic health affects Reduced visibility on roads	Sprinkling of water Tuning of construction vehicles & machines Use of Dust masks for all the workers	Particulate Matter Smoke CO NOx SO_x	At Pre-Project site	Vehicular emissions Dust Ambient air quality	Monthly for emissions and daily for dust	Contractor MPC
Noise	Stress Hypertension Hearing loss Headache	Avoid working at night Lubrication of construction vehicles Ear plugs	Noise levels	Close proximity of Proposed project site	Noise monitoring device	Monthly	Contractor MPC
Land and soil	Soil erosion/ degradation	Water sprinkling, stone pitching, reusing of the excavated soil	Surface topography	Pre-Project site	Visual assessment Photographic evidences	From beginning till completion of project	Contractor MPC
Vegetation	No cutting of trees is involved	Avoid unnecessary cutting of trees In case of cutting of trees, one plant should be replaced by 6 plants	No of trees cleared or cut Ensure re-plantation by 1:6 ratio of same species	Project vicinity and access route	Visual assessment Photographic evidences	From beginning till operational phase	MPC

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Monitoring	Frequency of Monitoring	Responsibility
Water	Wastage and misuse of water	Avoid un necessary use of water Prevent leakages	Water supply and use	Pre-Project site	Visual assessment Record log of water usage	From beginning till the end of project	Contractor
Social Environment	Difference of opinion between contractor laborers and permanent employees	Specify time scale for construction activities Trainings of all personnel including contractor, laborers and permanent employees should be involved in the project	Regular training sessions and meetings	Pre-Project site	Review of training schedule	Daily	MPC
Roads and networks	Traffic congestion Night time visibility of drivers is reduced	Diversion routes must be allocated to maintain traffic flow Signs and reflectors must be boarded for driver's visibility	Signs and detours are being followed	Intersections of diversions	Observations	Weekly	Contractor

Aspect	Impact	Mitigation	Monitoring Parameter	Location	Monitoring	Frequency of Monitoring	Responsibility
Health and safety	Lack of awareness to visitors about safety may lead to accidents	Safety symbols and instructions will be boarded at work sites	Safety precautions	On all project sites	Tool box talk Visual assessments Record of PPEs, Near Miss, incidents, accidents and hazards	Daily	Contractor MPC
	Incompetent and untrained workers might cause harm to themselves and others	Trained personnel will be appointed for the specific work					
	Construction works may include many risks and hazards that may lead to injuries or even death	Appropriate PPEs must be used	Use of PPEs				

Exhibit 8.3: Environmental Monitoring Checklist

S. No.	Inspection parameter	Implementation Status		Remarks
		YES	NO	
1	**Landform and Soil**			
	1.1 Is sprinkling of water done time to time before, during and after construction work?			
	1.2 Excavation and other earth works are limited to the proposed construction area?			
	1.3 Are temporary construction sites being affected?			
	1.4 Is stone pitching of soil done where necessary?			
	1.5 Are the lubricants and oils stored properly with impervious lining in labeled container?			
	1.6 Is backfilling of the excavated area done with the same excavated soil?			
	1.7 Are construction vehicles parked and washed at a designated area?			
	1.8 Is construction waste disposed of properly?			
	1.9 Are pipes and tanks well maintained?			

S. No	Inspection parameter	Implementation Status		Remarks
		YES	NO	
	1.10 Is the extended assembly shop basement paved with impervious material?			
	1.11 Is fuel supply line from oil tanks to dispenser placed above ground level?			
2	**Water Resources**			
	2.1 Is there any separate water supply line for the construction site?			
	2.2 Is concrete mixing done near or above water supply lines?			
	2.3 Is the water conservation message communicated to all the employees?			
3	**Impacts on Air Quality**			
	3.1 Is sprinkling of water ensured to control fugitive dust emissions?			
	3.2 Are Construction vehicles and machinery well maintained and tuned in order to control emission of CO, SO_X and NO_X?			

S. No	Inspection parameter	Implementation Status		Remarks
		YES	NO	
	3.3 Is proper ventilation ensured in the building rooms to avoid suffocation and asphyxiation?			
	3.4 Are all the vehicles well maintained and emissions are monitored to comply with the SEQS limits?			
4	**Noise**			
	4.1 Are construction vehicles properly lubricated and tuned?			
	4.2 Is the produced Noise during construction within the SEQS limit?			
	4.3 Is the staff aware of noise generating technologies used in the assembly line and know how to avoid them?			
5	**Biological Resources (wildlife and vegetation)**			
	5.1 Is a log kept for trees and vegetation being cleared during the construction process?			
6	**Socioeconomic Impacts**			
	6.1 Is unskilled jobs are provided to the local residents?			

S. No	Inspection parameter	Implementation Status		Remarks
		YES	NO	
	6.2 Is a proper area allocated for construction vehicles and machineries and no public roads or places are affected?			
	6.3 Are construction activities carried out in daytime?			
7	**Health and Safety Impacts**			
	7.1 Are all necessary PPEs provided to all the workers and employees i.e. masks, gloves, safety shoes, safety goggles and helmet etc. (during construction)?			
	7.2 Are MSDS and safety precautions communicated to all workers and employees?			
	7.3 Status of trainings conducted for safe material handling and storage?			
	7.4 Status of safety and first aid training, on regular basis?			
	7.5 Is proper clean environment maintained in Assembly shop?			

S. No	Inspection parameter	Implementation Status		Remarks
		YES	NO	
	7.6 Spill Response kit available for any spill hazard?			
	7.7 Is emergency response training given to employees?			
	7.8 Are the Danger signs and symbols installed in the whole assembly area at particular places and within the risky area of proposed project?			

CHAPTER

9

CONCLUSION

The IEE of the 25 MW Power project has achieved the following goals:

- Identification of environmental regulatory requirements that apply to the proposed project activities;
- Identification of the environmental features of the project area including the physical ,biological and social disturbance and likely impact of the project on the environment;
- Recommendation of appropriate mitigation measures that MPC will incorporate and ensure as per this IEE into the project to minimize the adverse environmental impacts.

Baseline physical, biological and socio-economic and cultural data and information was collected from a variety of primary and secondary sources, including field surveys, review of relevant literature and online publications. The collected data was used to organize profiles of the physical, biological and socio-economic environments, likely to be affected by the proposed project. Public consultations were carried out and the aim of public consultation was to assure the quality, comprehensiveness and effectiveness of the IEE as well as to ensure that the views and opinions of the local people were adequately taken into account in the decision making process.

Further an Initial Environmental Examination Report was made to highlight the potential impacts of the proposed project on the area's physical, biological and socio-economic, gender and cultural environments.

It is concluded that the potential impacts of the 25MW Wind Power will be insignificant on most of the environmental receptors, provided that the EMP and its mitigation measures proposed in this report are implemented in true spirit.

After assessing the proposed project activities and investigating the project area, the environmental consultants, GEMS have concluded that:

"If the activities are undertaken as proposed and described in this report, and the recommended mitigation measures and environmental management plan is adopted, the project will not result in any long-term or significant impacts on the local community as well as on the physical, biological and socio economic environment of the project area."

8416

Report No. PPI-290.1-Draft-Moro/17

ELECTRICAL GRID STUDIES

For

25 MW Moro Wind Power Project WPP at Jhimpir, District Thatta

Draft Report
(October 2017)

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Executive Summary

- The study objective, approach and methodology have been described and the plant's data received from the client Moro Wind Power Project has been validated.
- The wind project by Moro, referred to as Moro WPP in the remainder of the report, is expected to start commercial operation by end of 2020. Therefore, the scenario of Summer 2021 has been selected to carry out the study as it will help determine the maximum impact of the project.
- The latest generation, transmission plan and load forecast provided by NTDC has been used for the study, attached in Appendix – 2, vide data permission letter no. GMPP/TRP-380/4775-77 dated 15-08-2017.
- Moro WPP which is the plant under study, has been placed in a loop at existing 220/132kV Jhimpir-1 grid station. Moro Wind Power Plant would be connected by a 13 km double circuit of 132 kV looping in-out with a sub cluster connecting neighboring Wind Power Plant of Tapal Energy and Hartford WPP 132kV.
- The existing grid system of HESCO and NTDC in the vicinity of Moro WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Moro WPP and no bottlenecks or constraints have been found in the grid system.
- Wind Farm of Moro WPP has been modeled considering Type-3 WTGs. They are Doubly Fed Induction Generators which are designated as Type-3 WTG. The terminal voltage is 0.69 kV. The medium voltage level of wind farm has been selected as 33 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Farm substation to connect to the Jhimpir-1 220/132 kV grid station of NTDC.
- Load flow analysis has been carried out for peak and Off-Peak scenarios of August/September 2021 considering the COD targeted by Moro WPP and a future scenario of 2023, for the dispersal of power from Moro WPP into NTDC system using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme has been

evolved by performing the load flow studies testing the steady state performance for normal as well as N-1 contingency conditions fulfilling the Grid Code criteria of Wind Power Plants. The reactive power requirement at point of common coupling to meet PF of ± 0.95, voltage and line loading criteria are fulfilled by these studies. All the scenarios have been studied by considering maximum dispatch from all the existing/planned WPPs in the Jhimpir and Gharo Clusters.

- With the proposed interconnection for the base year of 2021, the load flow results for Peak and Off-Peak scenarios establish that the proposed scheme of interconnection of Moro WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in terms of absorbing all the output of Moro WPP under normal as well as the contingency conditions.
- Maximum and minimum short circuit levels for three-phase faults and single-phase faults have been evaluated. The maximum SC levels have been evaluated for the year 2023 and minimum short circuit level for the year 2021 for the most stringent conditions. The fault levels of Moro WPP 132 kV are 9.13 kA and 6.34 kA for 3-phase and single-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Moro WPP Farm Substation as per NTDC requirements for 132 kV. The fault levels for Moro WPP 33 kV are 9.65 kA and 8.06 kA for 3-phase and single-phase faults respectively for year 2023. Therefore, the short circuit rating for 33 kV switchgear is recommended as 31.5 kA. It has been found that the proposed scheme provides maximum SC strength for the evacuation of Moro WPP power to the grid.

The switchgear ratings for Moro WPP substation are as follows:

132 kV:

Short circuit rating = 40 kA (3 sec.)

Continuous rating = 2500 A

33 kV:

Short circuit rating = 31.5 (3 sec.)

Continuous rating = 2500 A

- Transient Stability analysis has been carried out for Moro WPP based on their selection of Type-3 WTGs, with connectivity of proposed scheme. Different disturbances have been simulated to apply stresses from the system faults on the wind farm and vice versa and it was found that Moro WPPWTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Moro WPP side did not cause any stress on the main grid or the power plants nearby and in the HESCO area such that the whole system remained stable under all events.
- The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault clearing due to stuck-breaker (breaker failure) reason. The simulations have proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.
- The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and unbalance are within the permissible limits of IEC and other International Standards.
- There are no technical constraints whatsoever in the way of bringing in the 25 MW of Moro WPP Wind Power Plant at the proposed site and scheduled time of commissioning, in any respect of steady state (load flow) or short circuit or dynamic performance (stability) or power quality issues related to this plant.

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Appendix –9: Dynamic Data for Stability Analysis

1. Introduction

1.1 Background

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

Study of about 25 Wind Power Plants have recently been completed for the evacuation of power till the year 2019. Moro WPP is one of the entrepreneurs who come forward to install a wind power plant after the completion of 2019 WPPs.

The proposed wind farm will have the installed capacity of about 25 MW of electricity. The project is being developed in the private sector and the electricity generated from this project would be supplied to power grid of NTDC. The services of Power Planners International have been engaged to perform the impact studies of penetration of this wind power in the national grid to evolve the most feasible interconnection scheme for this plant.

1.2 Objectives

The overall objectives of this study are:

1. Impact of Moro WPP Wind Power Plant on the System
2. Impact of the System on Moro WPP Wind Power Plant

These impacts are to be studied for different operating conditions of Plant as well as the System. The operating condition of the plant may vary from its 100 % output to 0 % i.e. no output at all. The system conditions would be peak load, off-peak load for the spot year of study i.e. 2021. A future scenario of 2023 is also studied. The impacts are required to be studied for steady state as well as the dynamic and disturbed conditions of the system. The specific objectives are:

1. To develop a feasible scheme of interconnections of Moro WPP Wind Power Plant (WPP) with HESCO/NTDC network at 132 kV for which right of way (ROW) and space at the terminal substations would be required to be made available.

2. To check the load-ability of lines and transformers to be within their rated limits satisfying the clauses OC 4.8, OC 4.9, and OC 4.10 of NEPRA Grid Code regarding the criteria of operation of frequency, voltage and stability under normal and contingency conditions for peak and off-peak load conditions of grid as well as the plant.
3. To check the voltage profile of the bus bars of the neighboring interconnected network under different operating conditions.
4. To check the reactive power limitations of the wind turbines and the neighboring generators of the system; and evaluate the size of switched shunt capacitor banks at Medium Voltage level of substation of collector system of Moro WPP Wind Farm to regulate the voltage under steady state and contingency conditions to fulfill the Grid Code criteria of ± 0.95 Power Factor at the point of common coupling (interface point) interconnecting Wind Farm and the Grid i.e. 132 kV gantries of outgoing circuits.
5. To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations at 220 kV and 132 kV voltage levels to be within the rating of equipment of these substations and determine the short circuit ratings of the proposed equipment of the Medium Voltage substation of collector system of Moro WPP Wind Farm and the NTDC/HESCO substations of 132 kV connecting with the Moro WPP Wind Farm.
6. To check the minimum short circuit strength of the system to handle large variation of generation of wind turbine
7. To check if the interconnection with the grid withstands transient stability criteria of post fault recovery with good damping satisfying the NEPRA Grid Code.
8. Transient stability to see the dynamic performance of Moro WPP in response to Grid disturbances and vice versa the dynamic impact of disturbances in Moro WPP on the Grid.

9. To check the ability of the wind turbine generators of Moro WPP to remain connected following major disturbances and grid disruptions i.e. the Low Voltage Ride Through (LVRT) capability to satisfy the Grid Code requirement of LVRT for 180 ms.
10. Analysis of power quality issues such as flicker, voltage-unbalance, harmonics and resonance of the system.

1.3 Planning Criteria

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

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

Short Circuit:

132 kV Substation Equipment Rating 40kA

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

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

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

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

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

Reactive Power and Power factor:

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

Power Quality Requirements:

As per IEC61400-21standards

1.4 Operating Criteria

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

Black Start and Islanded Operation:

Exempted

Active Power and Frequency Control:

Exempted from precise frequency control responsibility

Synchronization / De-Synchronization:

(i) The Wind Power Plant will manage for
   (a) Smooth Synchronization
   (b) Smooth De-Synchronization

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

Power Generation Capability Forecasting Requirement:

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

(ii) The forecasting, as required in (i), will be estimated by Wind Power Plant through
   (a) Expected availability of plant during the period of forecast.
   (b) Predicted value of wind speed at site based upon analysis of historic wind data available.

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

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

1.5 Input Data

The input data of HESCO / NTDC has been used in this study as per letter No. GMPP/TRP-380/4775-77 dated 15-08-2017. The load forecast and the generation expansion plan of NTDC provided vide this letter has been used as shown in Appendix 2.

The input data regarding Moro WPP Wind Farm has been provided by the client who has indicated to use 2.2 MW Type-3 WTG.

2. Description of Problem & Study Approach

2.1 Description of the Problem

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

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

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

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

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

There are different models of different sizes and make available in the market viz. GE, Vestas, Nordex, Gamesa, Siemens, Goldwind and Vensys etc. The dynamics of each model may be different with respect to grid's dynamics. Moro WPP Wind Energy is considering using 2.2 MW Type-3 WTGs which are Doubly Fed Induction Generators.

2.2 Approach to the problem

We will apply the following approaches to the problem:

- According to the COD of Moro WPP as provided by the Client Moro WPP, we have decided to perform our analysis for the scenario of August/September 2021 to judge the maximum impact of the plant after the COD of the plant.
- The base case for the year 2021 comprising all 500 kV, 220 kV and 132 kV, and 66 kV system would be prepared envisaging the load forecast, the generation additions and transmission expansions for each year particularly in the Southern parts of the country. The case would include all the proposed and existing Wind Power Plants which have been developed or are going to be developed on a fast track basis and are expected to be commissioned by 2021 as per the latest schedule of AEDB.
- Interconnection scheme without any physical constraints, like right of way or availability of space in the terminal substations, would be identified.
- Perform technical system studies for peak load conditions of high wind seasons' power dispatches, to confirm technical feasibility of the interconnections.

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

3. Analysis of Network Prior to Moro WPP Interconnection

3.1 Description of the Network

The electrical grid, which is relevant for interconnection of Moro Wind PP, is the 500, 220 and 132 kV network that stretches through South of Hyderabad and Jamshoro up to coastal areas of Southern Sind. The sketch of this network for the spot year 2021 after the addition of reinforcements in the area is shown in Appendix-4.

In this sketch, all the existing and proposed WPPs in the Jhimpir and Gharo clusters are modeled. Based on the location of Moro WPP and the availability of Transmission line capacity the connectivity of Moro WPP has been decided.

We have carried out the studies of the case "without" Moro WPP but including all the other planned and existing WPPs which have COD by 2021 to ascertain if there are any constraints in the system prior to Moro WPP's commissioning.

3.1.1 Load Forecast

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

3.1.2 Generation and Transmission Expansion Plan

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

3.2 Load Flow Analysis

Load flow analysis has been carried out for the NTDC / HESCO network including all the existing and planned wind power plants at Jhimpir and Gharo clusters but without including Moro WPP to see if the network was adequate for dispersal of wind power without it. The case has been studied for the system conditions of August/September 2021. In order to ensure proper economic dispatch in the southern area for this High Wind, High Water Season, it was essential to have a reasonable energy mix with contributions from both thermal and wind power plants. We kept the dispatch of the nearby power plant such as Thatta, Nooriabad and Kotri-Site at its maximum. Kotri GTPS was operated at 50% capacity. Output from all the existing/ under construction/

planned Wind Plants was kept at maximum. The results are shown plotted in Exhibit 3.0 in Appendix-3 which indicates that no circuit is loaded more than its rated power carrying capacity and the voltage profile at all the bus bars of 132 kV, 220 kV and 500 kV is within the permissible range. All power plants are running at lagging power factor within their rated range.

The N-1 contingency check has also been applied for the three Southward branches each, and the results are attached in Appendix-3 as below:

Exhibit 3.1	Hartford to Tapal 132kV Single Circuit Out
Exhibit 3.2	Hartford to Jhimpir-1 132kV Single Circuit Out
Exhibit 3.3	UEPL to Jhimpir-1 132kV Single Circuit Out
Exhibit 3.4	Tapal to UEPL 132kV Single Circuit Out
Exhibit 3.5	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 3.6	Jhimpir-1 T.M.Khan 132 kV Single Circuit Out
Exhibit 3.7	Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit Out
Exhibit 3.8	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.9	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.10	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.11	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 3.12	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 3.13	Jamshoro 500/220 kV Single Transformer Out
Exhibit 3.14	Jamshoro to Dadu 500kV Single Circuit Out
Exhibit 3.15	Matiari-CS to Dadu 500kV Single Circuit Out

The load flow results of the network in the close vicinity of Moro WPP shown plotted in Exhibits 3.1 to 3.15 indicate that all the power flows on the lines are within the rated limits of this network.

Therefore, it is established with Load flow results that the network existing before Moro WPP in the same vicinity in Jhimpir cluster including the Jhimpir-1 220/132 kV collector substation is enough to absorb their power and has no limitations in terms of power transfer capacity under normal as well as N-1 contingency, prior to

connection of Moro WPP. We will check the adequacy of network after adding Moro WPP in Chapter 6.

4. Development of Interconnection Scheme

4.1 Interconnection of Moro WPP 25 MW WPP

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

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

In case of Moro WPP, the nearest substation is the collector substation of Jhimpir-1 220/132 kV which has been commissioned for evacuation of power from already planned Wind Power Plants.

4.2 Proposed Interconnection Scheme

The scheme of interconnection of Moro WPP with Jhimpir-1 220/132 kV substation is as follows:

- Moro Power Plant would be connected by a double circuit of 132 kV looping in-out with a sub cluster connecting neighboring Wind Power Plant of Tapal Energy and Hartford WPP 132kV. The looping length would be about 13 km and the conductor used will be Greeley.

The connection scheme of Moro WPP for the scenario of August/September 2021 as shown in Appendix - 4 is by interconnecting Moro WPP in the second loop proposed at Jhimpir-1 220/132 kV substation.

5. Modeling of Moro Wind Farm

5.1 Electrical Layout of Wind Farm

5.1.1 Moro WPP Selection

Moro WPP has selected Type-3 WTGs which they are considering to install on their Wind Farm at Jhimpir. It is a Doubly Fed Induction Generator. Each WTG would step up from its terminal LV voltage of 0.69 kV to a medium voltage (MV) that will be 33 kV.

5.1.2 Electrical Layout

The WTGs would be connected to MV collector cables of 33 kV laid down in the Farm connecting each line (row) of the WTGs to the Farm substation. The layout is shown in **Sketch – 3** (Appendix-5), briefly described as follows;

Line – 1	WTGs 1-6	(6 x 2.2 = 13.2 MW)
Line – 2	WTGs 7-11	(5 x 2.2 = 11 MW)

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

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

The two collector circuits of 33 kV would thus be laid as shown in Sketch-3 and explained as follows;

Collector Line-1	from WTG-1 to Farm Substation (2.433 km)
Collector Line-2	from WTG-7 to Farm Substation (2.37 km)

Since the collector would carry a max of approximately 13.2 MW at normal rating, the 33 kV collector circuits loading capacity should be in the range of 15 MVA each, giving some margin for reactive power at 0.95 Power Factor and some losses in the circuits with certain overload capacity as well.

5.1.3 33 kV Collector Circuits

The MV voltage level selected by Moro WPP for interconnection of collector groups of WTGs in the Farm is 33 kV.

5.2 Wind Farm Substation 132/33 kV

A substation would be built in the middle of the Farm to collect all the power from the WTGs, spread out in the Farm, at medium voltage (MV) level of 33 kV and step-up this power to high voltage (HV) level of 132 kV so that the Farm's output may be evacuated to the main grid of NTDC. The single line diagrams of the substation are briefly shown in Sketch-1 and 2 in Appendix-5 for 33 kV and 132 kV respectively.

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

- Single bus scheme with a sectionalizer to enable to have two bus sections at 33 kV.
- Double-bus single-breaker scheme with a Bus Coupler at 132 kV

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

5.2.1 Conceptual Design of 33 kV

The single line diagram SLD–1 in Appendix-5 shows the conceptual design of 33 kV (MV) bus bar of the Farm substation. It comprises of

- Two single bus-sections of 33 kV with a bus sectionalizer
- Four breaker bays to connect four collector double circuits of WTG Lines 1-2
- Two breaker bays to connect two transformers of 132/33 kV
- Two breaker bays for connecting two auxiliary transformers of 33/0.4 kV
- Two breaker bays to connect switched shunt capacitor banks

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity = 31.5

Normal continuous current = 1250 A for line breakers

= 2500 A for Bus Sectionalizer and Power TF

5.2.2 Conceptual Design of 132 kV

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

- Double bus bars with a Bus Coupler
- Two breaker bays to connect two transformers 132/33 kV
- Two breaker bays to connect two circuits of 132 kV i.e. double circuit on single tower overhead line to connect to the grid system.

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity = 40 kA

Normal continuous current = 1250 A for line and TF breakers

= 2500 A for Bus Sectionalizer

The other equipment of the substation consists of:

- Two 132/33 kV, 25 MVA ONAN/ONAF1 OLTC transformers, 132±11×1%/33kV, to fulfill N-1 criteria of Grid Code
- Two station auxiliary transformers 33/0.4 kV
- SVC of the size of 6 MVAR with contactors and PLC (Programmable Logic Controller).
- Energy meters would be installed on HV side (132 kV) of the 132/33 kV transformers.

6. Load Flow Analysis

Load flow analysis has been carried out for the proposed scheme of interconnection of Moro WPP with NTDC grid for the base scenario of September 2021.

6.1 Modeling of Wind Farm in Load Flow

Representation of all the individual machines in a large Wind Farm is inappropriate in most grid impact studies [1]. There is a provision in the model structure of PSS/E to allow single equivalent WTG machine model to represent multiple WTGs. However, there are limitations. Disturbances within the local collector grid cannot be analyzed, and there is some potentially significant variation in the equivalent impedance for the connection to each machine. A single machine equivalent requires the approximation that the power output of all the machines will be the same at a given instant of time. For grid system impact studies, simulations are typically performed with the initial wind of sufficient speed to produce the rated output on all the machines. Under this condition, the assumption that all the machines are initially at the same (rated) output is not an approximation [2]. Otherwise this assumption presumes that the geographic dispersion is small enough that the wind over the farm is uniform. Though simulations of bulk system dynamics using a single machine equivalent are adequate for most planning studies, we have adopted a rather more detailed level of modeling by using an equivalent machine just for one group of WTGs connected to one collector feeder. Since we have two collector feeders connecting to two groups of WTGs, therefore there are two equivalent WTGs assumed for each collector group in this study report. The Farm Substation is represented by two bus bars as Moro medium voltage bus named Moro -MV 33 kV and Moro 132 kV, with two inter-bus transformers of 25 MVA each. These transformers have an overload capacity of 25 MVA for a limited time to cover N-1 contingency criteria of Grid Code i.e. in case of outage of one transformer, the other can take up the full output of Farm i.e. 25 MVA.

6.2 Reactive Power Requirements

Moro is considering using 2.2 MW Type-3 WTGs, which are doubly fed induction generators, in their WPP. Its power factor is 0.95 lagging (capacitive/generating) and 0.95 leading (inductive/absorbing). The maximum reactive power output that can be available at the 0.69 kV terminal is 0.723 MVAR for each WTG. Part of this reactive power will be consumed by the 0.69/33 kV step-up (GSU) transformer and the rest may be consumed in the MV collector cables of the wind farm. However, some reactive power might reach the MV bus bar of Farm substation. That means each WTG is self sufficient to meet VAR absorption requirement of its step-up transformer with some contribution of VARs to the Farm MV network.

The Grid Code Addendum No.1 requires to meet the criteria of ± 0.95 power factor at the point of interconnection with the NTDC/HESCO grid at 132 kV (point of common coupling). Therefore, a Farm of 25 MW generating capacity is required to pump 8.217 MVAR to the grid at full output of 25 MW. The VAR generating capability of WTG at 0.95 PF will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers, collector cables and the HV/MV i.e. 132/33 kV transformers at the Farm substation. In order to meet the Grid Code criteria, we need to install SVC at 33 kV bus of the Farm substation of sufficient size capable of delivering approx. +/- 6 MVAR at 132 kV bus after VAR loss across 132/33 kV transformers.

6.3 Load Flow Analysis for Peak Load Scenario of September 2021

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

The integrated case has been studied for the system conditions of summer 2021, the time line associated with the COD of Moro WPP. In order to ensure proper economic dispatch in the southern area for this High Wind High Water Season, it was essential to have a reasonable energy mix with contributions from both thermal and wind

power plants. We kept the dispatch of the nearby power plant such as Thatta, Nooriabad and Kotri-Site at its maximum. Kotri GTPS was operated at 50% capacity. Output from all the existing/ under construction/ planned Wind Plants was kept at maximum.

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

6.3.1 Normal Case

Exhibit 6.1.0 shows the normal case under the system conditions of summer 2021. All the wind farms in Jhimpir and Gharo clusters with installed capacity of 50 MW or 49.5 MW have been assumed after deducting Farm losses and given some diversity in the maximum output of all the Wind Power Plants at one time. For Moro WPP, 23.7 MW is assumed to be delivered at the point of delivery to grid at 132 kV.

All these loadings are within the rated limits of these circuits. The bus voltages on all the substations in Southern HESCO grid are within the normal limits of operation.

We see that all the WTGs are running at a power factor above its rated value of 0.90 not using full reactive power capability leaving enough margin to cover contingencies. The SVC of 6 MVAR at 33 kV bus bar is supplying 4.0 MVAR at (33 kV) voltage and, after VAR loss across 132/33 kV transformers, supplying about 4.0 MVAR (nearly 0.95 PF) at 132 kV bus i.e. fulfilling the Grid Code criteria at the point of interconnection. The voltage profile on all the bus bars of 132 kV of HESCO grid are well within the normal operating criteria of ± 5 % off the nominal.

6.3.2 Contingency cases and evolving of reliable scheme

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

Exhibit 6.1.1	Moro 132/33 kV Single Transformer Out
Exhibit 6.1.2	Moro to Tapal 132kV Single Circuit Out
Exhibit 6.1.3	Moro to Hartford 132kV Single Circuit Out
Exhibit 6.1.4	Hartford to Jhimpir-1 132kV Single Circuit Out

Exhibit 6.1.5	UEPL to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.1.6	Tapal to UEPL 132kV Single Circuit Out
Exhibit 6.1.7	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 6.1.8	Jhimpir-1 T.M.Khan 132 kV Single Circuit Out
Exhibit 6.1.9	Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit Out
Exhibit 6.1.10	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.1.11	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.1.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.1.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.1.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.1.15	Jamshoro to Dadu 500kV Single Circuit Out
Exhibit 6.1.16	Matiari-CS to Dadu 500kV Single Circuit Out

The load flow results of the network in the close vicinity of Moro WPP shown plotted in Exhibits 6.1.1 to 6.1.16 indicate that all the power flows on the lines are within the rated limits of this network.

6.4 Load Flow Analysis for Off-Peak Load Scenario of September 2021

Load flow analysis has been carried out for the off-peak conditions of September 2021 for the NTDC / HESCO network to see the steady state impact of reduced loads and generations as a higher loading on the circuits is expected during the off-peak conditions.

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

Exhibit 6.2.0 shows the normal case under the off-peak system conditions of August/September 2021. All these loadings are within the rated limits of these circuits. The bus voltages on all the substations in Southern HESCO grid are within the normal limits of operation.

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

Exhibit 6.2.1	Moro 132/33 kV Single Transformer Out

Exhibit 6.2.2	Moro to Tapal 132kV Single Circuit Out
Exhibit 6.2.3	Moro to Hartford 132kV Single Circuit Out
Exhibit 6.2.4	Hartford to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.2.5	UEPL to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.2.6	Tapal to UEPL 132kV Single Circuit Out
Exhibit 6.2.7	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 6.2.8	Jhimpir-1 T.M.Khan 132 kV Single Circuit Out
Exhibit 6.2.9	Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit Out
Exhibit 6.2.10	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.2.11	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.2.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.2.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.2.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.2.15	Jamshoro to Dadu 500kV Single Circuit Out
Exhibit 6.2.16	Matiari-CS to Dadu 500kV Single Circuit Out

The load flow results of the network in the close vicinity of Moro WPP shown plotted in Exhibits 6.2.1 to 6.2.16 indicate that all the power flows on the lines are within the rated limits of this network.

6.5 Load Flow Analysis for Future Scenario of 2023

Load flow analysis has been carried out for the peak conditions for future scenario of 2023 for the NTDC / HESCO network. All the future reinforcements that were proposed till 2023 are modeled in the case.

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

Exhibit 6.3.0 shows the normal case under the peak system conditions of future year 2023. All these loadings are within the rated limits of these circuits. The bus voltages on all the substations in Southern HESCO grid are within the normal limits of operation.

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

Exhibit 6.3.1	Moro 132/33 kV Single Transformer Out
Exhibit 6.3.2	Moro to Tapal 132kV Single Circuit Out
Exhibit 6.3.3	Moro to Hartford 132kV Single Circuit Out
Exhibit 6.3.4	Hartford to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.3.5	UEPL to Jhimpir-1 132kV Single Circuit Out
Exhibit 6.3.6	Tapal to UEPL 132kV Single Circuit Out
Exhibit 6.3.7	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 6.3.8	Jhimpir-1 T.M.Khan 132 kV Single Circuit Out
Exhibit 6.3.9	Jhimpir-1 to T.M.Khan Road 220 kV Single Circuit Out
Exhibit 6.3.10	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.3.11	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.3.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.3.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.3.14	Jamshoro 500/220 kV Single Transformer Out
Exhibit 6.3.15	Jamshoro to Dadu 500kV Single Circuit Out
Exhibit 6.3.16	Matiari-CS to Dadu 500kV Single Circuit Out

The results show that power flows on intact 132 kV circuits remain within their rated limits.

6.6 Conclusion of Load Flow Results

With the proposed reinforcements and the curtailment process for the base year of 2021 under special circumstances, the load flow results of the proposed scheme of interconnection of Moro WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in terms of absorbing all the output of Moro WPP under normal as well as the contingency conditions for all the scenarios studied.

Moro Wind Power Plant would be connected by a double circuit of 132 kV looping in-out with a sub cluster connecting neighboring Wind Power Plant of Tapal Energy and Hartford 132kV to Jhimpir-1 220/132 kV collector substation.

References:

1- WECC Wind Generator Modeling Group; *Generic Type-3 Wind Turbine-Generator Model for Grid Studies; Version 1.1*, September 14, 2006, p. 2.2
2- *Ibid.* p.3.1

7. Short Circuit Analysis

7.1 Methodology and Assumptions

The methodology of IEC 909 has been applied in all short circuit analyses in this report for which provision is available in the PSS/E software used for these studies. For calculations of maximum fault levels the bus voltage has been assumed as 1.1 PU i.e. 10 % above the nominal as per IEC909. For calculations of minimum fault levels the bus voltage has been assumed as 0.9 PU i.e. 10 below the nominal. That covers the entire ± 10 % range of the ratings of the equipment.

7.1.1 Assumptions for maximum and minimum short circuit levels

7.1.1.1 Assumptions-Maximum short circuit levels

For evaluation of maximum short circuit levels, we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the future year of 2023 to assess the maximum impact of Moro WPP.

The maximum fault currents have been calculated with the following assumptions under IEC909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence

Desired voltage magnitude at bus bars set equal to 1.10 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition.

However tabular results of some significant bus bars of 220 kV and 132 kV in the electrical vicinity of Moro WPP have also been produced and placed in Appendix-7.

7.1.1.2 Assumptions-Minimum Short Circuit Levels

The minimum fault currents are important for the evaluation of power quality issues such as flicker, unbalance, sudden voltage dip and harmonics.

To assess the minimum short circuit levels, we have considered conditions of 2021 to simulate the minimum short circuit strength of southern grid. For Moro WPP, we have

assumed dispatch of 25% of its capacity for the minimum short circuit calculations i.e. just one collector group with partial output of approx. 11.9 MW is on bar.

For minimum fault currents we have applied the following assumptions under IEC 909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence

Desired voltage magnitude at bus bars set equal to 0.9 P.U. i.e. 10 % lower than nominal, which is the minimum permissible voltage under contingency condition.

7.2 Fault Currents Calculations

7.2.1 Maximum Short Circuit Levels for the Year 2023

The short circuit levels have been calculated and plotted on the bus bars of 220 kV and 132 kV of substations lying in the electrical vicinity of our area of interest i.e. Jhimpir-1, Jhimpir-2, T.M.Khan Road, and Gharo area, and are shown plotted in the Exhibit 7.2 for the scenario of 2023 and attached in Appendix-7. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-7 for 220 kV and 132 kV bus bars of our interest i.e. the substations connecting in the three branches of 132 kV running South of Hyderabad up to Southern Sind coast line. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 7.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations which normally are 25 kA or 31.5 kA for older substations and 40 kA for new substations.

The fault levels of Moro 132 kV are 9.12 kA and 6.34 kA for 3-phase and single-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Moro Farm Substation as per NTDC requirements for 132 kV. The fault levels for Moro 33 kV are 9.65 kA and 8.06 kA for 3-phase and single-phase faults respectively for year 2023. Therefore, the short circuit rating recommended for 33 kV switchgear is recommended as 31.5 kA.

Table-7.1

Maximum Short Circuit Levels with Moro WPP – 2023

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Moro -MV 33 kV	9.65	8.06
Moro 132 kV	9.12	6.34
Tapal Energy 132 kV	9.85	6.69
Hartford 132kV	10.36	8.17
UEPL 132kV	24.78	19.92
Jhimpir-1 132 kV 132kV	31.08	27.40
Jhimpir-2 132 kV	25.98	24.90
Jhimpir-1 220 kV	23.92	18.63
Jhimpir-2 220 kV	31.19	23.97
Gharo-New 220 kV	12.30	9.02
TM.KH.RD 220 kV	23.4	18.49

7.2.2 Minimum short circuit levels

The minimum fault levels have been calculated for minimum dispatch of power in the grid system. The plotted results of short circuit analysis are attached as Exhibit 7.1. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the faulted bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-7 for the 132 kV bus bars of our interest.

The total minimum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 7.2.

Table-7.2

Minimum Short Circuit Levels with Moro WPP 2021

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Moro -MV 33 kV	7.25	6.43
Moro 132 kV	6.94	6.52
Tapal Energy 132 kV	7.56	5.47
Hartford 132kV	7.73	6.52
UEPL 132kV	16.82	14.96
Jhimpir-1 132 kV 132kV	20.05	19.64
Jhimpir-2 132 kV	19.05	19.15
Jhimpir-1 220 kV	16.84	14.24
Jhimpir-2 220 kV	22.52	18.56
Gharo-New 220 kV	9.36	7.28
TM.KH.RD 220 kV	16.87	13.68

7.3 Conclusions of Short Circuit Analysis

As a whole for the peak scenario of 2023, the fault levels at all the 132 kV bus bars are well below the short circuit rating of the equipment at these substations.

The fault levels of Moro 132 kV are 9.12 kA and 6.34 kA for 3-phase and single-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Moro Farm Substation as per NTDC requirements for 132 kV. The fault levels for Moro 33 kV are 9.65 kA and 8.06 kA for 3-phase and single-phase faults respectively for year 2023. Therefore, the short circuit rating recommended for 33 kV switchgear is recommended as 31.5 kA.

Similarly, for minimum short circuit case for the year 2021, the fault levels are also well below the short circuit rating of the equipment at these substations.

The short circuit strength is very important for Power Quality issues like flicker, harmonics and voltage unbalance. Exhibit 7.1.1 and 7.1.2 show the results of minimum fault levels in MVA to be used in Power Quality analysis carried out in Ch.9.

The fault levels indicate that there are no constraints in terms of short circuit ratings of the equipment of the adjoining substations and there is improvement in minimum fault levels. The proposed interconnection scheme holds well on the basis of short circuit analysis as well.

8. Transient Stability Analysis

The objective of transient stability study is to see:

1. Dynamic impact of Moro Wind Power Plant on the System
2. Dynamic impact of the System on Moro Wind Power Plant

8.1 Assumptions & Methodology

8.1.1 Type-3 WTG Dynamic Model

Moro is considering using Doubly Fed Induction Generator which is designated as Type-3 WTG in their Wind Power Plant. We have used the generic Type-3 wind turbine-generator model, which has been developed and has been made available by Siemens–PTI to their users of PSS/E software. Only the main parameters have been incorporated in this model, whereas other details and minute control parameters have been based on assumptions in the controllers of generic model of Siemens-PTI software PSS/E.

8.2 Dynamic Impact of System Disturbances

8.2.1

Fault Type: 3-Phase			
Fault Location: Moro 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Trip Moro To Tapal 132kv Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Moro MV 33 kV 2. Moro 132 kV 3. Hartford 132 kV 4. Jhimpir-1 132 kV 5. Jhimpir-2 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.1.1
Frequency	Moro 132 kV	Recovers after fault clearance	8.1.2

• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.1.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.1.4
• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.1.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.1.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.1.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.1.8
• **MW Line Flow** • **MVAR Line Flow**	Moro to Hartford 132kV S/C	Attains steady state value after damping of oscillations	8.1.9
• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.1.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.1.11

8.2.2

Fault Type: 3-Phase			
Fault Location: Moro 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Trip Moro To Tapal 132kv Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Moro MV 33 kV 2. Moro 132 kV	The voltages of all the bus bars	8.2.1

	3. Hartford 132 kV 4. Jhimpir-1 132 kV 5. Jhimpir-2 132 kV 6. Jhimpir-2 220 kV	recover after fault clearance	
Frequency	Moro 132 kV	Recovers after fault clearance	8.2.2
• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.2.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.2.4
• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.2.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.2.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.2.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.2.8
• **MW Line Flow** • **MVAR Line Flow**	Moro to Hartford 132kV S/C	Attains steady state value after damping of oscillations	8.2.9
• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.2.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.2.11

8.2.3

Fault Type: 3-Phase			
Fault Location: Moro-MV 33 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Trip Moro 132/33KV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Moro MV 33 kV 2. Moro 132 kV 3. Hartford 132 kV 4. Jhimpir-1 132 kV 5. Jhimpir-2 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.3.1
Frequency	Moro 132 kV	Recovers after fault clearance	8.3.2
• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.3.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.3.4
• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.3.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.3.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.3.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.3.8
• **MW Line Flow** • **MVAR Line Flow**	MW/MVAR Flow Moro 132/33 KV T/F	Attains steady state value after damping of oscillations	8.3.9

• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.3.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.3.11

8.2.4

Fault Type: 3-Phase			
Fault Location: Moro-MV 33 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Trip One Collector Group of 13.2MW			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Moro MV 33 kV 2. Moro 132 kV 3. Hartford 132 kV 4. Jhimpir-1 132 kV 5. Jhimpir-2 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.4.1
Frequency	Moro 132 kV	Recovers after fault clearance	8.4.2
• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.4.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.4.4
• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.4.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.4.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.4.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.4.8

• **MW Line Flow** • **MVAR Line Flow**	MW/MVAR Flow Moro 132/33 KV T/F	Attains steady state value after damping of oscillations	8.4.9
• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.4.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.4.11

8.2.5

Fault Type: 3-Phase			
Fault Location: Hartford 132 kV bus bar			
Fault Duration: 5 cycles (180 ms)			
Line Tripping: Trip Hartford to Jhimpir-1 132kv Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Moro MV 33 kV 2. Moro 132 kV 3. Hartford 132 kV 4. Jhimpir-1 132 kV 5. Jhimpir-2 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.5.1
Frequency	Moro 132 kV	Recovers after fault clearance	8.5.2
• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.5.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.5.4
• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.5.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.5.6

• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.5.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.5.8
• **MW Line Flow** • **MVAR Line Flow**	UEPL to Jhimpir-1 132kV S/C	Attains steady state value after damping of oscillations	8.5.9
• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.5.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.5.11

8.2.6

Fault Type: 3-Phase			
Fault Location: Hartford 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Trip Hartford to Jhimpir-1 132kv Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Moro MV 33 kV 2. Moro 132 kV 3. Hartford 132 kV 4. Jhimpir-1 132 kV 5. Jhimpir-2 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.6.1
Frequency	Moro 132 kV	Recovers after fault clearance	8.6.2
• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.6.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.6.4

• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.6.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.6.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.6.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.6.8
• **MW Line Flow** • **MVAR Line Flow**	UEPL to Jhimpir-1 132kV S/C	Attains steady state value after damping of oscillations	8.6.9
• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.6.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.6.11

8.2.7

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Trip Hartford to Jhimpir-1 132kv Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 132 kV 2. Jhimpir-1 220 kV 3. Hartford 132 kV 4. Jhimpir-2 132 kV 5. Jhimpir-2 220 kV 6. T.M Khan Road 220 kV	The voltages of all the bus bars recover after fault clearance	8.7.1
Frequency	Moro 132 kV	Recovers after fault clearance	8.7.2

• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.7.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.7.4
• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.7.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.7.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.7.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.7.8
• **MW Line Flow** • **MVAR Line Flow**	UEPL to Jhimpir-1 132kV S/C	Attains steady state value after damping of oscillations	8.7.9
• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.7.10
Rotor Angles	1.. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.7.11

8.2.8

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 220 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Trip Jhimpir-1 to T.M Khan Road 220kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 132 kV 2. Jhimpir-1 220 kV	The voltages of all the bus bars	8.8.1

	3. Hartford 132 kV 4. Jhimpir-2 132 kV 5. Jhimpir-2 220 kV 6. T.M Khan Road 220 kV	recover after fault clearance	
Frequency	Moro 132 kV	Recovers after fault clearance	8.8.2
• **Plant MW Output** • **Plant MVAR Output**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.8.3
• **Speed** • **Pmechanical**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.8.4
• **Torque** • **Pitch Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.8.5
• **Paero** • **Shaft Twist Angle**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.8.6
• **Turbine Rotor Speed Deviation** • **Generator Speed Deviation**	Moro Collector Group-2 0.69 kV	Recovers	8.8.7
• **Pitch control** • **Pitch compensation**	Moro Collector Group-2 0.69 kV	Recovers after damping down oscillations	8.8.8
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M Khan Road 220kV Single Circuit	Attains steady state value after damping of oscillations	8.8.9
• **MW Output** • **MVAR Output**	MW/MVAR Flow of Tapal Energy 132KV	Recovers after damping down oscillations	8.8.10
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Jamshoro 220 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.8.11

8.5 Conclusion of Stability Study

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

There are no constraints of connecting Moro WPP with the NTDC grid in terms of transients or dynamic behavior of system under the disturbed conditions either on the Farm side or on the Grid side.

9 Power Quality

The issues of power quality are of particular importance to wind turbines that may cause flicker and distortions in the power supply due to harmonics and unbalance. These issues are more significant for weak systems of low short circuit strength. Therefore, we have investigated these issues for the case of minimum short circuit of 2021 for the proposed scheme of interconnection. The same case has been re-evaluated with per unit MVA values and plotted for 3-phase faults in Exhibits 7.1.1 and 7.1.2 in Appendix-7

9.1 Flicker

We have used IEC61400-21 for the calculations of flicker levels for steady-state continuous operation and for switching conditions [1].

9.1.1 Continuous Operation

The probability of 99th percentile flicker emission from a single wind turbine during continuous operation for short time $P_{st\Sigma}$ and longer time flicker levels $P_{lt\Sigma}$ are assumed same and calculated by the following formula

$$P_{st\Sigma} = P_{lt\Sigma} = \frac{1}{S_k} \cdot \sqrt{\sum_{i=1}^{N_{wt}} (c_i(\psi_k, v_a) \cdot S_{n,i})^2}$$

where

$c(\psi_k, v_a)$ is the flicker coefficient of the wind turbine for the given network impedance phase angle, ψ_k at the PCC, and for the given annual average wind speed, v_a at hub-height of the wind turbine at the site;

S_n is the rated apparent power of the wind turbine;

S_k is the short-circuit apparent power at the PCC.

N_{wt} is the number of wind turbines connected to the PCC.

PCC is the point of common coupling of WTGs that is MV bus of Moro Farm substation.

For minimum short circuit case we have assumed the same case as discussed in paragraph 7.1.1.2 of Chapter 7 in which output of Moro Wind farm reduced as low as 25 % of its rated capacity. Therefore, taking one collector group as one equivalent generator of 2.2x11 = 24.2 MW we have calculated as follows;

S_n= 2.44 MVA at 0.95 PF (For 1 WTG)

N_{WT} = 6

S_k for MV bus = 410 MVA

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

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

where

S_n is the rated apparent power of the wind turbine;

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

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

Putting this data in the above Equation, we find

$P_{St\Sigma} = P_{lt\Sigma}$= 0.014604 = 1.46 %

Whereas the acceptable value is 4 % as mentioned in Ref. [2]. Therefore we are much less than the maximum permissible level and the WTGs at Moro Wind farm would not cause any flicker problem during steady state operation even in the weakest system conditions of minimum short circuit level.

9.1.2 Switching Operation

The most common switching operations would be as follows;

a. Wind turbine start-up at cut-in speed
b. Wind turbine start-up at rated wind speed
c. The worst case of switching between the WTGs

The flicker emission from the wind farm of many machines can be calculated by the following equation as per IEC61400-21 (Section 8.3.2)

$$P_{st\Sigma} = \frac{18}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{10,i} \cdot (k_{f,i}(\psi_k) \cdot S_{n,i})^{3.2} \right)^{0.31}$$

$$P_{lt\Sigma} = \frac{8}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{120,i} \cdot (k_{f,i}(\psi_k) \cdot S_{n,i})^{3.2} \right)^{0.31}$$

where

$N_{10,i}$ and $N_{120,i}$	are the number of switching operations of the individual wind turbine within a 10 min and 2 h period respectively;
$k_{f,i}(\psi_k)$	is the flicker step factor of the individual wind turbine;
$S_{n,i}$	is the rated power of the individual wind turbine.

The values of N_{10} and N_{120} are usually provided by the manufacturers based on field measurements, but if these are not available then IEC61400-21 proposes in section 7.6.3 to use as follows;

For switching conditions of (a) and (b)

$N_{10} = 10$

$N_{120} = 120$

For switching conditions of (c)

$N_{10} = 1$

$N_{120} = 12$

The value of flicker step factor $k_{f,i}(\psi k)$ is also provided by the manufacturer after the field and factory measurements; but for the present analysis we assume it to be equal to 1.

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

$PSt\Sigma = 0.33946$

$Plt\Sigma = 0.32595$

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

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

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

9.2 Voltage Unbalance

9.2.1 Voltage Step-Change

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

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

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

Where

S_{WKA} = MVA rating of the WTG

S_{KE} = Short circuit MVA at connection point

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

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

S_{WKA} = 2.44 MVA for the equivalent WTG of a collector group for the minimum case

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

S_{KSS} = 380 MVA (Exhibit 7.1.2)

Substituting these values we get

$\Delta V = 0.000756794 = 0.0756794\ \%$

Which is much less than the limit of 3 %

9.2.2 Voltage Fluctuation

For the limits of voltage fluctuation, we need to satisfy the following equation [2].

$$\sqrt{\sum} (P_{WKA} / S_{KE})^2 \leq 1/25 \text{ or } 4\ \%$$

Where

P_{WKA} = MW rating of the WTG

S_{KE} = Short circuit MVA at connection point

Punching all the numbers in this equation, we get

Voltage Fluctuation = 0.006470588 = 0.6470588 %

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

10 Conclusions & Recommendations

- Moro WPP which is the plant under study, has been placed in a loop at existing 220/132kV Jhimpir-1 grid station. Moro Wind Power Plant would be connected by a 13 km double circuit of 132 kV looping in-out with a sub cluster connecting neighboring Wind Power Plant of Tapal Energy and Hartford WPP 132kV.
- The existing grid system of HESCO and NTDC in the vicinity of Moro WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Moro WPP and no bottlenecks or constraints have been found in the grid system.
- Wind Farm of Moro WPP has been modeled considering Type-3 WTGs. They are Doubly Fed Induction Generators which are designated as Type-3 WTG. The terminal voltage is 0.69 kV. The medium voltage level of wind farm has been selected as 33 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Farm substation to connect to the Jhimpir-1 220/132 kV grid station of NTDC.
- Load flow analysis has been carried out for peak and Off-Peak scenarios of August/September 2021 considering the COD targeted by Moro WPP and a future scenario of 2023, for the dispersal of power from Moro WPP into NTDC system using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme has been evolved by performing the load flow studies testing the steady state performance for normal as well as N-1 contingency conditions fulfilling the Grid Code criteria of Wind Power Plants. The reactive power requirement at point of common coupling to meet PF of ± 0.95, voltage and line loading criteria are fulfilled by these studies. All the scenarios have been studied by considering maximum dispatch from all the existing/planned WPPs in the Jhimpir and Gharo Clusters.
- With the proposed interconnection for the base year of 2021, the load flow results for Peak and Off-Peak scenarios establish that the proposed scheme of interconnection of Moro WPP shows no bottlenecks or capacity constraints in the

adjoining 500 kV, 220 kV and 132 kV network in terms of absorbing all the output of Moro WPP under normal as well as the contingency conditions.

- Maximum and minimum short circuit levels for three-phase faults and single-phase faults have been evaluated. The maximum SC levels have been evaluated for the year 2023 and minimum short circuit level for the year 2021 for the most stringent conditions. The fault levels of Moro WPP 132 kV are 9.13 kA and 6.34 kA for 3-phase and single-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Moro WPP Farm Substation as per NTDC requirements for 132 kV. The fault levels for Moro WPP 33 kV are 9.65 kA and 8.06 kA for 3-phase and single-phase faults respectively for year 2023. Therefore, the short circuit rating for 33 kV switchgear is recommended as 31.5 kA. It has been found that the proposed scheme provides maximum SC strength for the evacuation of Moro WPP power to the grid.

  The switchgear ratings for Moro WPP substation are as follows:

  132 kV:

  Short circuit rating = 40 kA (3 sec.)

  Continuous rating = 2500 A

  33 kV:

  Short circuit rating = 31.5 (3 sec.)

  Continuous rating = 2500 A

- Transient Stability analysis has been carried out for Moro WPP based on their selection of Type-3 WTGs, with connectivity of proposed scheme. Different disturbances have been simulated to apply stresses from the system faults on the wind farm and vice versa and it was found that Moro WPPWTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Moro WPP side did not cause any stress on the main grid or the power plants nearby and in the HESCO area such that the whole system remained stable under all events.
- The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault

clearing due to stuck-breaker (breaker failure) reason. The simulations have proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.

- The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and unbalance are within the permissible limits of IEC and other International Standards.
- There are no technical constraints whatsoever in the way of bringing in the 25 MW of Moro WPP Wind Power Plant at the proposed site and scheduled time of commissioning, in any respect of steady state (load flow) or short circuit or dynamic performance (stability) or power quality issues related to this plant.