TRICOM
Wind Power (PVT) LTD.

Suite # 306, 3rd Floor, Adamjee House, I. I. Chundrigar Road, Karachi-74000
Phone: 021-3241-0775, 3241-6391, Fax: 021-3241-5479
E-mail: concrd@cyber.net.pk,

TWPL/NEPRA/2018/002

January 22, 2018

THE REGISTRAR,
NATIONAL ELECTRICAL POWER REGULATORY AUTHORITY,
NEPRA Tower, Attaturk Avenue (East)
G-5/1,
Islamabad

SUBJECT: **APPLICATION FOR GRANT OF GENERATION LICENSE TO TRICOM WIND POWER (PRIVATE) LIMITED FOR ITS 50MW WIND POWER GENERATION PROJECT TO BE LOCATED AT JHIMPIR, DISTRICT THATTA, PROVINCE OF SINDH**

Dear Sir,

1. Pursuant to Rule 3 of the National Electric Power Regulatory Authority Licensing (Generation) Rules 2000, TRICOM WIND POWER (PRIVATE) LIMITED hereby submits for NEPRA's kind consideration and approval, the Generation License Application (together with the information and annexures attached thereto).

2. The Generation License Application (including its annexures) are submitted in triplicate, together with:

   (a) A Pay Order No. **11961213** dated **22nd January 2018** of **Habib Metropolitan Bank Limited** amounting to PKR 305,760/- (Pakistani Rupees Three Hundred five Thousand Seven Hundred and Sixty Only) drawn in favor of NEPRA, as the application fee for the Generation License Application (as communicated to us by NEPRA);

   (b) Extract of Board Resolution of Tricom Wind Power (Private) Limited; and

   (c) Statement of Authorized Representative of Tricom Wind Power (Private) Limited, Mr. Abdul Sattar Jumani.

3. In light of the submissions set out in the Generation License Application and the information attached to the same, NEPRA is kindly requested to process the Generation License Application at the earliest, thereby enabling Tricom Wind Power (Private) Limited to proceed further with the development of the project.

Respectfully submitted for and on behalf of:
TRICOM WIND POWER (PRIVATE) LIMITED

WIND POWER (PVT) LTD. Karachi

ABDUL SATTAR JUMANI
CHIEF EXECUTIVE OFFICER

TRICOM
Wind Power (PVT) LTD.

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Phone: 021-3241-0775, 3241-6391, Fax: 021-3241-5479
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EXTRACT OF THE RESOLUTION BY CIRCULATION
PASSED BY THE BOARD OF DIRECTORS OF
TRICOM WIND POWER (PRIVATE) LIMITED
DATED: JANUARY 22, 2018

"RESOLVED THAT Mr. Abdul Sattar Jumani-Chief Executive Officer of the Company be and is hereby authorized to file in person or through a duly appointed legal counsel (i) an application for the grant of a generation license; (ii) an application for the determination of generation tariff (including any review petitions); (iii) any document of support thereof and/or to make any oral/written representations on behalf of Tricom Wind Power (Private) Limited (TWPL), Before the National Electric Power Regulatory Authority (NEPRA); and (iv) to engage a legal counsel to represent the Company before the NEPRA in relation to TWPL's 50 MW wind power project at Jhimpir Area, Taluka & District Thatta, Sindh, Pakistan; and to undertake any matter(s)necessary or incidental thereto."

CERTIFICATE

Certified that the foregoing is a true extract of resolution by circulation passed by the Board of Directors of Tricom Wind Power (Private) Limited on January 22, 2018.

POWER (PVT) LTD. Karachi TRICOM

Abdul Sattar Jumani
Chief Executive Officer

January 23, 2018

GENERATION LICENSE APPLICATION FOR 50 MW TRICOM WIND POWER (PVT.) LTD IN JHIMPIR, SINDH

PROJECT COMPANY:

TRICOM WIND POWER (PVT) LIMITED

PROJECT TECHNICAL CONSULTANT:

RENEWABLE RESOURCES (PVT) LIMITED

TRICOM WIND POWER (PVT.) LTD. ★ Karachi

DOCUMENT STRUCTURE

This document is the Generation License Application for a Wind Power Project having a capacity of 50 MW in Jhimpir, Sindh to be set up by Tricom Wind Power (Pvt.) Ltd (the "**Applicant**", "**TWP**").

The document comprises of the Project summary and following Annexures.

The following Project documents are annexed to this application in pursuant to Section-5 of Article-3 of NEPRA Licensing (Application & Modification Procedure) Regulation, 1999:

Annexure - I	Project Information
Annexure –IA	Technology Details of Gamesa G114-2.0 Wind Turbine Generator
Annexure - II	Certificate of Incorporation
Annexure - III	Memorandum and Articles of Association, Form 28
Annexure - IV	Board Resolution and Affidavit
Annexure - V	Last Filed Annual Return
Annexure – VI	Profile of Applicant, Curriculum Vitae of Senior Management, Technical and Professional Staff
Annexure – VII	Evidence regarding availability of adequate Financial and Technical Resources including relevant excerpts of balance sheets of the Sponsors
Annexure – VIII	Charge or encumbrances attached to the company assets
Annexure – IX	Feasibility Report of Tricom Wind Power (Pvt.) Limited including Grid Interconnection Study and Initial Environmental Examination Report
Annexure – X	Power Evacuation Certificate

PROSPECTUS

The Applicant obtained the Letter of Intent (LOI) from Directorate of Alternative Energy, Energy Department, Government of Sindh (DAE, ED-GoS) on 28th August 2015 for the wind power project, having capacity of 50 MW (the "**Project**"). The land for the Project has been allotted by Government of Sindh.

Tricom Wind Power (Pvt.) Ltd is the Applicant for a 50 MW Wind Power Project to be located in Jhimpir, District Thatta, Sindh, which is towards the East of Karachi. The National Highway and Superhighway are the major connecting roads to the Project site, having a distance of approximately 110 km from Port Qasim. The Project site consists of approximately 327 acres of land, which has been allotted to the project company. The Jhimpir wind corridor is identified as a potential area for the development of wind power projects. The monsoon from the Indian Ocean, which is stable in its direction and high in quality, brings rich wind energy resource to the site.

The complete feasibility study submitted to DAE, ED-GoS which has been approved.

The Grid Interconnection Study was conducted by well-known Consultant Welt Konnect (Pvt.) Ltd, and approved by NTDC.

Initial Environmental Examination (IEE) Report submitted to Sindh Environmental Protection Agency (SEPA) and IEE Report has been approved by SEPA.

The Project will have an installed capacity of 50 MW with 25 Wind Turbine Generators (WTGs) of 2.0 MW capacity each. The scheme of interconnection with NTDC grid has been determined in the Grid Interconnection Study.

The Project will apply for the tariff simultaneously with this application. Upon issuance of the Generation License and determination of tariff, the applicant would execute Energy Purchase Agreement with the power purchaser and aims to reach financial close by December 2018; the expected commercial operation date of the Project is 2nd Quarter of 2020, subject to award of tariff, execution of concession agreements and availability of Grid.

This document is submitted pursuant to Section - 5 of Article - 3 of NEPRA Licensing (Application & Modification Procedure) Regulation, 1999 (the "**Regulations**"); and list of documents required are attached as Annexure as mentioned in Document Structure.

Annexure-I:

PROJECT INFORMATION

Project Background

General Information:

(i).	Name of the Company/Licensee	Tricom Wind Power (Pvt) Limited
(ii).	Registered/Business Office	7-A, Tabba Street, Muhammad Ali Society, Karachi
(iii).	Plant Location	Jhimpir, District Thatta, Sindh
(iv).	Type of Generation Facility	Wind Power

Since the issuance of the LOI, the Applicant conducted various studies to assess the feasibility of the Project. These studies included the Wind Resource Assessment, Geo Technical investigation, Digital Topographic map, Initial Environmental Examination, whereas the Grid Interconnection Study is under process by NTDC itself. The complete feasibility study has been approved by the Applicant to DAE, ED-GoS.

In order to select EPC and O&M contractors for the Project, the Applicant has selected most efficient and economical WTG and EBOP suppliers, suitable for the site from the available players in the local market, for awarding the turnkey EPC contracts for construction of the Project followed by a turnkey O&M Contractor.

Project Sponsor

JV of Adamjee Group of Companies and Yunus Brothers Group, the Sponsor of TWP with 100% shareholding in TWP.

Yunus Brothers Group

Yunus Brothers Group was established in 1962 as a trading business house. Yunus Brothers became one of the largest business conglomerates in Pakistan, with investments in Textiles, Cement, Construction, Real Estate, Energy and commodity trading business, has an annual turnover which exceeds US$ 1.50 billion. It owns one of the largest cement manufacturing facility and the largest textiles manufacturing set up in the country.

The investments in energy sector of Yunus Brothers Group (YBG) comprises of:

- Lucky Energy (Pvt.) Limited (LEPL), a NEPRA licensed Small Power Producer (SPP), in service as a Captive Power Plant, was incorporated in July 1993.
- Yunus Energy Limited, a 50 MW Wind Power Project achieving COD in September 2016.

- Lucky Electric Power Company, a 660 MW Coal Fired Power Project under development stage.
- Yunus Wind Power Limited, a 50 MW Wind Power Project under development stage.
- Lucky Wind Power Limited, a 50 MW Wind Power Project under development stage.

LEPL, is a Gas-Powered, thermal Power Generation Facility, with a total production capacity of 56.575 MW. It is equipped with world's one of the most sophisticated and highly-efficient Generator Sets from Caterpillar, Janbacher, GE, etc.

50 MW Wind Project of Yunus Energy Limited is successfully operating since September 2016. The Project consists of 20 WTGs of Nordex N-100/2500.

YBG is on the move to further upgrade and enhance its existing power generation capacity and simultaneously embarking on a diversification plan to explore new avenues for commercial supply of electricity to National Grid by making best use of hydel resources in north of Pakistan, wind energy in Wind corridor of Sind Province of Pakistan and 660 MW coal power project at Port Qasim in Karachi.

All pre-equipment selection surveys and relevant formalities are underway to facilitate the National grid with 215MW with Hydel to be a humble contribution in overcoming the mounting energy crisis in the country.

YBG group companies are fully capable of self-generation to meet their energy requirement with latest high-tech generation equipment available in today's world with details as under:

THERMAL GENERATION	
PROJECT	GENERATION CAPACITY
Gadoon Textile Mills (HFO & Gas Based)	56 MW
Lucky Cement Ltd. Karachi Project	80 MW
Lucky Cement Ltd. KPK Project	100 MW
Yunus Textile Mills Limited	20 MW
Lucky Textile Mills Limited	8 MW
Group's Total Generation Capacity	**264 MW**

GROUP'S PROJECTS (IN IPP MODE) IN DEVELOPMENT AND CONSTRUCTION PHASES	
PROJECT	GENERATION CAPACITY
Wind Power – Operational	50 MW
Hydel Energy Project in KPK	215 MW
Wind Power – Development Phase	150 MW
Coal Powered Project at Port Qasim Karachi	660 MW
Total	**1,075 MW**

Adamjee Group of Companies

The Adamjee name has been a prominent and highly reputed name amongst the business circles of the Indian subcontinent throughout the 20th century.

Adamjee Group of Companies is a conglomerate company based primarily in Karachi, Pakistan. The group was founded by Sir Adamjee Haji Dawood. Owners of Adamjee Group are among the top 40 wealthiest families of Pakistan. The company had changed fortunes over the past 50 years, initially originating as a jute and banking conglomerate, later spreading to other industries such as tea, textiles, matches, sugar, paper board, chemicals, engineering and insurance.

Many of Adamjee Group companies are publicly traded on the Pakistan Stock Exchange (PSX) and enterprises under the umbrella of the group are:

- Adamjee Engineering Limited
- Chempro Pakistan Limited
- Adamjee Polymers Limited
- Adamjee Durabuilt Limited
- Adamjee Pharmaceuticals Limited
- Pacific Multi Products Limited
- Adamjee Diesel Engineering (Pakistan) Limited
- Adamjee Insurance Limited
- Adamjee Foundation
- Adamjee Automotive Limited.

Project Site

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

1. Location in the wind corridor
2. Wind conditions at the site
3. Topographic conditions
4. Site accessibility
5. Location of the grid regarding the site for interconnection

The site is located within the wind corridor identified by Government of Pakistan and the land has been allotted to the Project Sponsors.

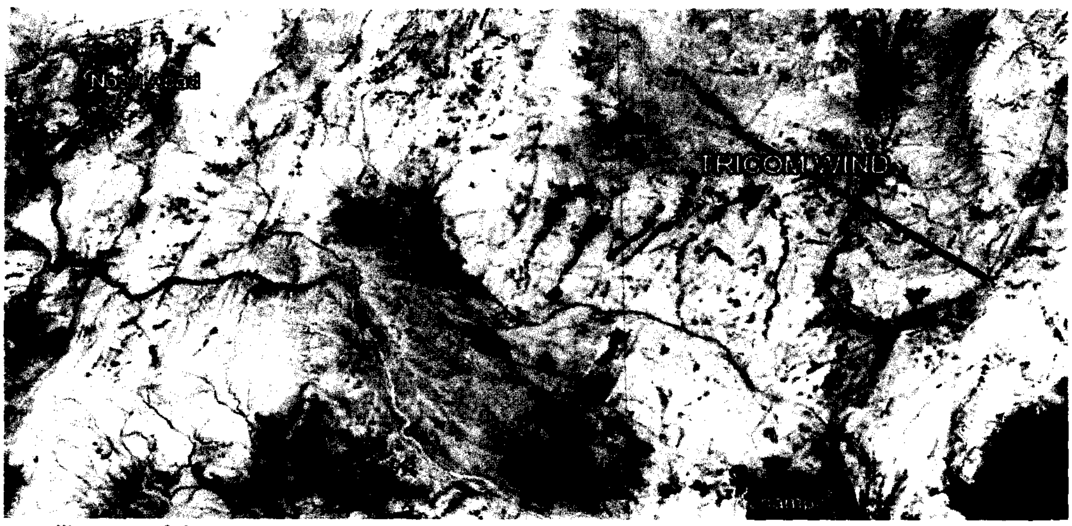
The site is in Jhimpir District Thatta, Sindh, which is one of the most promising areas where wind power projects can be viably installed.

Land Description of the Project Site

The wind farm Project is located in Jhimpir, which is located approximately 110 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 347 acres of land, which is allotted by GoS. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site. The Jhimpir wind corridor is identified as potential area for the development of wind power projects. The overview of the project site is shown in Figure below:

TRICOM Site overview

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



Satellite map of the TRICOM Site

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

The proposed site area lies in an arid zone with very little annual precipitation. The result is that there is sparse vegetation in the area. Some hardy tree species are visible scattered far and wide in the area. The area is rocky with some rock outcrops towards the Super Highway. The terrain at the site and surrounding area is generally flat with elevations varying between 55 m in the southwest corner of the site to 100 m in the northeast corner.

The proposed site is located about 110 km from Port Qasim, Karachi. Karachi borders on the Arabian Sea and the weather belongs to tropical monsoon climate. Rainfall is scarce with about 200 mm for a whole year and most of this is concentrated in July and August. The temperature in winter from November to February is temperate, but it is hot with high temperature in summer from April to August as the highest temperature has reached 44.02°C.

Wind Farms Layout at Project Site

The overview of wind farm of Tricom Wind and neighboring wind farms are shown in Figure below:

The micrositing of the Tricom Wind Project with 25 Turbines is shown in Figure below:

The coordinates of WTGs are given in Table below:

Turbine No.	Coordinates (UTM z42 WGS84)	
	Easting [m]	**Northing [m]**
TRICOM_T01	400706	2781079
TRICOM_T02	401552	2780500
TRICOM_T03	401835	2780307
TRICOM_T04	402117	2780114
TRICOM_T05	402399	2779921
TRICOM_T06	402681	2779727
TRICOM_T07	402964	2779534
TRICOM_T08	403528	2779148
TRICOM_T09	403811	2778955
TRICOM_T10	404093	2778762
TRICOM_T11	404375	2778569
TRICOM_T12	404657	2778376
TRICOM_T13	404940	2778183
TRICOM_T14	405222	2777989
TRICOM_T15	405504	2777796
TRICOM_T16	405786	2777603
TRICOM_T17	406069	2777410
TRICOM_T18	406633	2777024
TRICOM_T19	406915	2776831
TRICOM_T20	407198	2776638
TRICOM_T21	407480	2776445
TRICOM_T22	407762	2776252
TRICOM_T23	408045	2776058
TRICOM_T24	408327	2775865
TRICOM_T25	408609	2775672

Topographical and Geological Conditions at Project Site

Topographical conditions

The Project site is on a plain area at an elevation of 55-100 m, which is generally flat, but a bit higher on the east and lower on the west. The landform at wind farm sites is mainly of pediment and the vegetation there is less developed.

Geological conditions

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

Hydrology

According to the regional hydrological data available, the Project site is in a dry area, where the water table is deeply underground, and the surface water and water in the shallow surface layers is weakly to slightly corrosive to the concrete and is corrosive to the rebars in the concrete which has been submerged in water for a long-time or alternatively in wet and dry conditions. Corrosion prevention measures will be adopted in the design and implementation of the wind farm.

Site Accessibility

The major section of track from Karachi to the site is via the National and Super high-way. The track is a multi-lane road. It has a flat terrain, and long and heavy vehicles can easily navigate through this road. Generally, minor track settlement is required from Nooriabad onwards to reach site area. The total distance from Karachi to the site is approximately 110 km.

There are number of neighboring wind farms in the surrounding area of Thatta. The site is located in Jhimpir-Thatta, Sindh that is towards the East of Karachi and within the same corridor as many other wind power projects. The project site is towards the North East of the FFC Wind Project, Zorlu Wind project, Three Gorges Wind Project, Hawa Wind Project, and JPL Power Project.

Telecommunication at project site

Close to the site, there is wire based telecommunication available in the nearby towns. Cellular phone suppliers Mobilink, Telenor, Warid, Ufone and Zong have coverage on the site area.

For the SCADA system of the wind farm, a wire based telecommunication infrastructure has to be installed.

Availability of Semi-Skilled and Skilled Labor

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

Project Site Security and Safety

The Applicant is quite cognizant of the fact that security situation in the country is unsatisfactory. The Applicant has plans to use the infrastructure available in the region in the most efficient manner to provide seamless security at offices, accommodation and site.

The Applicant has carried out a comprehensive environmental study to assess the impact of the Project on the environment. The Study titled "Initial Environment Examination" (IEE) was submitted to Sindh Environmental Protection Agency (SEPA) on 05th September 2016, which had been approved by the Agency. As per the study, the Project has no significant hazardous impact on the environment. However, the study has addressed minor adjustments that shall be required during the construction phase in order to ensure the safety of the environment and Project personnel. The study also details an environment management plan, which will be enforced by the project team and the EPC contractor. The recommendations of the IEE will be strictly followed along with heed paid to further guidance by SEPA in its approval of the IEE. As per the EPC Contract to be signed by the Project Company, the EPC Contractor will be responsible for adhering to the recommendations of the IEE during the construction phase in order to comply with the SEPA approval. A copy of the IEE shall be provided to the EPC Contractor as part of the EPC Contract.

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

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

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

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

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

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

Grid Connectivity

Tricom Wind Project will have 04 cluster groups and would be connected by a double circuit of 132kV of Jhimpir New-I.

Annual Energy Production

The Annual Energy Production is estimated at 166.44 GWh. The tables below show key details relating to power generation from the Project.

Installed Gross ISO Capacity of Tricom Wind Farm	**50.0 MW**
Annual Energy Generation	166.44 GWh
Capacity Factor	**38%**

Project Cost

The estimated project cost is **USD 87.65 Million**.

Debt : Equity Ratio
USD 70.12 Million (80%) : USD 17.53 Million (20%)

Gamesa – The WTG manufacturer

The Gamesa 2.0 MW (G114-STD 1 CII model) wind turbines are of the three-bladed wind-facing rotor type with a rated power of 2 MW. Its rotor diameter is 114m and hub height of 93m. The Gamesa 2.0 MW (G114-STD 1 CII model) wind turbines are regulated by an independent pitch control system in each blade and has an active yaw system. The control system allows the wind turbine to be operated at variable speed, maximizing the power produced at all times and minimizing the loads and noise.

A description is given below of the main components of the Gamesa 2.0 MW (G114-STD 1 CII model) wind turbines.

Wind Farm Capacity & Configuration:

Wind Turbine Details:

(a).	**Rotor**	
(i).	Number of blades	3
(ii).	Rotor diameter	114 m
(iii).	Swept area	10,207 m^2
(iv)	Wind speed in operation (rpm)	13.07
(b).	**Blades**	
(i).	Blade length	56 m
(ii)	Weight	13 tons
(c).	**Gearbox**	
(i).	Type	1 stage planetary / 2 parallel
(d).	**Generator**	
(i).	Power	2,070 kW (rotor + stator)
(ii).	Voltage	690 V
(iii).	Type	Doubly-fed with coil rotor and slip rings
(iv).	Enclosure class	IP 54
(v).	Coupling	Flexible coupling
(vi).	Power factor	+0.95 to -0.95
(e).	**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
(f).	**Brake**	
(i).	Type	Disc Brakes
(g).	**Tower**	
(i).	Type	Conical barrel tube
(ii).	Hub heights	93.0 m
(iii)	Material	Structural carbon steel

Other Details:

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

Energy Yield of the Wind Farm

The energy yield details of Tricom Wind Farm are given in Table below:

-1	Total Installed/Gross ISO Capacity (MW)	50.0
-2	Total Annual Full Load Hours	3328
-3	Average Wind Turbine Generator(WTG) Availability	95%
-4	Total Gross Generation of the Generation Facility/Wind Farm (in GWh)	204.5
-5	Array & Miscellaneous Losses (GWh)	21.6
-6	Availability Losses(GWh)	9.65
-7	Balance of Plant Losses (GWh)	6.75
-8	Annual Energy Generation (20 year equivalent Net AEP) GWh	166.44
-9	Net Capacity Factor	38%

Plant Characteristics

The plant characteristics are given in table below:

S. No.		
1	Generation Voltage	690 V
2	Frequency	50 Hz
3	Power Factor	0.95 leading - lagging
4	Automatic Generation Control	Pitch controlled
5	Ramping rate	As per grid code
6	Alternative Fuel	N/A
7	Aux. consumption	800 kW
8	Time required to synchronize to the grid	As per grid code

Control, Metering, Instrumentation and Protection

The information regarding Control, Metering instrumentation and Protection are given in Table below:

S. No.		
1	Metering	0.2S for revenue metering
2	Protection	Line distance/differential relay with overcurrent/earth fault backup protection
3	Instrumentation	5P20 for protection application

EPC Contractor

Based on the Wind Resource Assessment Studies on various WTGs having footprints in Pakistan, Gamesa G 114 – 2.0 is found most suitable WTG for the site. This application is being submitted on Gamesa G 114 – 2.0 WTG. TWP will carry out a competitive bidding process for selection of EPC contractor for the Project as per NEPRA's guidelines for EPC selection 2017.

Annexure –II

Certificate of Incorporation

A006456

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. 0092812

I hereby certify that TRICOM WIND POWER (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 Sixth day of April, Two Thousand and Fifteen.

Incorporation fee Rs. 52000/= only

(Saghir Ahmed Hashmi)
Joint Registrar of Companies
Karachi

Registrar
Securities and Exchange Commission of Pakistan
SECP

Certified to be True Copy

Joint Registrar of Companies

Annexure-III

MEMORANDUM AND ARTICLES OF ASSOCIATION

THE COMPANIES ORDINANCE, 1984

(Private Company Limited by Shares)

Memorandum of Association of

TRICOM WIND POWER (PVT.) LIMITED

I. <u>NAME</u>
The name of the Company is "**Tricom Wind Power (Pvt.) Limited**".

II. <u>REGISTERED OFFICE</u>
The Registered Office of the Company will be situated in the province of Sindh.

III. <u>OBJECT CLAUSE</u>
The Sole Object for which the company is established is as under:

1. To set up, establish, operate, manage, generate and run power generation plants, from different means and sources and to generate and supply electricity to all concerns.

2. In order to carry out and fulfill the above object, the Company shall be authorized:

a. To generate, produce, manufacture, store, sell, export, supply electricity to all concerns, by whatever means including wind-mill, thermal, hydal, gas, and WIND for industrial, commercial and residential use through distribution network and to construct, install, operate and maintain thereon power house, civil and mechanical works and structures, grid stations, transmission towers, power lines, building, workshops and other facilities as may time to time be necessary for the attainment of the object of the company.

b. To construct, lay-down, establish, fix, and carry out all necessary power stations, cables, wires, lines, accumulators, and works and to generate accumulate, distribute and supply electricity to cities, towns, streets, docks, markets, theaters, industrial zones, sites, areas and parks, buildings and places public and private.

c. To carry on and undertake all civil, electrical and mechanical works related to the aforementioned business, and to generate, accumulate, distribute and such by electricity for the purposes of light, heat, motive power and for all other purposes for which electrical energy can be employed, and to deal in all apparatuses and things required for or cab[illegible] of being used in connection with the generation with the distribution, supply, accumulation and employment of electricity.

d. To manufacture, process, buy, sell, exchange, alter improve, otherwise deal in all kinds of electrical plants, machinery, equipments, appliance, energy saving devices, and products, gadgets, components and parts including specialized equipments for the purposes of the business for the Company, and to manufacture, import, export, sell, buy, and deal in all accessories, articles, apparatus, equipment and goods, which may seem calculated to promote or to be capable of being used in connection with the use of electric power supply.

e. To enter into, make and perform contracts and arrangements of every kind and description with the Central, Provincial Government, City Government, or Local Authority or person that may be conducive to the Company's object and to obtain from any Government Authority, firm or person any rights, privileges, contracts, concessions, exemptions, permissions approvals and grants which the company may think desirable, and to obtain and carry out, exercise and comply with any arrangements, rights, privileges, contracts and concession and dispose of the same or turn into account the same.

f. To purchase, take on lease or in exchange, or otherwise acquire any lands and buildings in Pakistan or elsewhere, and any estates or interest therein and any rights connected with any such lands and buildings, and to buy, sell, lease, mortgage any such lands, buildings, estates, interests and rights therein, to enter into such arrangements, collaborations, joint ventures or else with local and/or foreign companies for acquiring, undertaking building, and development of power projects in Pakistan and elsewhere.

g. To manage, improve, develop, buy, sell, exchange, mortgage, charge, hypothecate, pledge, assign, transfer or otherwise deal with all or any part of the property and assets, whether movable or immovable, tangible or intangible, and any right, title and interest of the Company.

h. To carry on any other business, which may deemed to the company capable of being conveniently carried with the above or calculated directly or indirectly to enhance the value or render profitable any of the company's properties or rights, but the company shall not do any unlawful act or business.

i. To sell or dispose off machinery, plants, equipment, materials and all articles and things belong to the company and also all the products thereof either for immediate or future delivery upon such terms and conditions as may be deem expedient.

j. To acquire technical knowledge, know how, process, recipes formulas, engineering and manufacturing data, to appoint consultants and advisers, for advice on managerial, financial and technical problems of the company.

k. To apply for purchase or otherwise acquire and protect and renew in any part of the world any patents, patent rights, trade marks, designs, licenses concessions and the like conferring any exclusive or limited right to their use, or any secret or other information as to any invention which may seem capable of being used for any of the purposes of the company, or the acquisition of which may seem calculated directly or indirectly to benefit the company, and to use, exercise, develop, or grant license in respect of or otherwise turn to account the property, rights or information so acquired and to expand money in experimenting upon, testing or improving any such patents, inventions or rights.

l. To purchase, or otherwise acquire, and invest in shares, scrip, stocks, debentures, certificates, bonds or other financial instruments, of any entity, whether listed or non-listed, and public or private, and to receive dividends, profits or mark up, and/or to sell and dispose of the same as deem fit.

m. To takeover, acquire, amalgamate and merge with any other company to spin-off its division, and to sign, execute, arrangement, schemes, and contracts relating to such arrangements, as deem expedient or necessary in achieving these objects.

n. To enter into partnership or into arrangement for sharing profits, cooperation, joint venture, reciprocal concessions with local domestic and/or international foreign companies, for expansion of business, and trade or otherwise with any persons, firms or company, to carry on any business or transaction which the company is authorized to carry on.

o. To employ professionals, and other persons well conversant with relevant knowledge, experience and skills, and having technical expertise as may be deemed necessary or proper for the efficient handling and carrying on the business of the company.

p. In the event of winding-up, to distribute any of the properties of the company amongst the members in species or kind but it manner that no distributing amounting to a reducing of capital be made except with the sanction (if any) for the time required by law.

q. To adopt such means of making known the articles, goods and products of the company as may seem expedient, and in particular by advertising in the media, through books, journals, press, films, projectors and cinema houses, television, radio and through circulars, publication of books and periodicals.

r. To grant donations, make contributions and give financial assistance to charitable and other societies, association, clubs, schools, colleges and universities and other institutions as may be deemed proper.

s. To open and maintain offices, branches, commercial centres, depots, show rooms, offices, go-downs and to appoint agents except managing agent, sub-agents, attorneys, representatives, distributors and to establish and run trading and distributorship agencies, factories, laboratories, testing centres, technical institutions on such terms and conditions as may be deemed reasonable and proper.

t. To sell or dispose of or transfer the business, property, whether movable or immovable, undertaking of the company or any part thereof for such consideration as the company may think fit.

u. To open account , overdraft accounts and cash credit with or without security, to keep fixed and other deposits with any bank accept/ discount, executes, sign, issue and deal in cheques, bills of exchange, drafts, promissory notes, bill of lading, debentures, bonds, warrants, debenture coupons and other negotiable instruments in connection with the business of this company.

v. To borrow money in Pakistan as well as in foreign currencies at any time and from time to time for the purpose of the company with or without securities and to avail third party guarantees and collateral, upon such terms as the directors may deem expedient, to take advances from or by cash credit or current or overdraft accounts with any bank, financial institutions, society, company or organizations, including the directors of the company and/or mortgage, hypothecation, charges, pledge or by the issue of debenture charged upon or any of the company's properties (both present and future) or by such other means as the Directors may in their absolute discretion deem fit.

w. To do such other things as are incidental or conducive in the opinion of the board of Directors to the attainment of the above objects or any of them.

x. To pay all or any costs, charges and expenses preliminary and incidental to the promotion, formation, establishment and registration, of the company.

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

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

IV. LIABILITY

The liability of the members is limited.

V. CAPITAL

The authorized capital of the Company is Rs.10,000,000/- (Rupees: Ten Millions only) divided into 1,000,000 (One Million) shares of Rs.10/- each; with Power to increase and reduce the capital of the Company, and to divide the shares in the capital for the time being into several classes and consolidate or sub-divide the shares and issue shares of higher or lower denomination and to attach thereto respectively such preferential, deferred or special rights, privileges or conditions as may be determined by the company in general meeting and to modify or abrogate any such rights, privileges or conditions in such manner as may be determined by the Company in general meeting, subject however to the provisions of Sections 92 and 108 of the Companies Ordinance, 1984.

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

Names and Addresses of Subscribers	Nationality	Occupation	No. of Shares taken by each Subscriber	*Signature*
Mr. Aftab Adamjee S/o. Gul Muhammad Adamjee(Late) Plot No.79/II, H. Street, Khayaban-e-Rahat, Phase-VI, D.H.A. Karachi (Pakistan) C.N.I.C.# 42301-9633064-7	Pakistani	Business of Power	1 (One)	
Mr. Mohammed Akber Ismail S/o. Mr. Ismail Ahmed Apartment C-5, Dunes Apartments, Clifton, Block-5, Karachi (Pakistan) C.N.I.C.# 42301-1180294-5	Pakistani	Business of Power	1 (One)	
Mr. Habil Ahmed Khan S/o. Mr. Irshad Ahmed Khan House No.324, Street No.49, Sector G-10/3, Islamabad C.N.I.C. # 61101-9543551-1	Pakistani	Business of Power	1 (One)	
		TOTAL	3 (Three)	

Dated this 30th day of March, 2015.

Witness :
Name :National Institutional Facilitation Technologies (Pvt.) Limited

Address :5th floor AWT Plaza I.I. Chundrigar Road, Karachi

Company Registration Office Karachi
Securities and Exchange Commission of Pakistan
SECP

Certified to be True Copy
Joint Registrar of Companies

Serial No.
Name of Company
Brief description of the document
Date of Registration

Joint Registrar of Companies
Companies Registration Office,
Karachi

THE COMPANIES ORDINANCE, 1984
(A PRIVATE COMPANY LIMITED BY SHARES)

ARTICLES OF ASSOCIATION

OF

TRICOM WIND POWER (PVT.) LIMITED

PRELIMINARY

1. The Regulations contained in Table 'A' in the First Schedule to the Companies Ordinance, 1984 shall not apply to the Company except to the extent repeated and contained hereinafter and the following shall be the Articles of Association of the Company.

INTERPRETATION

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

(a) "The Company" means **TRICOM WIND POWER (PVT.) LIMITED**

(b) **"The Ordinance"** means the Companies Ordinance, 1984.

(c) **"Section"** means Section of the Ordinance.

(d) **"The Office"** means the Registered Office for the time being of the Company.

(e) **"The Register"** means the Register of the Members to be kept in pursuance of Section 147 of the Ordinance.

(f) **"The Dividend"** includes bonus.

(g) **"The Articles"** means these Articles as originally framed or as from time to time altered in accordance with law.

(h) **"The Directors"** means the Directors for the time being.

(i) **"The Board"** means Board of Directors of the Company for the time being.

(j) **"Month"** means Calendar month according to English Calendar.

(k) **"Year"** means Calendar year according to English Calendar.

Company Registration Karachi
Securities and Exchange Commission of Pakistan
SECP

(l) "The Seal" means the common seal of the company.

(m) **"Securities"** include shares, Modaraba Certificates, PTC, TFC & Debenture Certificates.

(n) **"Proxy"** includes Attorney duly constituted under Power of Attorney.

(o) **"PTC & TFC"** means Participation Term Certificates and Term Finance Certificates respectively.

(p) "In Writing" and written include printing, lithography, and any other modes of representing or reproducing words in a visible form.

(q) **"Words"** and phrases used herein but not defined shall be assigned the same meaning as given to them in the Ordinance.

PRIVATE COMPANY

3. The Company is a private Company within the meaning of clause (28) of Section 2(1) of the Ordinance and accordingly:

(a) No invitation shall be issued to the public for any share, debenture or debenture stock of the Company.

(b) The number of members of the Company (exclusive of the members in the employment of the Company) shall be limited to fifty, provided that for the purposes of these provisions where two or more persons hold one or more shares jointly in the Company, they shall be treated as single member and;

(c) The right to transfer shares in the Company is restricted in the manner and to the extent hereinafter provided.

SHARES

4. <u>Share Capital:</u> The authorized capital of the Company is Rs.10,000,000/- (Rupees: Ten Millions only) divided into 1,000,000 (One Million) shares of Rs.10/- each; with Power to increase and reduce the capital of the Company, and to divide the shares in the capital for the time being into several classes and consolidate or sub-divide the shares and issue shares of higher or lower denomination and to attach thereto respectively such preferential, deferred or special rights, privileges or conditions as may be determined by the company in general meeting and to modify or abrogate any such rights, privileges or conditions in such manner as may be determined by the Company in general meeting, subject however to the provisions of Sections 92 and 108 of the Companies Ordinance, 1984.

5. **(a) Allotment:** The Shares shall be under the control of the Directors who may allot or otherwise dispose of the same or any of them to such persons, on such terms and conditions and at such times as the Directors think fit and with full power to issue to any person any shares at a premium or at par or subject to the provisions of the Ordinance. While issuing further shares, requirements of Section 86 of the Ordinance shall be observed.

(b) The directors may offer or otherwise allot securities (other than share) of this company to any of the financial institutions or security holders in the form of debentures, P.T.Cs or T.F.Cs or agree to offer or allot as the case may be in conversion or for redemption of such securities issued for the financial consideration provided by such institutions or lenders of monies to the company, at par or otherwise as they think fit keeping in view the circumstances at such time and the directors themselves may receive from members of the company advance on issue of such securities on profit and loss sharing basis or on such other terms as they think fit and with or without a right for conversion into the shares of the company in full or in part.

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

7. **Issue of securities on different conditions:** Shares of different classes may be issued so that the right as between various shares of the same class as to profit, votes and other benefits shall be proportionate to the paid up value of shares and any security may be issued on terms that it is or at the option of the company liable to be redeemed (other than share).

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

9. **Return of Allotment :** The directors shall, as regards any allotment of shares, duly comply with such of the provisions of Section 73, as may be applicable thereto.

10. **(a) Certificates:** Every person whose name is entered as a member in the register of members shall, without payment, be entitled to receive, within ninety days after allotment or within forty-five days of the application for registration of transfer, a certificate under the seal specifying the share or shares held by him and the amount paid up thereon.

Company Registration Office Karachi Securities and Exchange Commission of Pakistan SECP

(b) Every person whose name is entered as a member of Modarba, PTC, TFC, or any other security holder in a register shall be entitled without payment to one certificate for all his shares or securities of each class as the case may be or upon payment of such sum for every certificate after the first as the directors shall determine, to several certificates each for one or more on his securities. Every certificate shall be under the seal of the company and bear mechanically impressed signatures or autographic signatures of any one director or secretary or the person appointed for that purpose and shall specify number and class and distinguishing number (If any) of shares or securities to which it relates and amount paid up thereon.

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

12. **Duplicate Certificate:** If a share certificate is defaced, lost or destroyed, it may be renewed on payment of such fee, if any, not exceeding one rupee, and on such terms, if any, as to evidence and indemnity and payment of expenses incurred by the company in investigating title, as the directors think fit.

TRANSFER OF SHARES

13. **Registration on Transfer:** No transfer of any share shall be made or registered without previous sanction of the majority of Directors who may without assigning reason decline to give any such sanction.

14. **Execution of Transfer:** The instrument of transfer of any share in the company shall be executed both by the transferor and transferee, and the transferor shall be deemed to remain holder of the shares until the name of the transferee is entered in the register of members in respect thereof.

15. **Form of Transfer:** Shares in the company shall be transferred in any usual or common form which the directors shall approve.

TRANSMISSION OF SHARES

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

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SECP

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

18. **Entitlement of Dividend:** A person becoming entitled to a share by reason of death of the holder shall be entitled to the same dividends and other advantages to which he would be entitled if he were the registered holder of the share except that he shall not, before being registered as a member in respect thereto, be entitled in respect thereof to exercise any right conferred by membership in relation to meetings of the company.

ALTERATION OF CAPITAL

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

20. The company may, by ordinary resolution.

    (a) consolidate and divide its share capital into shares of larger amount than its existing shares;

    (b) sub-divide its existing shares or any of them into shares of smaller amount than is fixed by the Memorandum of Association;

    (c) cancel any shares which, at the date of the passing of the resolution in that behalf have not been taken or agreed to be taken by any person and diminish the amount of its share capital by the amount of shares so canalled.

21. **Decrease:** The company may, by special resolution, reduce its share capital in any manner subject to provisions of Section 96 to 106 of the Ordinance.

GENERAL MEETING

22. **Annual General Meeting:** A general meeting, to be called annual general meeting, shall be held in accordance with the provisions of Section 158, within eighteen months from the date of incorporation of the company and thereafter once at least in every calendar year within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding annual general meeting as may be determined by the directors.

Company Registration Office Karachi SECP Securities and Exchange Commission of Pakistan

23. **Extra Ordinary General Meeting:** All general meetings of a company other than an annual general meeting shall be called extraordinary general meetings.

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

NOTICE AND PROCEEDINGS OF GENERAL MEETINGS

25. **Notice:** Twenty-one days' notice at the least (exclusive of the day on which the notice is served or deemed to be served, but inclusive of the day for which notice is given) specifying the place, the day and the hour of meeting and, in case of special business the general nature of that business, shall be given in manner provided by the Ordinance for the general meeting, to such person as are under the Ordinance or the regulations of the company, entitled to receive such notice from the company but the accidental omission to give notice to, or the non-receipt of notice by any member shall not invalidate the proceedings at any general meeting.

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

27. **Quorum:** No business shall be transacted at any general meeting unless a quorum of members is present at the time when the meeting proceeds to business. Three members personally present having twenty-five percent of the total voting power either of their account or as proxies shall be a quorum.

28. **Adjourned Meeting:** If within half an hour from the time appointed for the meeting a quorum is not present, the meeting, if called upon the requisition of members, shall be dissolved; in any other case, it shall stand adjourned to the same day in the next week at the same time and place, and, if at the adjourned meeting a quorum is not present within half an hour from the time appointed for the meeting, the members present, being not less than two, shall be a quorum.

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

30. **Power to Adjourn General Meeting:** The chairman may, with the consent of any meeting, at which quorum is present (and shall if so directed by the meeting), adjourn the meeting from time to time but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place. When a meeting is adjourned for ten days or more, notice of the adjourned meting shall be given as in the case of an original meeting. Save as aforesaid, it shall not be necessary to give any notice of an adjournment or of the business to be transacted at an adjourned meeting.

31. **Adoption of Resolution:** At any general meeting a resolution put to the vote of the meeting shall be decided on a show of hands unless poll is (before or on the declaration of the result of the show of hands) demanded. Unless a poll is so demanded, a declaration by the chairman that a resolution has, on a show of hands, been carried, or carried unanimously or by a particular majority, or lost, and an entry to that effect in the minute book of the company shall be conclusive evidence of the fact, without proof of the number or proportion of the votes recorded in favour of, or against that resolution.

32. **Poll:** A poll may be demanded only in accordance with the provisions of Section 167.

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

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

VOTES OF MEMBERS

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

36. **Vote for Joint-holders:** In case of joint-holders, the vote of the senior who tenders a vote whether in person or by proxy, shall be accepted to the exclusion of the votes of the other joint-holders; and for this purpose seniority shall be determined by the order in which the names stand in the register of members.

37. **Proxy:** On a poll votes may be given either personally or by proxy; Provided that no body corporate shall vote by proxy as long as a resolution of its directors in accordance with the provisions of section 162 is in force.

38. **Instrument of Proxy:** The instrument appointing a proxy shall be in writing under the hand of the appointer or of his attorney duly authorized in writing. A proxy must be a member.

39. **Deposit of instrument of proxy:** The instrument appointing a proxy and the power-of-attorney or other authority (if any) under which it is signed, or a notary certified copy of that power of authority, shall be deposited at the registered office of the company not less than forty-eight hours before the time for holding the meeting at which the person named in the instrument proposes to vote and in default the instrument of proxy shall not be treated as valid.

40. **Form of Proxy:** An instrument appointing a proxy may be in any usual or common form or as near thereto as may be which the directors shall approve.

DIRECTORS

41. **Number of Directors:** The number of Directors shall not be less than two. The Company may from time to time in annual general meeting vary the number of directors.

42. **First Directors:** The first Directors of the Company are:

1. Mr. Aftab Adamjee
2. Mr. Mohammed Akber Ismail
3. Mr. Habil Ahmed Khan

43. **Share Qualification of Directors:** The directors shall not be required to hold any qualification shares except that they should be members.

44. **Chief Executive:** The Directors shall appoint Chief Executive in accordance with provisions of Sections 198 and 199.

45. **Term of office casual vacancy and eligibility for re-election:** The Directors shall be elected in accordance with Section 178. A director elected under section 178 shall hold office for a period of three years unless he resigns earlier, becomes disqualified from being a Director or otherwise ceases to hold office. The retiring Directors shall be eligible for re-election. A casual vacancy on the Board of Directors may be filled up by the continuing Directors but the person so appointed shall hold office for the remainder of the term of the Director whom he replaces.

46. **Remuneration of Directors:** The remuneration of Directors shall from time to time be determined by the Company in general meeting subject to the provisions of the Ordinance but, however, each director, excepting the full time Chief Executive and the salaried Directors who are in the service of the Company, shall be paid a sum not exceeding Rupees five hundred as fee for attending Board meetings and also any reasonable expenses that may be incurred for coming to the place of meeting to attend if he happens to reside elsewhere. If any Director shall be called upon to perform any extra service or to make special exertion

reside out of Pakistan for any purpose of the Company or give special attention to the business of the company, the Company may remunerate the Director for so doing either by fixed sum or by percentage of profit or otherwise as may be determined by the shareholders in the general meeting.

47. **Alternate Directors:** A Director who is about to leave or is absent from Pakistan may with the approval of the Directors appoint any person to be an alternate Director during his absence from the country provided such absence shall not be less than a period of three months and such appointment shall have effect and such appointee whilst he holds office as an alternate Director, shall be entitled to notice of the meetings of the Directors and to attend and vote there at accordingly but shall ipso facto vacate office when his appointer returns to the country or office. Any appointment or removal under this Article shall be effected by notice in writing under the hand of Director making the same.

48. **Ineligibility:** No person shall become director of the Company if he suffers from any of the disabilities or disqualifications mentioned in Sections 187 and 188 and if already a director, shall case to hold such office from the date he becomes disqualified or disabled.

49. A Director shall not vacate his office by reason only of his being member of any company which has entered in to contract with, or done any work for the company of which he is director but such director shall not vote in respect of any such contract or work, and if he does so vote, his vote shall not be counted.

POWERS AND DUTIES OF DIRECTORS

50. **Management of business:** The business of the company shall be managed by the directors, who may pay all expenses incurred in promoting and registering the company, and may exercise all such powers of the company as are not by the Ordinance or any statutory modification thereof for the time being in force, or by these regulations, required to be exercised by the company in general meeting subject nevertheless to the provisions of the Ordinance or to any of these regulations, and such regulations being not inconsistent with the aforesaid provisions as may be prescribed by the company in general meeting shall not invalidate any prior act of the directors which would have been valid if that regulation had not been made.

51. **Directors have power to borrow, and give security:** The Directors may from time to time at their discretion borrow or secure the payment of any sums of money for the purposes of the Company.

52. **Power to issue securities: (a)** The Directors may borrow and secure the payment or repayment of such sum or sums in such manner and on such terms and conditions in all respects and manner as they may think fit, and in particular, by the issue of bonds, perpetual or redeemable debentures or debenture stock, Participation term Certificates, Term Finance Certificates or any mortgage or charge or other security of or on the undertaking of the whole or any part of the property of the Company (both present and future), any such mortgage may

Company Registration Office Karachi Securities and Exchange Commission of Pakistan SECP contain a power of sale and such other powers, as the Board of Directors may think fit.

(b) Register of Mortgages: The directors shall cause proper register to be kept in accordance with section 125 of the Ordinance of all mortgages and charges specifically affecting property of the company and shall comply with requirements of sections 121 and 122 of the Ordinance in regard to registration of mortgages and charges therein specified and requirement of section 130 of the Ordinance as to keeping a copy of every instrument creating mortgage or charge at the office and requirements of section 132 as to giving intimation of payment of satisfaction of charge or mortgage created by the company.

(c) Register of PTCs , TFCs and Debentures: Registers of holders of PTCs TFCs and debentures may be closed for any period not exceeding in whole thirty days in any year, subject as aforesaid every such register shall be open to inspection of registered holders of PTCs, TFCs and debentures and of any member but the company may impose any reasonable restrictions.

(d) Instrument of Transfer of PTCs, TFCs and Debentures: Subject to provisions of section 76 of the Ordinance, no transfer of PTCs, TFCs and debentures shall be registered unless a proper instrument of transfer duly stamped and executed by transferor and transferee has been delivered to the company together with certificates of concerned securities.

(e) Notice of refusal to Register Transfer: If the directors refuse to register transfer of PTCs, TFCs and debentures, they shall within thirty days from the date on which instrument of transfer was lodged with the company send to the transferee and transferor a notice showing the reason of refusal as required under section 78.

(f) Inspection of copies of Register of PTCs, TFCs and Debenture holders etc: The company shall comply with provisions of section 130 and allow inspection of register of PTCs, TFCs or debenture holders in pursuance of section 136 of the Ordinance. The company shall supply copies of register of PTCs, TFCs and debenture holders or Trust Deed for securing issue of PTCs, TFCs and holders of PTCs, TFCs and debenture shall have the same right to receive and inspect balance sheets and profit and loss accounts of the company and reports of Auditors and other reports as are possessed by holders of ordinary shares in the company.

53. **Vacation of Office:** A director shall ipso facto cease to hold office if:-

(a) he becomes ineligible to be appointed on any one or more of the grounds enumerated in Section 187 of the Ordinance.

(b) he absents himself from three consecutive meetings of directors or from all the meetings of the directors or for a continuous period of three months, whichever is the longer, without leave of ~~absence from~~ the directors;

54. **Removal:** The Company may be resolution in general meeting remove a director appointed under Section 176 or section 180 or elected in the manner provided for in section 178 of the Ordinance, 1984; Provided always that a resolution for removing a director shall not be deemed to have been passed if the number of votes cast against it is equal to, or exceeds-

(i) the minimum number of votes that were cast for the election of a director at the immediately preceding election of directors, if the resolution relates to removal of a director elected in the manner provided in sub-section (5) of section 178; or

(ii) the total number of votes for the time being computed in the manner laid down in sub-section (5) of section 178 divided by the number of directors for the time being: if the resolution relates to removal of a director appointed under section 176 or section 180.

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

56. **Minutes to be made of meeting:** The directors shall cause minutes to be made in books provided for the purposes:-

(a) of the names of the directors present at each meeting of the directors and of any committee of the directors;

(b) of all resolutions and proceedings at all meetings of the company and of the directors and of committees of directors;

And every director present at any meeting of directors or committee of directors shall sign his name in a book to be kept for that purpose.

PROCEEDINGS OF DIRECTORS

57. **Meeting of Directors:** The directors may meet together for the dispatch of business, adjourn and otherwise regulate their meetings, as they think fit. Questions arising at any meeting shall be decided by a majority of votes. In case of any equality of votes, the chairman shall have and exercise a second or casting vote. A director may, and the secretary on the requisition of a director shall, at any time, summon a meeting of directors. It shall not be necessary to give notice of a meeting of directors to any director for the time being away from Pakistan. The quorum for Directors' meetings shall be fixed by the Directors and unless so fixed shall be three.

58. Chairman: Mr. Aftab Adamjee shall be the first Chairman of Board of Directors and shall preside over all meetings of Board of Directors. If at any meeting he is not present within fifteen minutes after time appointed for the meeting or is unwilling to act as chairman, any one of the directors present may be elected to be chairman, and if none of the directors is present, or willing to act as chairman, the members present shall choose one of their number to be chairman.

59. Delegation of Power: The directors may delegate any of their powers not required to be exercised in their meeting to committees consisting of such number of Directors as may be determined and such committees shall, in the exercise of the powers so delegated, conform to any restrictions that may be imposed on them by the directors.

60. Acts of Director valid inspite of defective appointment: All acts done by any meeting of the directors or of a committee of directors, or by any person acting as a director, shall notwithstanding that it be afterwards discovered that there was some defect in the appointment of any such directors or persons acting as aforesaid, or that they or any of them were disqualified, be as valid as if every such person had been duly appointed and was qualified to be a director.

61. Resolution by Circulation: A resolution in writing signed by all the directors for the time being present in Pakistan and entitled to receive notice of a meeting of the directors shall be as valid and effectual as if it had been passed at a meeting of the directors duly convened and held subject to provisions of section 196.

THE SEAL

62. Common Seal: The Directors shall provide common seal for the purposes of the Company, and shall have power from time to time to destroy the same and substitute a new seal in lieu thereof and they shall also provide for the safe custody of the seal and the seal shall never be affixed except by the authority of Chief Executive or the Board of Directors previously given. And every deed or other instrument to which the seal of the Company is required to be affixed shall be sealed in the presence of and be signed by two Directors.

DIVIDENDS AND RESERVE

63. Declaration of Dividend: The company in general meeting may declare dividends but no dividend shall exceed the amount recommended by the directors.

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

65. Dividend out of Profit only: No dividends shall be paid otherwise than out of profit of the year or any other undistributed profits.

66. Dividend in proportion to amount paid: Subject to the rights of persons (if any) entitled to share with special or restricted rights as to dividends, all dividends shall be \declared and paid according to the amounts paid up on the shares

67. **Capitalization:** A General Meeting may direct Capitalization of the whole or any part of the undivided profits for the time being of the Company or the whole or any part of the Reserve Fund or Funds of the Company, by the distribution among the Members or any of them in accordance with their respective rights and interest\s and in proportion to the amounts paid or credited as paid thereon, of paid-up shares, debentures, or debenture stock, bonds, or other obligations of the Company, and the Directors shall give effect to such resolution and apply such portion of the profits or Reserve Funds as may be required for the purpose of making payment in full at par for the shares, debentures, or debenture stock, bonds or other obligations of the Company so distributed, provided that no such distribution or payment shall be made unless recommended by the Board. Where any difficulty arises in respect of such distribution or payment the Board may settle the same as they think expedient, and in particular they may issue fractional certificates and generally may make such arrangements for the acceptance, allotment and sale of such shares, debentures, debenture stocks, bonds or other obligations and fractional certificates, or otherwise, as they may think fit, and may make cash payments to any Member on the footing of the value so fixed in order to adjust rights, and may vest any shares, debenture, debenture stock, bonds or other obligations in trustees, upon such trusts for adjusting such rights as may seem expedient to the Board. When deemed requisite a proper contract shall be filed in accordance with the Ordinance and the Board may appoint any person to sign such contract on behalf of the Members holding the shares of the Company which shall have been issued prior to such capitalization and such appointment shall be effective.

68. **Dividend in Specie:** Any general meeting declaring a dividend may resolve that such dividend be paid wholly or in part by the distribution of specific assets and in particular, of paid up shares, debentures or debenture stock of the Company or in one or more of such ways.

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

70. **Retention of Profit:** The directors may carry forward any profits which they may think prudent not to distribute, without setting them aside as a reserve.

71. **Dividend to Joint-holder:** If several persons are registered as joint-holders of any shares, any one of them may give effectual receipt for any dividend payable on the share.

72. **Time of payment:** The dividend shall be paid within the period laid down in the Ordinance.

ACCOUNTS

73. **Books of account:** The directors shall cause to be kept proper books of account as required under section 230.

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

75. **Inspection by Members:** The directors shall from time to time determine whether and to what extent and at what time and place and under what conditions or regulations, the accounts and books or papers of the company or any of them shall be open to the inspection of members not being directors and no member (not being a director) shall have any right of inspecting any account and books or papers of the company except as permitted by law or authorized by the directors or by the company in general meeting.

76. **Balance sheet profit and loss accounts to be laid at Annual General Meeting:** The directors shall as required by section 233 and 236 cause to be prepared and lay before the company in general meeting such profit and loss accounts and balance sheets duly audited by a firm of chartered accountants. A balance sheet, profit and loss account, and other reports referred to in Article 77 shall be made out every year and laid before the company at the Annual General Meeting made up to a date not more than four months before such meeting. The balance sheet and profit and loss account shall be accompanied by a report of the auditors of the company and the report of directors.

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

78. **Directors to Comply with provisions of Ordinance:** The directors shall in all respect comply with the provisions of sections 230 to 236.

AUDIT

79. **Annual Audit:** Once at least in every year the accounts of the Company shall be examined and the correctness of the balance sheet and profit and loss account ascertained by one or more Auditor or Auditors.

80. **Appointment and Qualification of Auditors:** The first Auditors shall be appointed by the Board of Directors and thereafter by members at the Annual General Meeting every year to hold office until the next Annual Meeting in the following year and the following provision shall have effect:-

(a) A director or Officer of the Company shall not be appointed Auditor of the Company.

(b) A person other than the retiring auditor shall not be appointed Auditor at an Annual General Meeting unless notice of an intention to nominate that person to the office of auditor has been given by members to the Board not less than fourteen days before the annual general meeting and the Board shall send a copy of such notice to the retiring Auditor and shall give notice thereof to the members not less than seven days before the meeting.

(c) The Directors may fill any casual vacancy in the office of the Auditor, but while any such vacancy continues the surviving or continuing Auditor or Auditors, if any, may act.

81. **Remuneration of Auditors:** The remuneration of the Auditors shall be fixed by the Company in the General Meeting except the remuneration of Auditors appointed to fill any casual vacancy, which may be fixed by the Director.

NOTICES

82. **How notice to be served to members:** A notice may be given by the company to any member either personally or sending it by post to him to his registered address or (if he has no registered address in Pakistan) to address, if any, within Pakistan supplied by him to the company for the giving of notice to him. Where a notice is sent by post, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting a letter containing the notice and, unless the contrary is proved, it shall be deemed to have been effected at the time at which the letter would be delivered in the ordinary course of post.

83. **Notice to Joint holder:** A notice may be given by the company to the joint-holders of a share by giving the notice to the joint-holder named first in the register in respect of the share.

84. **Notice to person entitled to transmission:** A notice may be given by the company to the person entitled to a share in consequence of the death of a member by sending it through post in a prepaid letter addressed to him by name, or by title of representatives to the deceased at the address (if any) in Pakistan supplied for the purpose by the person claiming to be so entitled, or (until such an address has been so supplied) by giving the notice in any manner in which the same might have been given if the death had not occurred.

85. Notice of General Meeting: Notice of every general meeting shall be given in the same manner herein before laid down.

(a) to every member of the company except those members who, having no registered address within Pakistan, or have not supplied to the company an address within Pakistan, for the giving of notices to them, and also to:-

(b) to every person entitled to a share in consequence of the death of a member, who but for his death would be entitled to receive notice of the meeting, and

(c) to the auditors of the company for the time being.

Company Registration Office Karachi
Securities and Exchange Commission of Pakistan
SECP

WINDING UP

86. **Distribution of Assets:** If the Company shall be wound up, the surplus assets shall be applied first in repayment of the Capital of the Company paid upon the Ordinary shares and the excess, if any, shall be distributed among the members holding ordinary shares in proportion to the number of ordinary shares held by them respectively at the commencement of the winding up. If shares of different classes have been issued then surplus would be distributed in accordance with the rights of each class of shares.

87. **Division of assets in Specie:** If the company is wound up, the liquidator may, with the sanction of a special resolution of the company and any other sanction required by the Ordinance, divide amongst the members, in specie or kind, the whole or any of the assets of the company, whether they consist of property of the same kind or not.

88. **Valuation by liquidator:** For the purpose aforesaid,. The liquidator may set such value as he deems fair upon any property to be divided as aforesaid and may determine how such division shall be carried out as between the members or different classes of members.

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

INDEMNITY

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

ARBITRATION

91. **Differences to be referred to Arbitrator(s):** Whenever any difference arises between the company on the one hand and any of the members, their executors, administrators or assigns on the other hand, touching the true intent or construction, or the incident or consequences of these Articles or of the statutes, or touching anything thereto or thereafter done, executed, omitted or suffered in pursuance of these Articles or of the statutes or touching any breach or alleged breach of these Articles, or any claim on account of any such breach or alleged breach, or otherwise relating to the premises, or to these Articles or to any statute affecting the Company or to any of the affairs of the Company, every such difference shall, as a condition precedent to any other action at law be referred to,

in conformity with the Arbitration Act, 1940, or any statutory modification and substitution thereof and any rules made there under, to the decision of an arbitrator to be appointed by the parties in difference or if they cannot agree upon a single arbitrator to the decision of two arbitrators of whom one shall be appointed by each of the parties in difference, or in the event of the two arbitrators not agreeing, then to an umpire to be appointed by the two arbitrators, in writing, before proceeding on the reference, and such decision shall be final and biding on the parties.

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

Names and Addresses of Subscribers	Nationality	Occupation	No. of Shares taken by each Subscriber	*Signature*
Mr. Aftab Adamjee S/o. Gul Muhammad Adamjee(Late) Plot No.79/II, H. Street, Khayaban-e-Rahat, Phase-VI, D.H.A. Karachi (Pakistan) C.N.I.C.# 42301-9633064-7	Pakistani	Business of Power	1 (One)	
Mr. Mohammed Akber Ismail S/o. Mr. Ismail Ahmed Apartment C-5, Dunes Apartments, Clifton, Block-5, Karachi (Pakistan) C.N.I.C.# 42301-1180294-5	Pakistani	Business of Power	1 (One)	
Mr. Habil Ahmed Khan S/o. Mr. Irshad Ahmed Khan House No.324, Street No.49, Sector G-10/3, Islamabad C.N.I.C. # 61101-9543551-1	Pakistani	Business of Power	1 (One)	
		TOTAL	3 (Three)	

Dated this 30th day of March, 2015.

Witness :
Name : **National Institutional Facilitation Technologies (Pvt.) Limited**
Address : 5th floor AWT Plaza I.I. Chundrigar Road, Karachi.

Company Registration Office Karachi
Securities and Exchange Commission of Pakistan
SECP

Certified to be True Copy
23/1/16
Joint Registrar of Companies

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

Names and Addresses of Subscribers	Nationality	Occupation	No. of Shares taken by each Subscriber	*Signature*
Mr. Aftab Adamjee S/o. Gul Muhammad Adamjee(Late) Plot No.79/II, H. Street, Khayaban-e-Rahat, Phase-VI, D.H.A. Karachi (Pakistan) C.N.I.C.# 42301-9633064-7	Pakistani	Business of Power	1 (One)	
Mr. Mohammed Akber Ismail S/o. Mr. Ismail Ahmed Apartment C-5, Dunes Apartments, Clifton, Block-5, Karachi (Pakistan) C.N.I.C.# 42301-1180294-5	Pakistani	Business of Power	1 (One)	
Mr. Habil Ahmed Khan S/o. Mr. Irshad Ahmed Khan House No.324, Street No.49, Sector G-10/3, Islamabad C.N.I.C. # 61101-9543551-1	Pakistani	Business of Power	1 (One)	
		TOTAL	3 (Three)	

Dated this 30th day of March, 2015.

Witness :
Name : **National Institutional Facilitation Technologies (Pvt.) Limited**
Address : 5th floor AWT Plaza I.I. Chundrigar Road, Karachi.

Company Registration Office Karachi • Securities and Exchange Commission of Pakistan • SECP

Certified to be True Copy
Joint Registrar of Companies

FORM 28

[SECTION 184]

CONSENT TO ACT AS DIRECTOR/CHIEF EXECUTIVE

1. Incorporation Number	0092812		
2. Name of the Company	TRICOM WIND POWER (PVT.) LIMITED		
3. Fee Paid (Rs.)	400.00	Name & Branch of the Bank	KARACHI, MCB - KARACHI, MAIN BRANCH [0001]
4. Receipt No.	E-2018-716036	Date (DD/MM/YYYY)	

5. I/We, the undersigned, have consented to act as Director(s), Chief Executive of the above named company pursuant to section 184 of the Companies Ordinance 1984, and certify that I / We am / are not ineligible to become Director(s)/Chief Executive under section 187 or 190 of the Companies Ordinance, 1984.

Name in Full	Father's/Husband's Name	Address	Occupation	NIC No. or Passport No. (In case of foreign national)	Signature
Mr. Jawed Yunus Tabba-Nominee Director of Lucky Energy (Pvt.) Limited	Muhammad Yunus	House No.56/57, Block-A, Adamjee Nagar, Jouhar Road, Karachi		42201-2111104-7	
Mr. Muhammad Sohail Tabba-Nominee Director of Lucky Energy (Pvt.) Limited	Muhammad Yunus Tabba	House No.A/53, Adamjee Nagar, Jouhar Road, Karachi		42000-0568372-5	
Mr. Muhammad Ali Tabba-Nominee Director of Lucky Energy (Pvt.) Limited	Muhammad Razzak Tabba	House No.17/1-A, Mohammed Ali Society, Jouhar Road, Karachi		42201-6464247-3	

6. Signature	
7. Name of Signatory	Mr. Muhammad Amin
8. Designation	Secretary
9. NIC Number	42401-2081970-7
10. Date (DD/MM/YYYY)	17/01/2018

Ph: 021 99206449

NO. DAE/GEN/119/2016
GOVERNMENT OF SINDH
Directorate of Alternative Energy
ENERGY DEPARTMENT
Karachi, dated: December 13, 2017

Say No to Corruption

SUBJECT: **MINUTES OF THE PANEL OF EXPERT COMMITTEE MEETING REGARDING APPROVAL OF FEASIBILITY STUDY FOR DEVELOPMENT OF 50 MW WIND POWER PROJECT BY M/S TRICOM WIND POWER (PVT.) LIMITED (TWPPL)**

The undersign is directed to enclose herewith minutes of the Panel of Expert (PoE) Committee meeting held on October 20, 2017 at 11:30 AM in the committee room of Energy Department, Government of Sindh, Karachi for information and further necessary action.

Encl: As above

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

Distribution:

1. **Secretary,** Finance Department, Govt. of Sindh, Karachi
2. **CEO,** AEDB, OPF Building, Shahrah-e-Jamhuriat, G-5/2, Islamabad.
3. **CEO,** M/s Tricom Wind Power (Pvt.) Limited, Office 301, 3rd Floor, Plot No.41-C, Bukhari Commercial, Lane 9, Phase-VI, DHA, Karachi.
4. PS to Secretary, Energy Department, Govt. of Sindh

Government of Sindh
Directorate of Alternative Energy
ENERGY DEPARTMENT

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Subject: **MINUTES OF MEETING – PANEL OF EXPERTS (POE) MEETING TO REVIEW THE FEASIBILITY STUDY REPORT OF M/S TRICOM WIND POWER (PVT.) LIMITED FOR DEVELOPMENT OF 50 MW WIND POWER PROJECT**

The meeting of Panel of Experts for the proposed 50 MW Wind Power project by M/s Tricom Wind Power (Pvt.) Limited (TWPPL) was held under the chairmanship of Director Alternative Energy, Govt of Sindh/ Chairman Panel of Expert, on 30th November, 2017 at 10:30 hours in the Committee Room of Energy Department, 3rd Floor, State Life Building No.3 Dr. Ziauddin Ahmed Road (opposite CM House) Karachi. The following were the participants of the meeting:

i.	Engr. Mehfooz A. Qazi	Director Alternative Energy (In chair)
ii.	Mr. Irfan Ahmad	Director, The Energy Grid (Co-opted Member)
iii.	Mr. Shahnawaz Farhan Khahro	Deputy Director (Wind)
iv.	Mr. Niaz Ahmed Janjhi	Deputy Director (Solar On Grid)
v.	Mr. Mansoor Mujahid	Representative, M/s Tricom Wind Power (Pvt.) Ltd
vi.	Mr. Rizwan Qureshi	Representative, M/s Tricom Wind Power (Pvt.) Ltd
vii.	Ms. Paras	Internee, NIP, DAE

PROCEEDINGS:

2. The chair welcomed the participants and advised the project sponsors to present the para wise replies of the observations raised and communicated during the last POE meeting. Mr. Rizwan Qureshi, Representative, M/s Tricom Wind Power (Pvt.) Limited and his team of consultants consisting of Renewable Resources (Pvt.) Limited and M/s Bridge Factor (Pvt.) Limited presented the revised feasibility study of the project in the light of observations made during the 1st meeting of Panel of Experts. He informed that the studies have been carried by various consultants for the development of the proposed project site under the supervision of M/s Tricom Wind Power (Pvt.) Limited. He further informed that the project company intended to opt Upfront tariff, but due to non-availability of Upfront tariff they decided to opt the "Cost Plus" tariff for timely development of the Project and urged for timely approval of the feasibility study.

3. The following major technical studies have been conducted and revised as per commens of PoE Committtee;

S. No.	Activity	Name of the Consultant
1.	Technical Feasibility Study	M/s Renewable Resources (Pvt.) Ltd. (RE2 (Pvt.) Ltd)
2.	Transport Access Study	M/s RE2 (Pvt.) Ltd
3.	Initial Environmental Examination (IEE) Study	M/s Welt Konnect (Pvt.) Ltd.
4.	Geotechnical/Soil Investigation Study	M/s Welt Konnect (Pvt.) Ltd.
5.	Topographical Study	M/s Welt Konnect (Pvt.) Ltd.
6.	Wind Resource Assessment	M/s RE2 (Pvt.) Ltd
7.	Grid Interconnection Study	M/s Welt Konnect (Pvt.) Ltd.
8.	Project Financial Study	M/s Bridge Factor

4. Regarding land status, it was informed that the land was identified at Jhimpir Wind Corridor, District Thatta, for development of 50 MW wind power plant. The proposed project site is 17 km away from the nearest 220 KV grid-station of Jhimpir Grid. The land Utilization Department has allocated 347 acres land through Energy Department Government of Sindh on January 14, 2016.

5. Detailed deliberations on Para wise observations were held on all the technical and financial parameters of the projects and Para wise explanations were submitted by the technical consultants on various aspects of the project development. (copy enclosed).

6. Mr. Ali Afzal representative of the project consultant gave a detailed presentation regarding project development based on Gamesa Wind turbines of Model G114-2.0 MW with hub height of 93 meters' and 25 turbines of similar model.

7. Topography and Geotechnical studies were initially conducted and then the other works were commenced on the Environmental and Social Impact Assessment. Two Wind Masts has been installed by the project sponsors to measure wind data to ensure the project efficiency. He further briefed that the wind potential on the project site, average wind speed, and other climatic conditions data for the identified proposed site was collected.

8. Briefing about the project yield estimates, the sponsor informed PoE that, based on the collected information, the energy yield estimation was carried out by the technical team of M/s RE2 (Pvt.) Limited in coordination with international partners M/s Lahmeyer International and the results of the data analysis, the **capacity factor of 38%** has been determined for the financial viability of the project. The Panel of Expert observed that the derived capacity factor is in line with the international benchmarks achieved through various technologies and the risk of non-achievement of the said capacity factor lies with the project developers and not the power purchaser, hence, there is no need of third party validation of the resource confirmation. However, in case at any stage the wind risk is

shifted to the power purchaser, then a third party validation of wind resource will be carried out prior to such a decision in order to safeguard the interests of the power purchaser. As the risk of non –achievement of energy yield proposed by the project sponsor have no any negative impact on national exchequer, as the EPA fully covers the guarantee of yield estimates including LDs. The developer has already carried out its yield assessment through its consultant M/s RE2 (Pvt.) Limited in coordination with international partners M/s Lahmeyer International. The project sponsor has confirmed its due diligence and liability in case of non-achievement of the determined yield while determining the energy estimates in order to assure the reasonability of the tariff.

9. The project sponsor has also affirmed that the plant and machinery of the proposed power plant will be new and unused.

10. The Financial Controller, M/s Tricom Wind Power (Pvt.) Limited presented the main features of Grid Interconnection Study that includes load flow studies, short circuit Analysis and Transient stability. The Grid study has been approved by NTDC and has been submitted to HESCO as per CPPA guidelines.

11. Mr. Khawaja Bilal A. Wahid of Bridge Factor submitted the detailed financial model of the project and the indicative term sheet of the project costs. The PoE had given their comments in the light of benchmark tariff determined by NEPRA as per notification dated 27th January 2017. As per the revised study, based on Debt Equity ratio of 75:25, at mix of 50% Local and 50% foreign financing, the levelized tariff of US cents 7.5054/kwh has been worked out and is recommended for further consideration and subject to final approval by NEPRA.

DECISION:

12. Based on the project studies conducted it was revealed that the project sponsor has completed major milestones of the feasibility study including the following approvals:

a. Approval of Grid Interconnection Study by NTDC
b. Issuance of NOC for IEE by Sindh Environmental Protection Agency.
c. Land allocation by Board of Revenue (BOR), Govt. of Sindh.

13. Therefore, the Panel of Expert (POE) unanimously approved the Feasibility Study of 50 MW Wind Power Project by M/S Tricom Wind Power (Pvt.) Limited and advised the Project Company for further pursual of tariff and Generation License.

14. The meeting ended with a vote of thanks by the chair.

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Director
Alternative Energy

Annexure-XI

POWER EVACUATION CERTIFICATE

Power Evacuation Certificate from NTDCL is attached as Annexure XI

NATIONAL TRANSMISSION & DESPATCH COMPANY

General Manager Power System Planning, NTDC

No.GMPSP/TRP-380/3842 Dated: 03-07-2017

CERTIFICATE

Subject: Approval of System Studies of 50 MW Wind Power Project at Jhimpir, District Thatta, Sindh by M/s Tricom Wind Power (Private) Limited

NTDC hereby accords its approval in respect of System Studies submitted by M/s Tricom Wind Power (Private) Limited in respect of 50 MW Wind Power Project near Jhimpir, District Thatta, Sindh vide letter No. GMPP/CEMP/TRP-380/2535-40 dated 18-05-2017. HESCO has also approved the subject studies. Moreover, NTDC certifies that the power to be generated from 50MW Wind Power Project by M/s Tricom Wind Power (Private) Limited will not have any adverse effect on the National Grid as required under the prevailing Grid Code.

Signature: ____________________

Name: Maqsood Ahmad Qureshi

Designation: General Manager Power System Planning

Annexure-XII

INITIAL ENVIRONMENTAL EXAMINATION (IEE) REPORT AND APPROVAL

Environmental Study and its approval from SEPA are attached as Annexure XII.

Reference No: EPA/2016/04/12/IEE/65

ENVIRONMENTAL PROTECTION AGENCY

GOVERNMENT OF SINDH

Plot # ST-2/1, Sector 23, KIA, Karachi-74900
Ph: 5065950, 5065598, 5065637
5065532, 5065946, 5065621
epasindh@cyber.net.pk
Facsimile: 5065940

Dated: 05th September, 2016

SUBJECT: DECISION ON INITIAL ENVIRONMENTAL EXAMINATION (IEE)

1.	**Name & Address of Proponent:**	Managing Director, Tricom Wind Power (Pvt) Limited Office 8, Ground Floor, Evacuee Trust Complex, F-5/1, Islamabad.
2.	**Description of Project:**	Establishment of 50 MW Tricom Wind Power Project
3.	**Location of Project:**	Project site is located in Jhimpir about 80 km Northeast of Karachi.
4.	**Date of Filing of IEE:**	05-03-2016

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

i) All mitigation measures recommended in IEE report should be complied with, for achieving negligible impacts on physical, biological, environmental and socio-economic resources of the area. Sindh Environmental Quality Standards (SEQS) shall be followed in letter and spirit.

ii) A complete code of Health, Safety and Environment (HSE) shall be developed which should include efficient parameters at specific work place. For this purpose HSE setup should be established and supervised by a designated HSE officer at the senior level with sufficient administrative and technical authority to perform the designated functions. Proponent will make sure that the operating instructions and emergency actions are made available to every worker/labor at the site.

iii) The proponent shall be under obligation to compensate for any significant adverse short term, long term and irreversible impact occurred due to wind farm operations. During the project execution, safe distances of the under mentioned environmental sensitivities will be maintained:

- 500m from communities, industries and main transport network
- 300m from community water well
- 500m from archaeological / cultural site / monument
- Distance will be measured from the tip blade of last panel installed in the array or / and transmission power lines associated.
- Project activity will not be carried out within buffer zone of any projected area designated under Sindh wildlife protection act.

Always Remember--- Reuse, Reduce & Recycle

iv) Employment should be provided to local people and assured for unskilled jobs. Skilled jobs shall be given to locals after providing them proper field training, where a minimum training is required. Local people should be informed and explained well in advance about the operation. Compensation should be provided to inhabitants in case of loss of agriculture land, crop property, etc.. in accordance with the rates, that are agreed upon. All conflicting issues regarding compensation etc. should be settled in advance prior to the start of activity. Benefits to local people will be offered under Corporate Social Responsibility (CSR) policy, community development schemes will be decided in consultation with local communities and may be facilitated by involving district / local Government office.

v) Local people should be provided with community welfare schemes i.e., draught relief programmes, educational programmes, and establishment of health units, veterinary/live stock care unit etc., which should benefit them and develop mutual trust. Sustainability of these facilities should be ensured.

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

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

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

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

x) Compensation will be provided to the inhabitants in case of loss of agriculture land, crop property, etc., in accordance with the rates, that are agreed upon.

xi) The proponent shall be liable to submit quarterly environmental monitoring reports to EPA Sindh.

6. This approval shall be treated cancelled if any of the conditions, mentioned in para-5 above is violated. In follow up of the cancellation of this approval prosecution under the provision of Sindh Environmental Protection Act, 2014 will be initiated against the proponent.

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

8. The IEE report is meant only for proposed activities described in IEE only. Proponent should submit separate approval required under regulations, along with site specific Environment Management Plan for any consequent and subsequent activity for approval of EPA, Sindh.

Muhammad Imran Sabir
Deputy Director (Technical)

TRICOM WIND POWER PROJECT

Information

for

Schedule-I

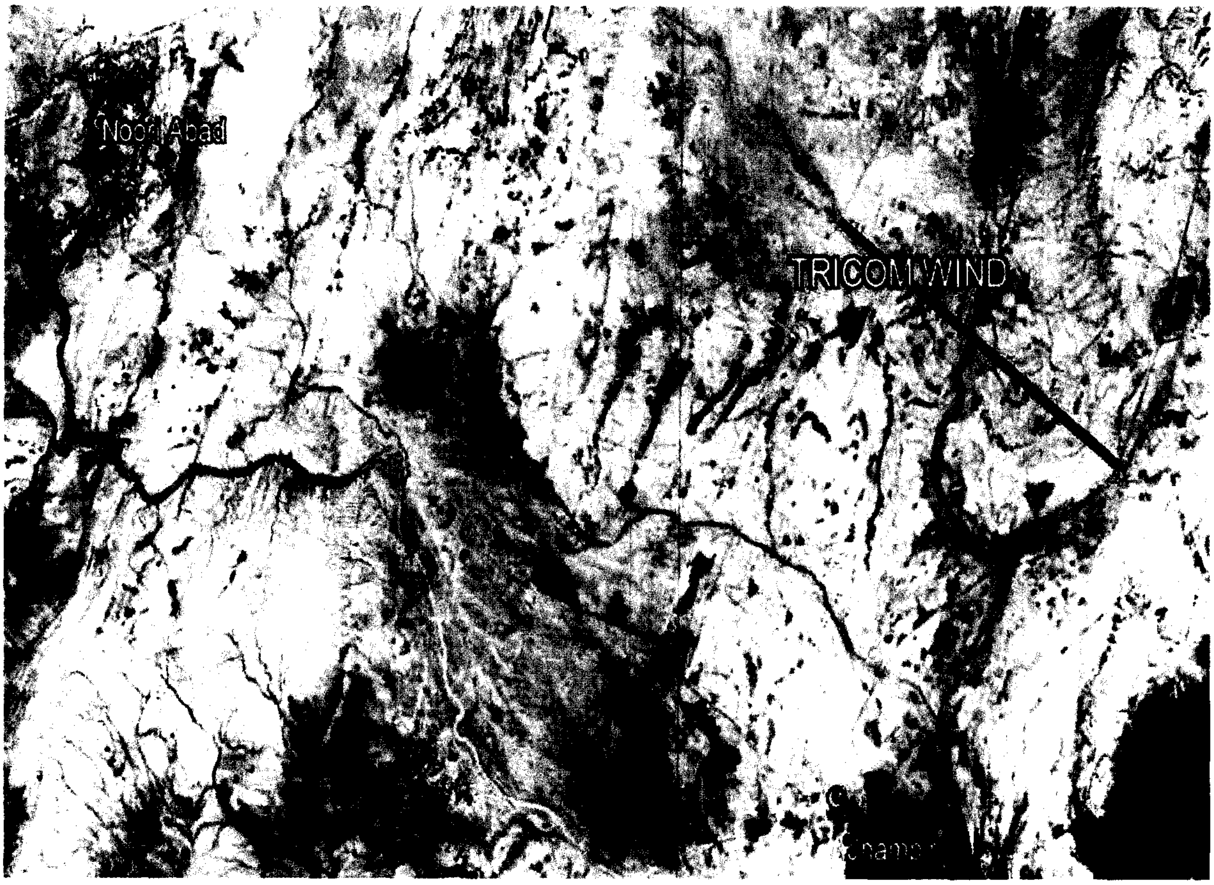
Plant Location

Coordinates

Node	Longitude (East)	Latitude (North)
1	68° 0'52.73"E	25° 8'35.76"N
2	68° 0'50.19"E	25° 8'32.16"N
3	68° 5'41.07"E	25° 5'33.57"N
4	68° 5'44.10"E	25° 5'37.59"N

Location Map

Satellite Map



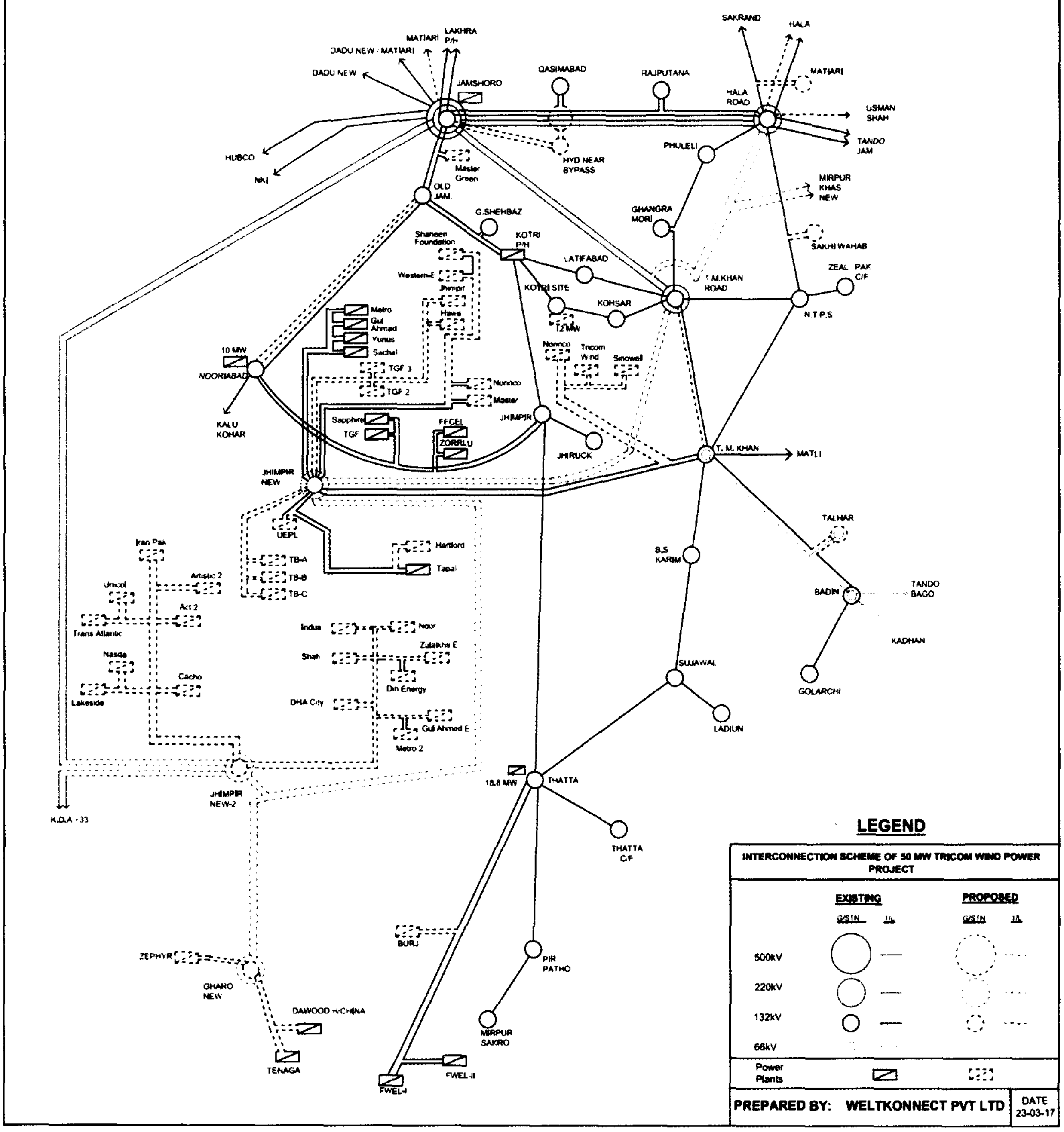
<u>**Micrositing of WTGs**</u>

Plant Single Line Diagram

INTERCONNECTION

ARRANGEMENT FOR DISPERSAL OF POWER FROM THE WIND FARM

INTERCONNECTION SCHEME FOR POWER EVACUATION OF 50 MW TRICOM WIND POWER PROJECT



Wind Farm Details

(A). General Information

(i).	Name of Applicant/Company	TRICOM WIND POWER (PVT) LIMITED
(ii).	Registered/Business Office	7-A, Tabba Street Muhammad Ali Society Karachi
(iii).	Plant Location	Jhimpir, District Thatta, Sindh.
(iv).	Type of Generation Facility	Wind Power

B. Wind Farm Capacity & Configuration

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

C. Wind Turbine Details

(a).	**Rotor**	
(i).	Number of blades	3
(ii).	Rotor diameter	114 m
(iii).	Swept area	10,207 m^2
(iv)	Wind speed in operation (rpm)	13.07
(b).	**Blades**	
(i).	Blade length	56 m
(ii)	Weight	13 tons
(c).	**Gearbox**	
(i).	Type	1 stage planetary / 2 parallel
(d).	**Generator**	
(i).	Power	2,070 kW (rotor + stator)
(ii).	Voltage	690 V
(iii).	Type	Doubly-fed with coil rotor and slip rings
(iv).	Enclosure class	IP 54
(v).	Coupling	Flexible coupling
(vi).	Power factor	+0.95 to -0.95
(e).	**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

(f).	**Brake**	
(i).	Type	Disc Brakes
(g).	**Tower**	
(i).	Type	Conical barrel tube
(ii).	Hub heights	93.0 m
(iii)	Material	Structural carbon steel

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

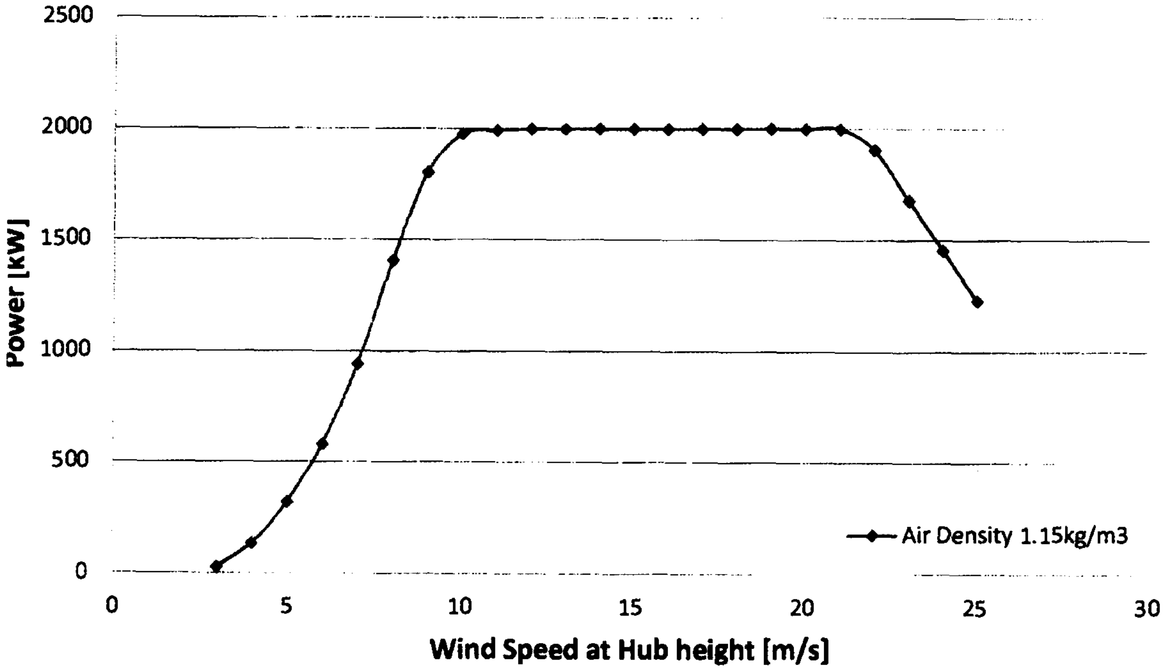
Power Curve

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

[redacted]

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

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



SCHEDULE-II

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

SCHEDULE-II

(1).	Total Installed Gross ISO Capacity of the Generation Facility /Wind Power Plant/Wind Farm (MW/GWh)	50.00 MW
(2).	Total Annual Full Load Hours	3328 Hrs
(3).	Average Wind Turbine Generator (WTG) Availability	95%
(4).	Total Gross Generation of the Generation Facility/Wind Farm (in GWh)	204.5 GWh
(5).	Array & Miscellaneous Losses GWh	21.6 GWh
(6).	Availability Losses GWh	9.65 GWh
(7).	Balance of Plant Losses GWh	6.75 GWh
(8)	Annual Energy Generation (20 year equivalent Net AEP) GWh	166.44 GWh
(9).	Net Capacity Factor	38 %

Note

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

LAHMEYER INTERNATIONAL

Oct, 2017

APPROVAL SHEET

TITLE	:	Feasibility Study Report for 50 MW Wind Power Project in Jhimpir-Sindh, Pakistan
DOCUMENT NUMBER	:	RE2-141-207-001 Issue: 01
CLASSIFICATION	:	**CONTROLLED**

SYNOPSIS

This document is a feasibility study report of 50MW Wind Power Project sponsored by Yunus Brothers Group & Adamjee Group. It contains the hardware specifications, electrical interface, civil works design and project cost. It also includes environmental impact assessment, soil investigations, site topography, grid interconnection studies and project management information. This report is prepared by Renewable Resources (Pvt.) Ltd, Pakistan.

DATE : Oct, 17

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LIST OF ABBREVIATIONS

AC	Alternate Current
AEDB	Alternative Energy Development Board
C.R	Core Recovery
CDM	Clean Development Mechanism
CFCs	Chlorofluoro Carbons
CH_4	Methane
Cm	Centimeter
CMA	Certified Management Accountant
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
CoP	Conference of the Parties
CPPA	Central Power Purchasing Agency
DC	Direct Current
DGPS	Dual Global Positioning System
DISCOs	Distribution Companies
EE	Energy Efficiency
EMC	Electromagnetic Compatibility
EMP	Environment Management Plan
EPA	Energy Purchase Agreement

EPC	Engineering Procurement Construction
EU	European Union
GDP	Gross Domestic Product
GENCOs	Generation Companies
GHG	Green House Gas
GIS	Geographic Information System
GoP	Government of Pakistan
GPS	Global Positioning System
GW	Gold Wind
HAWT	Horizontal Axis Wind Turbine
HESCO	Hyderabad Electric Supply Corporation
DAE, ED, GoS	Directorate of Alternative Energy, Energy Department, GoS
Hz	Hertz
IEE	Initial Environmental Examination
IPPs	Independent Power Producers
JI	Joint Implementation
Km	Kilometer
kV	Kilovolt
KW	Kilowatt
LNG	Liquefied Natural Gas
LOI	Letter of Intent

LPG	Liquefied Petroleum Gas
LOS	Letter of Support
LUC	Local Control Unit
m^2	Meter square
m^3/h	Meter cube per hour
MTDF	Medium Term Development Framework
MVA	Million Volt-Ampere
MW	Megawatt
N_2O	Nitrous Oxide
NCS	National Conservation Strategy
NEPRA	National Electricity Power Regulatory Authority
NEQS	National Environmental Quality Standards
NOCs	No Objection Certificates
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Dispatch Company
O & M	Operation & Management
OECD	Organization for Economic Cooperation and Development
OHL	Overhead Lines
OLTC	On-Load Tap Changer
PAEC	Pakistan Atomic Energy Commission
PCM	Pulse Code Modulation

PEPA	Pakistan Environment Protection Act
PLC	Programmable Logic Control
PMD	Pakistan Meteorological Department
PPIB	Private Power Infrastructure Board
PVC	Poly Vinyl Carbonate
QC	Quality Control
R & D	Research and Development
RE	Renewable Energy
RE2	Renewable Resources (Pvt.) Ltd
RQD	Rock Quality Designation
SF6	Sulfur Hexafluoride
SPT	Standard Penetration Test
UPS	Uninterruptible Power Supply
USA	United States of America
WAPDA	Water and Power Development Authority
WMO	World Metrological Organization
WTG	Wind Turbine Generator

ACKNOWLEDGEMENTS

The management of Tricom Wind Power (Pvt.) Ltd is thankful to Ministry of Water and Power and the dedicated team of Directorate of Alternative Energy, Energy Department, GoS for generous support at all stages of project development and looks forward for their continued support.

The management of Tricom Wind Power (Pvt.) Ltd also recognizes the kind cooperation of concerned Government departments (NEPRA, NTDC, and HESCO).

DISCLAIMERS

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

COMPANY CONTACT INFORMATION

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Email	irfanmirza@renewableresources.com.pk

DOCUMENT INFORMATION

Purpose and Scope:

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

1 EXECUTIVE SUMMARY

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

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

At present, fifteen (15) Wind power projects of approx. 730 MW are in operation. A total of nine 09 projects (all of 50 MW each) have achieved financial close and are under construction.

Tricom Wind Power (Pvt.) Ltd is sponsored by Yunus Brothers Group and Adam Gee Group, two leading business groups from Pakistan, are developing a Wind Power Project of 50 MW capacity in Jhimpir, Sindh, Pakistan. Renewable Resources (Pvt.) Limited (RE2) is the consultant for Tricom Wind Power (Pvt.) Ltd for developing this project. The project is being developed as Independent Power Producer on BOO (Build Own Operate) mode. The project is expected to achieve 38% capacity factor with 25 WTGs of 2,000 kW each.

The Sponsors have a valid LOI from Energy Department, Government of Sindh ("EDGOS") and has been allotted 347 acres of land in Jhimpir for which the GOS has already issued a land allotment letter.

As part of the project development, Tricom Wind Power (Pvt.) Ltd., has, in addition to legal and commercial, performed the technical tasks including geo-technical and topographic surveys at site, installation and wind data collection through an on-site met mast, the feasibility of transportation to the site, Initial Environment Examination (IEE) and the grid interconnection study.

The geotechnical analysis performed has deemed the site suitable for installation of wind turbines using raft foundations, while the topographic survey has not found any geographical features disturbing the wind, or presenting any obstruction to the installation of wind turbines and the construction of the auxiliary facilities. The energy yield has been evaluated using representative data, correlated with long term data from bankable sources including neighboring masts, regional weather stations and satellites. Based on this, the energy yield assessment shows the project can achieve 38% capacity factor using 25 Gamesa 2.0 MW Wind turbines. This analysis has modeled the entire Jhimpir region including the topography and the neighboring project, both in operation and planned, for the determination of accurate wake losses. The grid interconnection study has proposed the interconnection of the project through the Jhimpir-2 substation. This study has been approved by NTDC. The project, as communicated under the approval by NTDC, is required to comply with all the requirements of Grid Code Addendum – 1. The IEE has also completed and approved by the Sindh Environment Protection Agency (SEPA). This analysis has been performed in consideration with the requirements of the National Environment Quality Standards (NEQS) and international environmental protection guidelines by International lenders including the World Bank Group and Asian Development Bank.

In parallel to the approval of the feasibility, the Project Company is reviewing different financing options in line with the requirements of NEPRA. Following approval of this feasibility, the Project Company plans to finalize other project agreements with regulators including Energy Purchase Agreement (EPA), Implementation Agreement and tariff application.

1.1 PROJECT OVERVIEW AND SITE

The wind farm Project is located in Jhimpir, which is located approximately 110 km from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 347 acres of land, which is leased by GoS. The Karachi-Hyderabad Motorway (Super Highway) and National Highway are the connecting roads to the Project site. The Jhimpir wind corridor is identified as potential area for the development of wind power projects. The overview of the project site is shown in ***Figure 1***.

Figure 1: TRICOM Site overview

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

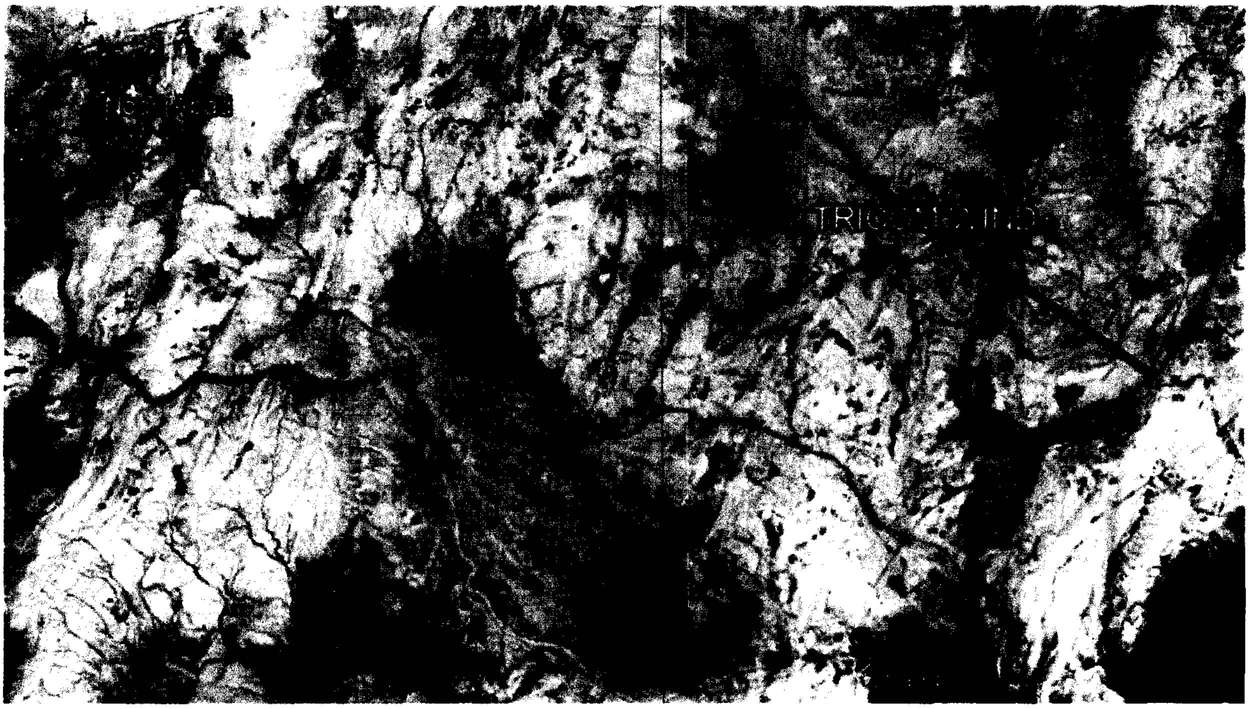


Figure 2: Satellite map of the TRICOM Site

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

1.1.1 Project Size

The Project shall have an installed capacity of around 50 MW, having area of 347 Acres.

1.1.2 Project Status and Calendar

The project calendar is given below:

Table 1-1-1: Project Planned Milestones

Activity / Milestone	2017		2018				2019		
	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR
Approval of Feasibility Study									
[illegible]									
Tariff petition and determination									
[illegible]									
Signing of IA									
[illegible]									
Project Construction									
[illegible]									

The project construction shall take 14 months from the date of planning till the COD.

Table 2-1-2: Project Construction Scheduling

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

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

1.1.3 Energy Yield Estimates

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

1.1.4 Geological Conditions

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

There were 20 bore holes with average depth of 5 feet. .

The Sub-surface conditions disclosed by this investigation show a (Geo Report: 0 – 5 ft Light Brown, Very Hard, Sandy Silt with Concretion) highly fissured chalky limestone with cavities in all borehole locations. The rocky formation displays a significant degree of fracturing which has weakened it.

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

1.1.5 Design of Civil Works

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

1.1.6 Design of Electrical Works

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

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

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

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

1.1.7 Construction Management

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

1.1.8 O & M Management

The O&M shall be managed by the EPC Contractor for initial 2 years of Warranty Period followed by a complete Field Service Agreement till end of eight years of operations thereafter. The local team shall remain part of the O&M and shall gradually take over after having On Job Trainings (OJT).

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

1.1.9 Environmental Management

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

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

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

1.1.10 Health and Safety

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

The safety and health supervision department will provide sound meter and other appropriate inspection equipment, as well as necessary public education service for production safety.

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

1.1.11 CDM Aspect

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

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

1.2 LIST OF ANNEXURE

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

ANNEX – II: Transportation and Access Study Report

ANNEX – II: Geo Technical Investigation Report

ANNEX – IV: Electrical Grid Interconnection Study Report

ANNEX – V: Initial Environmental Examination (IEE) Report

1.3 PROJECT TEAM

1.3.1 Tricom Wind Power (Pvt.) Ltd. (TRICOM)

TRICOM is a company incorporated under the laws of Pakistan and is owned by Yunus Brothers Group & Adamjee Group (the "Sponsors"). Yunus Brothers Group have also sponsored another of a 50 MW wind power project (YEL) at Jhimpir, Taluka & District Thatta, Province of Sindh, Pakistan. This project has achieved COD and is now in Operation & Maintenance phase. Adamjee Group has been changing fortunes over the past 50 years, initially originating as a jute and banking conglomerate, later spreading to other industries such as tea, textiles, matches, sugar, paper board, chemicals, engineering and insurance

Yunus Brothers Group in collaboration with Adamjee Group intend to develop a 50 MW wind power project located at Jhimpir, District Thatta, Sindh. In relation hereto, Yunus Brothers Group & Adamjee Group wish to invite and receive bids for inter alia, the engineering, procurement and construction of the wind power projects.

Sponsor are currently discussing financing options with various leading local and foreign banks.

1.3.2 Renewable Resources (Pvt.) Ltd – Project Consultant www.renewableresources.com.pk

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

RE2 is capable of conducting full feasibility package featuring power production estimates, grid interconnection and tariff model. RE2 is presently a consultant for various power Projects in Pakistan sponsored by local and international investors, with international banks.

2 COUNTRY AND INDUSTRY OVERVIEW

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

At this juncture, we are encountering the worst electricity crises of the history of Pakistan resulting in extended load shedding to an extent which virtually suspends social life.

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

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

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

3 REGULATORY REGIME

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

- Ministry of Water and Power
- National Electricity Power Regulatory Authority (NEPRA)
- National Transmission and Dispatch Company (NTDC)
- Central Power Purchase Agency Guarantee Ltd. (CPPA-GL)
- Directorate of Alternative Energy, Energy Department, GoS (DAE- ED, GoS)

3.1 MINISTRY OF WATER AND POWER

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

3.2 NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

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

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

3.3 NATIONAL TRANSMISSION AND DISPATCH COMPANY (NTDC)

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

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

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

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

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

The Directorate of Alternative Energy is responsible for harnessing the alternative/renewable energy resources, addresses the relevant issues/matters at provincial level, facilitate local and foreign investors and donors for promotion and implementation of alternative energy/renewable energy projects, plan and implement project through public funding, foreign grants, loans etc. and design alternative energy policy for province and review it from time to time.

4 CARBON CREDITS

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

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

4.1 EMISSION REDUCTION MECHANISMS

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

4.1.1 Emissions Trading

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

4.1.2 Clean Development Mechanism (CDM)

Clean Development Mechanism (CDM) allows richer countries to offset their CO_2 emission against the emissions prevented when technology that cuts down on greenhouse gas emissions is deployed in poor countries.

4.1.3 Joint Implementation (JI)

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

4.2 ROLE OF CDM IN TRICOM PROJECT

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

5 WIND INDUSTRY IN PAKISTAN

5.1 CURRENT STATUS OF WIND IPPs IN PAKISTAN

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

Initially very few suppliers wanted to work in new markets like Pakistan. But now many of the suppliers are keen for the Pakistani market. One factor might be continuous maturity of Pakistani market. Presently, GE, Nordex, Vestas and Goldwind are all active in the market.

5.1.1 Letter of Intent (LOI)

The total number of LOIs issued by AEDB and DAE GoS for various projects till date are in the range of 100.

5.1.2 Land Allocation by AEDB / GOS

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

5.1.3 Projects in Operation

Total of Fifteen (15) different projects with capacity of about 730 MW have achieved their CODs. Following projects have started their commercial operations:

Table 5-1: Projects in O&M phase

No.	Company	Capacity (MW)	COD
	FFC Energy Ltd	49.5	1st Quarter 2013
	Zorlu Energy	56.4	2nd Quarter 2013
	Foundation Wind Energy I	50.0	1st Quarter 2015
	Foundation Wind Energy II	50.0	4th Quarter 2014
	TGF Wind Farm Pakistan (Pvt) Ltd	49.5	4th Quarter 2014
	Sapphire Wind Energy Ltd	52.8	4th Quarter 2015
	Yunus Energy Ltd.	50.0	4th Quarter 2016
	Metro Power Company Ltd.	50.0	4th Quarter 2016
	Gul Ahmed Wind Power Ltd.	50.0	4th Quarter 2016
	UEP Wind (Pvt) Ltd.	99.0	2nd Quarter 2017
	Master Wind Energy Ltd.	52.8	4th Quarter 2016
	Tapal Wind (Pvt) Ltd.	30.0	4th Quarter 2016
	HydroChina Dawood Power (Pvt.) Ltd.	49.5	2nd Quarter 2017
	Tenega Genarsi Ltd.	49.5	1st Quarter 2017
	Sachal Energy (Pvt.) Ltd	49.5	4th Quarter 2017

Following projects have achieved financial close during 2015-16 and are currently under construction:

Table 5-2: Projects under Construction

No.	Company	Capacity (MW)
	Three Gorges Second Wind Farm.	50.0
	Three Gorges Third Wind Farm.	50.0
	HAWA Energy (Pvt.) Ltd.	50.0
	Hartford Altenative Energy (Pvt.) Ltd.	50.0
	Zephyr Energy (Pvt.) Ltd.	50.0
	Jhimpir Power (Pvt.) Ltd	50.0
	Tricon Boston – 1	50.0
	Tricon Boston – 1	50.0
	Tricon Boston – 1	50.0

5.1.4 Projects at Advanced Development Stages

Following projects have reached the Generation License / Tariff stage:

Table 5-3: Project at GL/Tariff stage

No.	Company	Capacity (MW)
	Master Green Energy Ltd.	50.0
	Metro Wind Power Ltd.	60.0
	Gul Ahmed Electric Ltd.	50.0
	ACT2 Wind (Pvt) Ltd.	50.0
	Artistic Wind Power (Pvt) Ltd.	50.0
	Uni Energy Ltd.	50.0
	Zulaikha Energy (Pvt.) Ltd.	50.0
	Noor Solar Energy (Pvt.) Ltd.	50.0
	Lakeside Energy (Pvt.) Ltd.	50.0
	Indus Wind Energy Ltd.	50.0
	Shaheen Renewable Energy.	50.0
	Iran-Pak Wind Power (Pvt.) Ltd.	50.0
	Tricom Wind Power (Pvt.) Ltd.	50.0
	Transatlantic Wind (Pvt.) Ltd.	50.0
	Cacho Wind Energy (Pvt.) Ltd	50.0

5.2 TARIFF REGIME IN PAKISTAN

5.2.1 Negotiated Tariff for Wind IPPs

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

5.2.2 Upfront Tariff for Wind IPPs

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

Currently, there is no Upfront tariff available for Wind Power Plants. TRICOM plans to opt for Cost Plus tariff.

6 PROJECT IN TERMS OF POLICY FRAMEWORK

6.1 LETTER OF INTENT (LOI)

First step was to obtain Letter of Intent from DAE GoS which was accomplished in August 2015. This letter entitled the Project Company to start working on wind power project at official level and get support from DAE GoS and other government departments in the preparation of feasibility study and acquisition of land for the project. The feasibility is being submitted before expiration of LOI but after the dead line given in the LOI for the feasibility.

6.2 ACQUISITION OF LAND

The land has been allocated from Government of Sindh in terms of legal formalities.

6.3 FEASIBILITY STUDY

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

6.4 GENERATION LICENSE

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

6.5 TARIFF DETERMINATION

A separate application shall be prepared for tariff.

6.6 LETTER OF SUPPORT (LOS)

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

6.7 ENERGY PURCHASE AGREEMENT (EPA)

Agreement between the Power Purchaser and the Project Company is called Energy Purchase Agreement (EPA). This agreement lists terms and conditions for the sale and purchase of electricity between the two companies. As soon as the feasibility study is submitted and tariff is filed, the Project Company shall enter into the discussions of EPA.

6.8 IMPLEMENTATION AGREEMENT (IA)

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

6.9 FINANCIAL CLOSE

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

7 PROJECT SITE

7.1 WIND CORRIDOR OF PAKISTAN

Pakistan has 1046 km long coastal line with very encouraging wind regime. According to a study carried out by NREL and the wind masts installed in the Gharo and Keti Bandar wind corridor, the average wind speed in the region is 7.4 m/s making a regional potential of more than 50,000 MW. Wind Map of Pakistan by NREL is shown in ***Figure 3***.

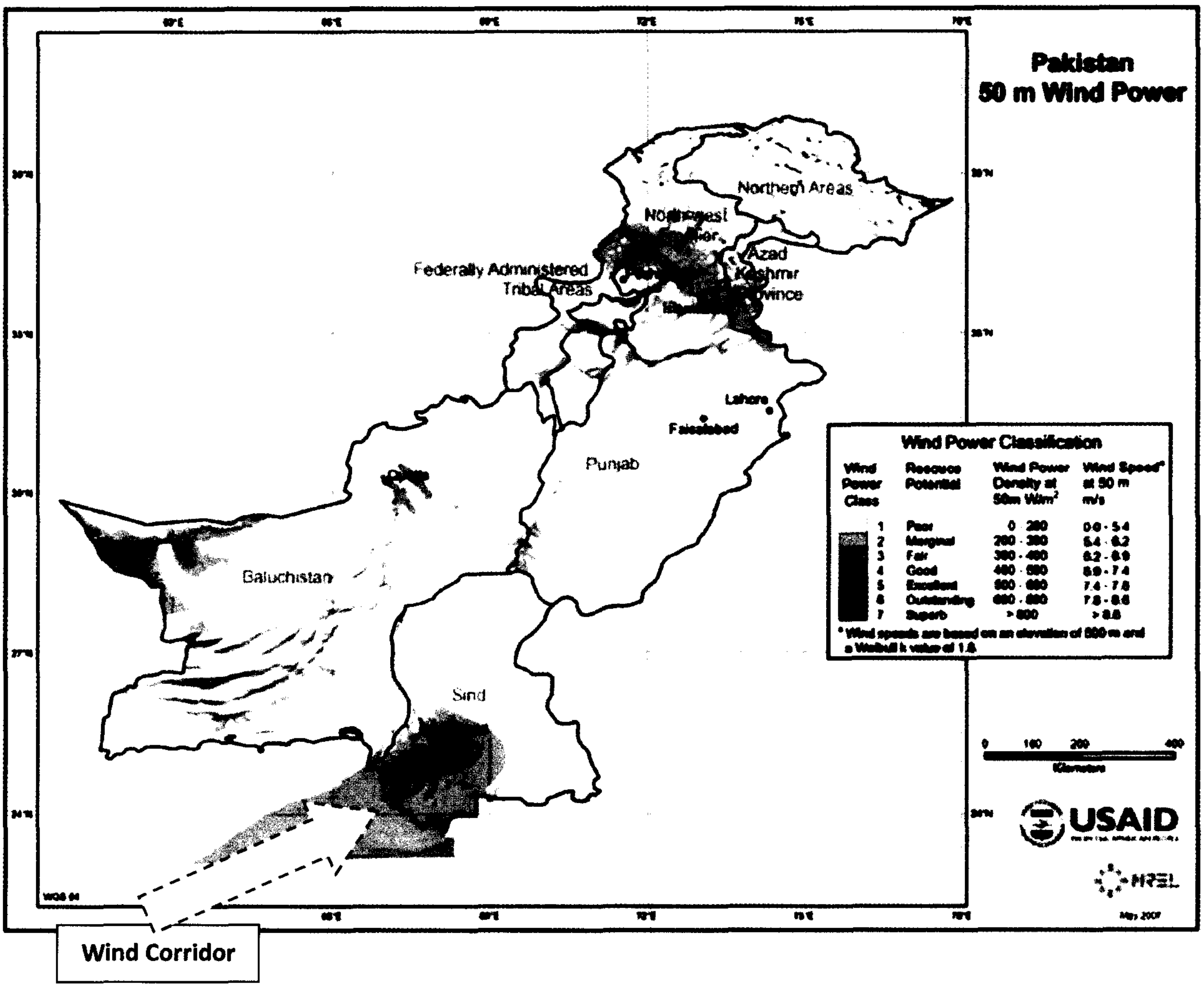


Figure 3: Wind Map of Pakistan by NREL

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

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

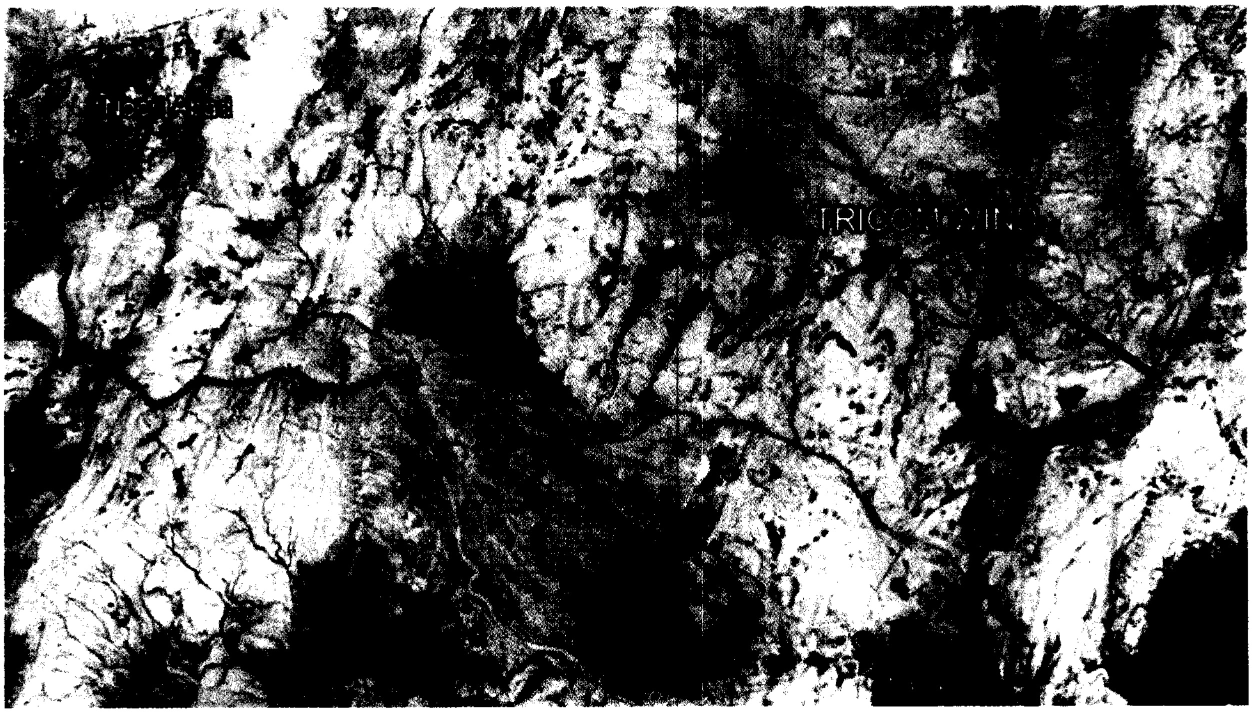


Figure 4: Overview of TRICOM Site

7.2 SITE DETAILS

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

Figure 5: TRICOM Site

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

Hyderabad Electrical Supply Company 132/11 kV grid station is DISCO in Jhimpir. Nearest Grid is New Jhimpir Grid. The distance of the grid station from the Project site is approximately seventeen (17) kilometers.

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

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

Figure 6: View of Project Site

7.3 TRANSPORTATION AND ACCESS NETWORK

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

The major track from Karachi to Nooriabad is via the Karachi-Hyderabad Motorway, and another access to the Project site is through Jhimpir. When travelling via the Karachi-Hyderabad Motorway, the access from Nooriabad to the site is a single track, which turns toward the site. However, the terrain is flat and long and heavy vehicles can easily navigate through this road. There are number of neighboring wind farms in the surrounding area of Jhimpir. There is no requirement to establish roads or tracks for movement of traffic. The total distance from Karachi to the site is approximately 110 km.

Due to the ongoing progress of the highway construction, the transportation via the super highway, M-9, is expected to be easier as compared to the ongoing and past projects, where trucks are take detours around such construction. Such developments have been considered in the transportation study.

It must also be stated that the link to the project site from the Nooriabad-Jhimpir highway is already constructed to support the construction of projects near Tricom Wind Power (Pvt.) Ltd

Further, a detailed transportation and logistics study shall be performed by the EPC contractor following financial close.

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

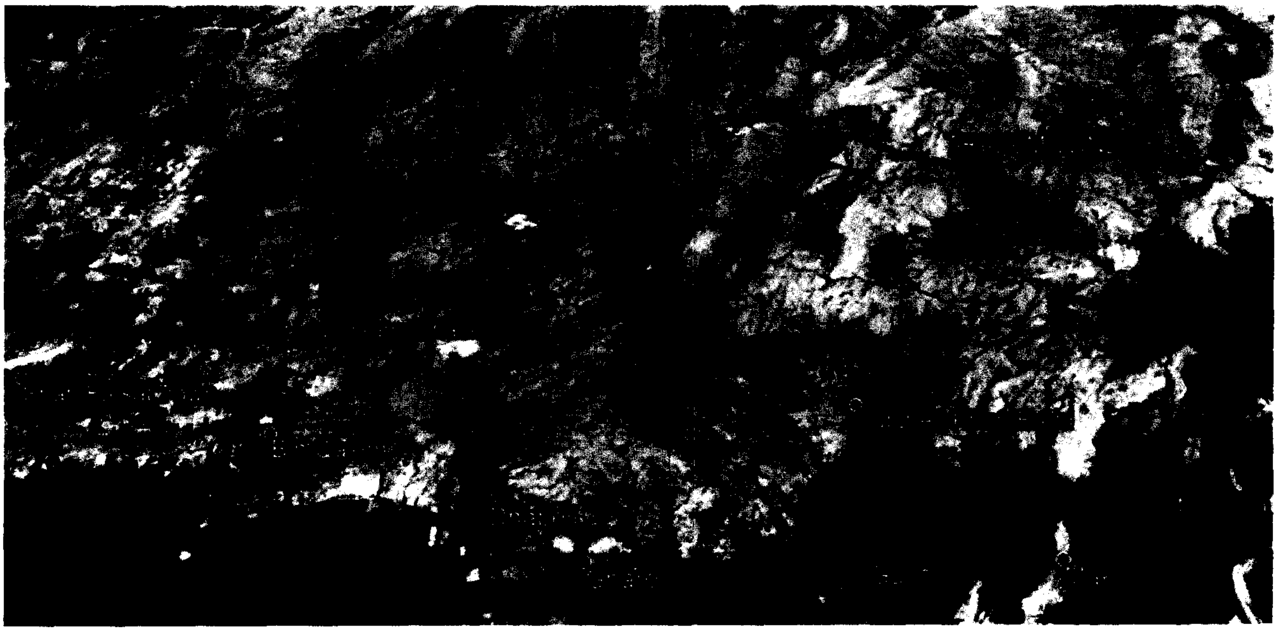


Figure 7: Access to the Site

The major track from Karachi to site is two-way road. The Port Qasim is the one of the major port of Pakistan and is the point of delivery of equipment for the proposed wind power project. It is located towards South-West of the site as shown in ***Figure-8***.

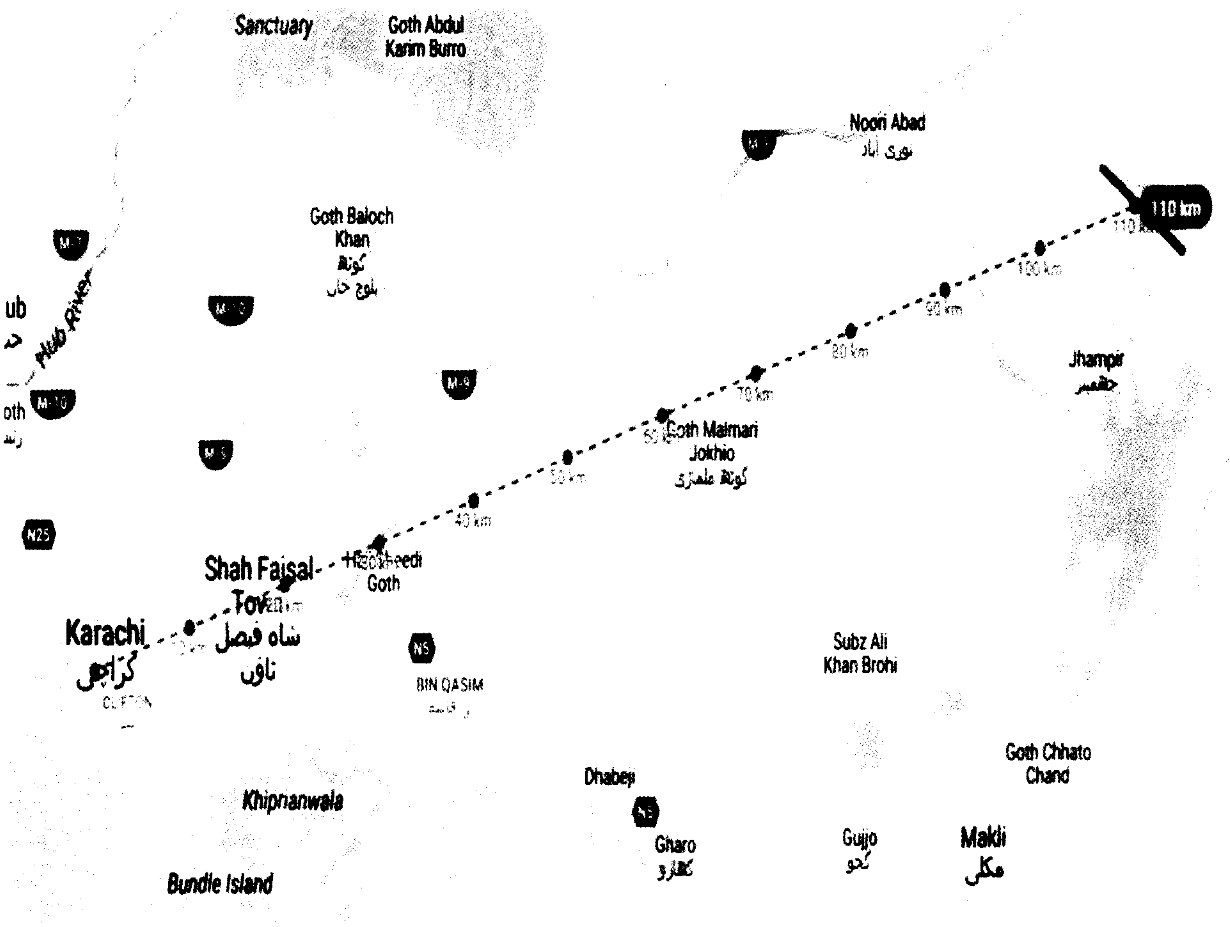


Figure 8: Detailed Access to the TRICOM Site

7.4 CLIMATIC CONDITIONS

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

Table 7-1: **Climate Conditions of Karachi**

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

7.5 EARTHQUAKES

According to the seismic zoning map of Pakistan, the Jhimpir region falls in ZONE II-B with moderate to severe damage area probability. This has been separately covered in the Geo Technical Study and the Environmental Impact Assessment.

8 SELECTION OF WTG AND EPC CONTRACTOR

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

Table 8-1: EPC Contractors

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

Turnkey EPC proposal are invited from EPC contractors which will be evaluated on merit and then initial meetings shall take place with all bidders. Following this, detailed negotiations will be done with the two better prospective options to make a final selection.

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

a) The quality of WTG and Type Certification according to site suitability
b) The quality and certifications of EBOP equipment
c) The ultimate energy yield potential at P90 for the Project
d) The total EPC cost and resultant tariff / IRR
e) Technical guarantees, warrantees and obligations
f) Time for Completion
g) The commercial and legal terms of the EPC package
h) Agreement to long term O&M

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

Generation License and Tariff of the Project will reach. The specifications of WTG under consideration are attached as **Annex VIII.**

9 GEOLOGICAL CONDITIONS

To collect detailed regional geological information, TRICOM hired professional services of Welt Konnect (Pvt.) Ltd: a Pakistani local prospecting agency to conduct field exploration drilling twenty (20) bore holes on the Site during December, 2015. The average drilling depth is 5 feet. The complete Geotechnical Investigation Report is report is attached as **Annex-IV**.

9.1 OBJECTIVES OF GEOTECHNICAL STUDIES

- To execute boreholes, at the site scattered along the strip.
- To execute field and laboratory geotechnical testing.
- To investigate the surface and sub-surface soil condition, to evaluate foundation design parameters.
- To provide shallow and deep foundation recommendations.

9.2 GEOLOGY OF KARACHI REGION AND SURROUNDINGS

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

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

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

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

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

The tectonic map of Pakistan, Geological and Sub Surface details of Jhimpir are shown in ***Figure 9 & Figure 10***:

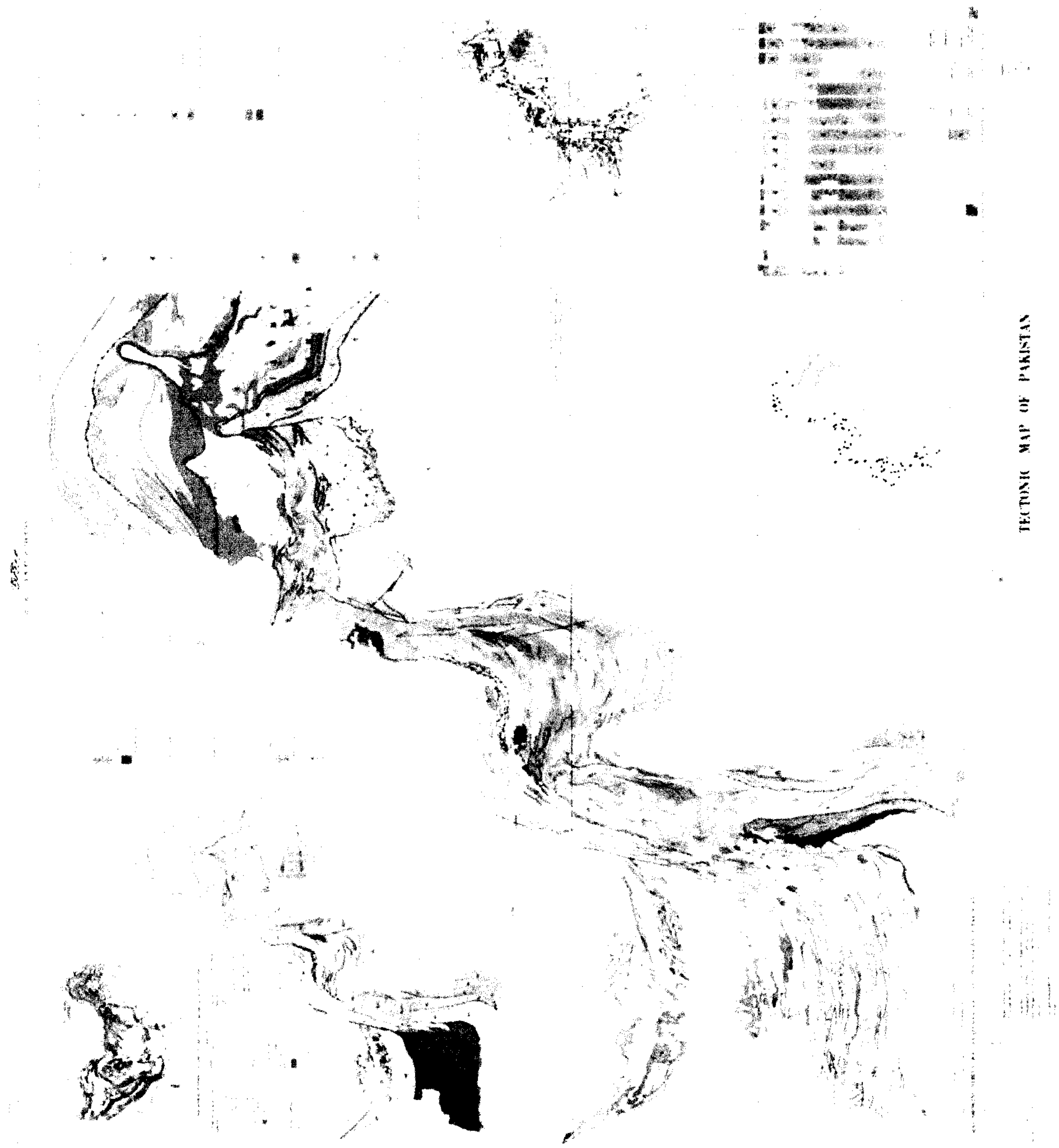


Figure 9: Tectonic Map of Pakistan

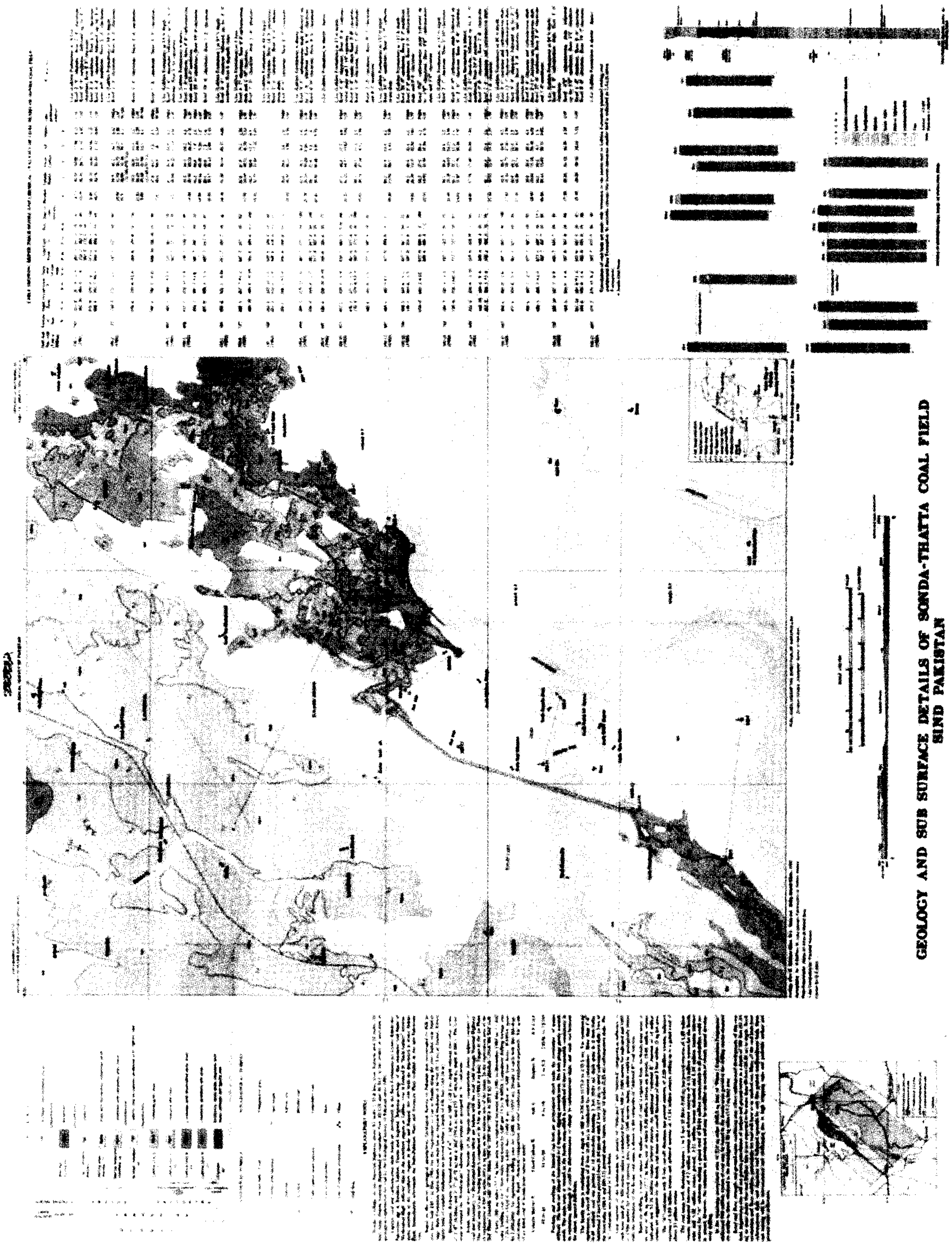


Figure 10: Geological and Sub Surface details of Jhimpir

9.3 SEISMOLOGY OF KARACHI REGION

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

Table 9-1: Earthquake Records around Karachi

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

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

Table 9-2: <u>Seismic Parameters of Karachi</u>

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

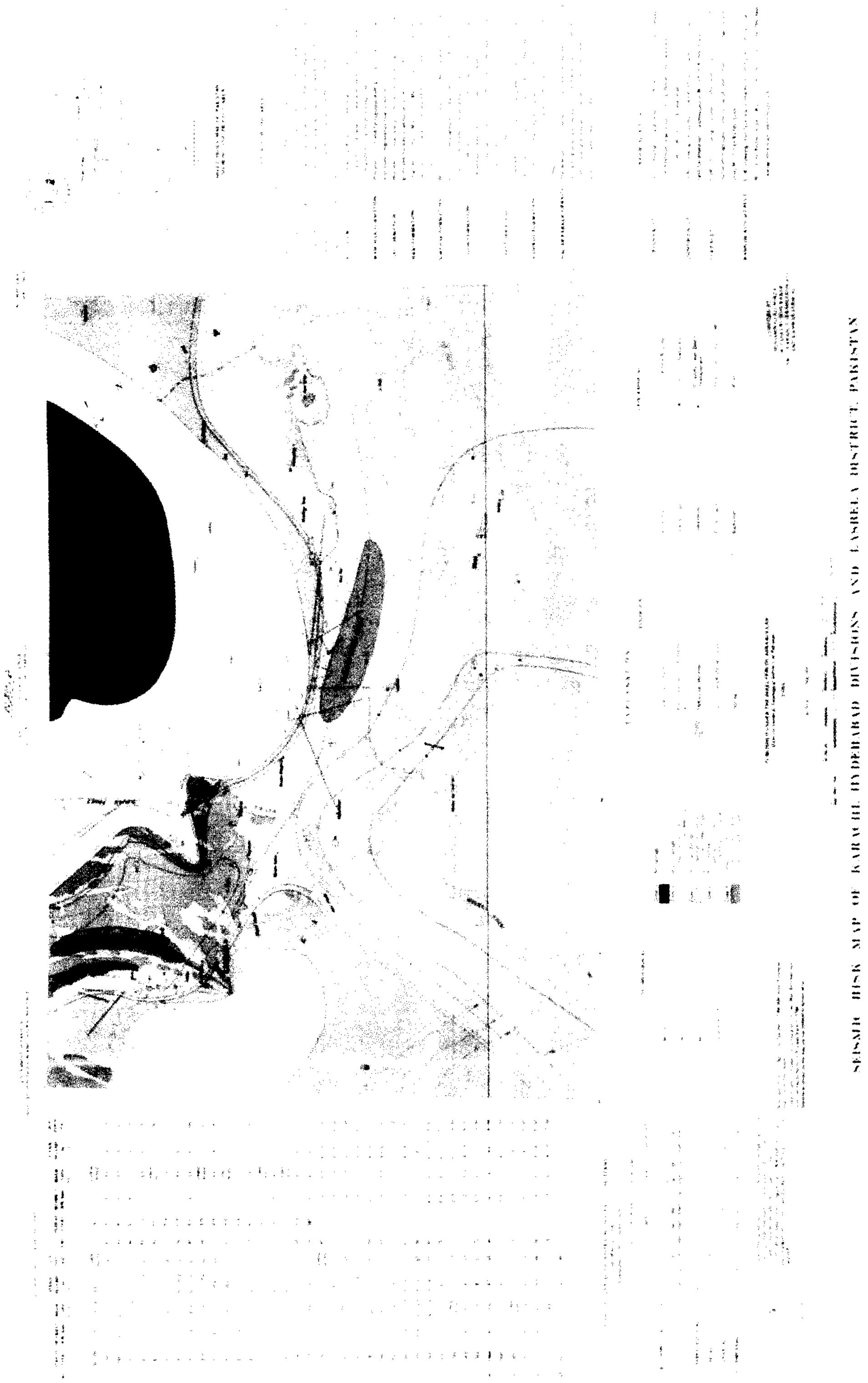


Figure 11: Seismic Map of Pakistan

9.4 FIELD WORK

9.4.1 Borehole Drilling

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

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

9.4.2 Rock Core Drilling

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

9.4.3 Location of Boreholes

Table 9-3: Location of Boreholes for Geo Technical Investigations

B1	25° 5'36.64"	68° 5'40.54"
B2	25° 5'42.97"	68° 5'29.55"
B3	25° 5'47.88"	68° 5'22.04"
B4	25° 5'54.84"	68° 5'12.20"
B5	25° 6'2.65"	68° 4'59.67"
B6	25° 6'9.09"	68° 4'46.38"
B7	25° 6'18.12"	68° 4'33.61"
B8	25° 6'25.36"	68° 4'22.93"
B9	25° 6'33.29"	68° 4'10.24"
B10	25° 6'42.91"	68° 3'54.02"
B11	25° 6'53.15"	68° 3'36.57"
B12	25° 7'3.51"	68° 3'18.90"
B13	25° 7'13.75"	68° 3'3.56"
B14	25° 7'26.61"	68° 2'43.60"
B15	25° 7'34.96"	68° 2'28.61"
B16	25° 7'44.08"	68° 2'13.70"
B17	25° 7'54.45"	68° 1'55.63"
B18	25° 8'6.75"	68° 1'35.59"
B19	25° 8'17.90"	68° 1'16.12"
B20	25° 8'29.78"	68° 0'57.09"

9.4.4 List of Field and Lab Tests

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

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

9.5 CONCLUSIONS OF GEOTECHNICAL STUDIES

A Geotechnical Investigation for TRICOM 50MW Wind Power Project Jhimpir, Sindh was carried out in Dec, 2015. The Scope of work included drilling of twenty (20) boreholes up to 5 feet depth. Soil and rock samples were also collected during the field investigation. Laboratory testing of soil and rock samples has been carried out in Geo Tech lab and includes natural moisture content, specific gravity, water absorption, density, unconfined compressive strength etc.

Chemical characteristics of soil and rock samples have also been assessed through determination of total dissolved solids, sulphate content, chloride content and pH.

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

10 CIVIL ENGINEERING DESIGN

The civil engineering design mainly includes following structures:

- Foundation of WTG Towers
- Foundation of substation and grid interconnection apparatus, i.e. transformer, switchgear.
- Construction of permanent buildings (residence and offices) of O&M staff.
- Construction of building for Protection and Control, Telecommunication and DC Power Supply.

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

11 ELECTRICAL ENGINEERING DESIGN

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

The dispatch voltage shall be 132 kV. There will be two-stage step-up voltage, one step up to MV level at the each WTG level through individual GSUs, and the other at the substation. The MV level shall be either 22 kV or 33 kV.

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

The Wind Farm shall be divided into collector groups, each having approx., five (05) WTGs. Every WTG shall be equipped with own step-up transformer and shall be connected with the successive WTG by means of Ring Main Units (RMU) and vacuum breaker in configuration in/out. The connection of the RMUs to the main MV Switchgear shall be achieved by under-ground XLPE insulated single core aluminum conductor.

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

The 132 kV substation shall consist of double bus with bus coupler and two breaker bays to connect main transformers with the 132 kV double circuit overhead lines (OHL). The Main Transformers shall meet the N-1 grid code criteria and thus will be two (02) in number (50 MVA each). The instrumentation transformers (CTs, VTs, CVTs) for all purposes shall be sized according to requirement.

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

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

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

12 CONSTRUCTION MANAGEMENT

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

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

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

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

In order to manage all the above operations correctly, TRICOM shall have a consultant as a "Construction Supervisor" or Owner's Engineer who shall supervise the quality and progress of all contractors and give approvals of milestones.

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

Table 12-1: Project Construction Scheduling

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

13 Initial Environment Examination (IEE)

The Initial Environment Examination (IEE) has been carried out as per Pakistan Environmental Protection Act, 1997 according to the requirements of Environmental Protection Agency, Government of Sindh and is already submitted. The report is prepared by Welt Konnect (Pvt) Ltd and attached as Annex V.

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

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

Impacts are manageable and can be managed cost effectively - very little environmental impacts are likely to result from the proposed power project. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as correction in work practices at the construction sites, or through the careful selection of sites and access routes. Since proposed land is covered with shrubs, thus there is no need for removal of any significant vegetation for the construction of the wind power Project.

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

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

- There is negligible removal of trees for the Project, which is the main positive impact to the proposed Project area.

- Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, black smoke, vibration are the short term negative impacts due to proposed Project with mitigations being properly taken care.

Proper GRM will be implemented by TRICOM to overcome public inconvenience during the proposed Project activities.

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

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

The environment and social impact associated with the Project is limited to the extent of construction phase and can be mitigated through a set of recommended measures and adequate provision for environment and social impacts which cover monitoring, measuring and mitigation.

Most impacts are expected to occur during the construction phase and are considered to be of a temporary nature. . The main Project impacts are associated with clearing of shrub vegetation, waste management and excavation and movement of soils.

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

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

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Any adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The potential cumulative and residual impacts of the Project as a whole indicate the Project classifies as a category "B", in accordance with ADB's Safeguards Policy Statement 2009. The Project is not considered highly sensitive or complex. Mitigation measures related to Construction, as specified in the EMP, will be incorporated into civil works contracts, and their implementation will be primarily the responsibility of the contractors. Hence, the proposed Project has limited adverse environmental and social impact which can be mitigated following the EMP& shall be pollution free Renewable source of Power generation with low Environmental foot prints.

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

14 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 any of General Electric GE 1.7-103 (1.7 MW), Gold Wind 121-2.5 (2.5 MW), General Electric GE 2.75 (2.75 MW), Gamesa G114-2.0 (2.0 MW), Gamesa G114-2.5 (2.5 MW), Nordex N131-3000 (3.0 MW), Vestas V126-3.3 (3.3 MW) turbines. The Project IRR as currently being assessed is suitable.

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

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

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

The Project Site is conveniently located close to the Grid of HESCO and NTDC

It is expected that the Project will achieve financial close by 2nd Quarter of year 2018 and construction will be completed by 3rd Quarter of year 2019. It is anticipated that the Project of TRICOM would be a valuable addition to the National Grid for generating electricity and contribute to overcome the current energy crises of the Pakistan.

ANNEX – IV

Electrical and Grid Interconnection Studies

OFFICE OF CHIEF TECHNICAL OFFICER

No. CPPAGL/CTO/DGM-II/MT-V/TWPPL/ 26077-80 **Date:** 19-06-2017

Chief Engineer (P&E)
2nd Floor, WAPDA Offices Complex Hussainabad
HESCO, Hyderabad.

Project: 50MW Tricom Wind Power (Pvt) Limited (TWPPL) at Jhimpir

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

Ref: General Manager Planning Power, NTDC GMP/CEMP/TRP-380/2535-40 dated 18.05.2017

General Manager Planning Power, NTDC has approved the Grid Interconnection Study (GIS) of Tricom Wind Power (Pvt) Limited only for interconnectivity purpose and intimated CPPA-G vide above referred letter. The salient points on the GIS report are as under:

"It is intimated that the Grid Code Addendum for Wind Power Projects is being updated at present and after its approval from NEPRA, the developers of the subject wind power project will be required to follow/implement the requirements/recommendations as given in the Grid Code Addendum for Wind Power Projects.

It is added that during EPA, if there is any major change in the parameters of the subject Tricom WPP as used in the subject grid interconnection study, then relevant studies will have to be revised.

Any Commitment regarding project execution or for any other purpose should be discussed with CPPA(G)L Ltd. and relevant departments of NTDC/HESCO.

Moreover, the comments of HESCO on the subject report may be obtained."

As desired by General Manager Planning Power, NTDCL, you are requested to furnish your comments to CPPA-G to proceed in the matter.

Manager (Tech)-V
CPPA-G Islamabad

Copy to:
1. Chief Technical Officer, CPPA-G Islamabad.
2. General Manager Planning Power, NTDC 4th Floor, PIA Tower, Egerton Road, Lahore).
3. M/s Tricom Wind Power (Private) Limited, Suit # 306, 3rd Floor, Adamjee House, I.I. Chundrigarh Road, Karachi. (Please provide a soft copy of approved GIS report to HESCO with the coordination of Planning NTDCL)
- Master File.

2017

Conducted For

Tricom Wind Power (Pvt.) Ltd

(The Client)

By

Welt Konnect (Pvt) Ltd

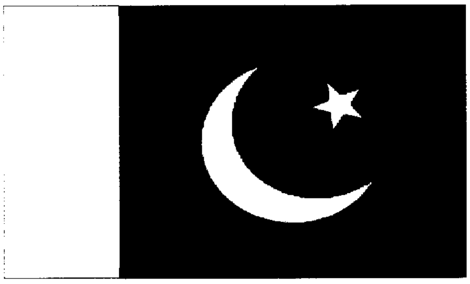
(Project Consultant)

05/12/2017

WELT KONNECT

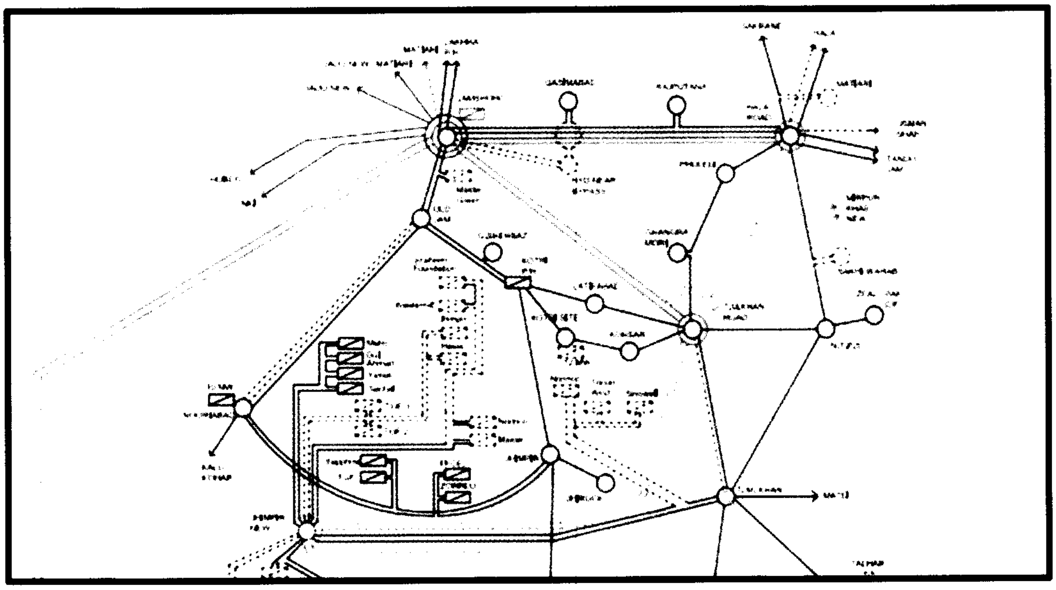
Driving You Into The Future

TRICOM WIND POWER (PVT) LTD



Grid Interconnection Study Of The 50 MW Tricom Wind Power Project

April, 2017



BY

WELT KONNECT PVT LTD

A SUBSIDIARY OF THE TRANSTECH GROUP

FOR

TRICOM WIND POWER (PVT) LTD

TRANS TECH
GROUP

APPROVAL SHEET

TITLE : Grid Interconnection Studies for Evacuation of Power from 50MW Tricom Wind Power Project to National Grid.

DOCUMENT NUMBER : 504-0786-03

CLASSIFICATION : **Un-Classified**

SYNOPSIS

This document is a Grid interconnection Study (GIS) Report for the 50 MW Tricom Wind Power Project being developed by Tricom Wind Power (Pvt.) Ltd. Please find below an overview of the report followed by a chapter wise synopsis:

GIS-Report This GIS report contains numerical analysis, data visualizations and simulations based on complex algorithms in various modules of PSSE V.34, for the proposed/engineered interconnection scheme, depicting (i) the load flow analysis (ii) contingency analysis (iii) fault (short-circuit) analysis (iv) power quality analysis and (v) transient stability analysis of the 50 MW Tricom Wind Power Project for the given network of Hyderabad Electric Supply Company (HESCO) in tandem with the National Grid of Pakistan at large.

Chapter 1 **Introduction**: provides the background and provides an understanding of the problem used for performing the Grid interconnection Study for the Tricom Wind Power Project.

Chapter 2 **Technical Data:** describes the general information about the equipment used in the Tricom Wind Power Project (WPP).

Chapter 3 **Study Objectives, Assumptions and Criteria:** describes the objectives, data assumptions employed in conducting the Grid Interconnection study and the planning criteria which is set for the subject power plant in the subsequent chapters of this GIS.

Chapter 4 **Proposed Interconnection Scheme:** this section presents the interconnection scheme allowing for evacuation of generated power from the 50 MW Tricom Wind power project to the national grid. The most efficient and viable scenario has been proposed after conducting various technical analysis described in various chapters of the GIS and taking into consideration requisite standards, limits and constraints of the transmission lines and the other technical equipment.

Chapter 5: **Load Flow Studies:** this section provides a detailed analysis of the proposed interconnection scheme using the latest power system simulation tools of PSSE V.34 to project and check the load flow of the subject power system in a single line diagram, whereas the results/sketches of the simulation analysis are provided in Appendix-3.

Chapter 6: **Curtailment Load Flow Studies:** this section provides an examination of the proposed interconnection scheme under a curtailment scenario to project and check the load flow of the subject power system in a low power generation setting, whereas the results/sketches of the simulation analysis are provided in Appendix-3.

Chapter 7: **Short Circuit Studies:** this sections provides information regarding the short circuit/fault analysis of the subject power system under operational conditions on the national grid of Pakistan for the given evacuation scheme, while the simulation results of the fault analysis are provided in Appendix-4.

Chapter 8: **Transient Stability Analysis:** the chapter covers a detailed analysis of the behavior of the WPP with respect to the network after applying a transient fault on the network. The simulation results of the transient stability analysis are provided in Appendix-6.

Chapter 9: **Power Quality Analysis:** a detailed analysis about the power quality of the subject WPP, including investigation of the voltage unbalance and flicker effects on the power system, is presented in this Chapter.

Chapter 10: **Conclusions:** In this study, a stable and reliable interconnection of the 50 MW Tricom Wind Power Plant is considered for the 132 KV HESCO transmission network circuits, in compliance with the planning criteria of the applicable NEPRA Grid Code, which shows that the power flow under the prescribed interconnection scheme is feasible with short circuit ratings within limits and liable power quality of proposed GIS having no adverse effect on the local network or National Grid.

DATE: 24th April, 2017

TABLE OF PROFESSIONALS

Sr. No.	Work Scope	Reviewed By	Designation	Approved By
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10	Data Analysis and Scrutiny	Hamed Rizwan	Project Engineer	Habil A. Khan
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12	Regulatory and Policy Framework Analysis	Zeeshan Ahmed	Policy Specialist	Yousuf Khan

PREPARED BY: Mr. Zeeshan Ahmed
Mr. Yousuf Khan

REVIEWED BY: Mr. Habil Ahmed Khan

APPROVED BY: Mr. Fiaz Ahmad

Revisions

S #	REV. #	DATE	VOL #	SECTION	DESCRIPTION OF CHANGE

DISTRIBUTION

1. Central Power Purchase Authority (CPPA-G)
2. National Transmission Dispatch Company (NTDC)
3. Hyderabad Electric Supply Company (HESCO)
4. Tricom Wind Power (Pvt) Ltd
5. Weltkonnect (Pvt) Ltd

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LIST OF ABBREVIATIONS

AC	Alternate Current
AEDB	Alternative Energy Development Board
Approx.	Approximately
BOR	Board of Revenue
CCGT	Combined Cycle Gas Turbine
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CNG	Compressed natural Gas
CO2	Carbon dioxide
COD	Commercial Operational Date
CoP	Conference of the Parties
CPPA	Central Power Purchasing Agency
CPV	Concentrator photovoltaic
DAE GOS	Directorate of Alternate Energy, Government of Sindh
DC	Direct Current
deg	Degree
DG	Diesel Generator

DISCOs	Distribution Companies
EE	Energy Efficiency
EF_y	Baseline Emission Factor
EIA	Environmental Impact Analysis
EMC	Electromagnetic Compatibility
EMP	Environment Plan
EPA	Energy Purchase Agreement
EPC	Engineering Procurement Construction
FESCO	Faisalabad Electric Supply Company
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GIS	Grid Interconnection Study
GEPCO	Gujranwala Electric Power Company
GENCOs	Generation Companies
GHG	Green Gas
GS	Grid Station
GoP	Government of Pakistan
GPS	Global Positioning System

GSM	Global System for Mobile Communications
HCA	Host Country Approval
HESCO	Hyderabad Electric Supply Corporation
HFCs	Hydro Fluorocarbons
HOMER	Hybrid Optimization Model for Electric Renewables
HSE	Health Safety and Environment
Hz	Hertz
IA	Implementation Agreement
IDC	Interest During Construction
IEE	Initial Environmental Examination
IESCO	Islamabad Electric Supply Company
IEEE	Institute of Electrical and Electronic Engineers
IFC	International Finance Cooperation
IPPs	Independent Power Producers
IRR	Internal Rate of Return
JEDI	Jobs and Economic Development Impact
JI	Joint Implementation
JRC	European Joint Research Centre

Km	Kilometer
KV	Kilovolt
KW	Kilowatt
LESCO	Lahore Electric Supply Company
LNG	Liquefied Natural Gas
LOI	Letter of Intent
LOS	Letter of Support
LPG	Liquefied Petroleum Gas
LUC	Local Control Unit
LVRT	Low Voltage Ride Through
m^2	Meter Square
m^3/h	Meter cube per hour
mm	Millimeters
MEPCO	Multan Electric Power Company
mmcft	Million Cubic Feet
MoU	Memorandum of Understanding
MTDF	Medium Term Development Framework
MVA	Million Volt-Ampere

MW	Megawatt
NAPWD	Northern Area Public Works Department
NCS	National Conservation Strategy
NEC	National Energy Conservation
NEPRA	National Electricity Power Regulatory Authority
NEQs	National Environmental Quality Standards
NGOs	Non-Government Organizations
NOCs	No Objection Certificate
NOCT	Nominal Operating Cell Temperature
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Dispatch Company
O & M	Operation & Management
OECD	Organization for Economic Cooperation and Development
OEMs	Original Equipment Manufacturer
OHL	Overhead Lines
OLTC	On-Load Tap Changer
OM	Operating Margin
OSHA	Occupational Safety and Health Administration

PCRET	Pakistan Council of Renewable Energy and technology
PDD	Project Design Document
PEPA	Pakistan Environment Protection Act
HESCO	Peshawar Electric Supply Company
PINs	Project Idea Note
PLC	Programmable Logic Control
PMD	Pakistan Meteorological Department
POE	Panel of Experts
PPDB	Punjab Power Development Board
PPIB	Private Power Infrastructure Board
QESCO	Quetta Electric Supply Company
QC	Quality Control
R & D	Research and Development
RE	Renewable Energy
RFP	Request for Proposal
RFQ	Request for Quotation
RMP	Risk Management of Project
ROC	Return on Capital

ROE	Return on Equity
RQD	Rock Quality Designation
SEPCO	Sukkar Electric Supply Company
SOP	Standard Operating Procedure
TESCO	Tribal Electric Supply Company
TOE	Tons Oil Equivalent
tsf	Tones/square foot
TTG	Trans Tech Group
TWP	Tricom Wind Power (Pvt) Ltd
UNFCCC	United Nations Framework Convention on Climate Change
UPS	Uninterruptible Power Supply
WAPDA	Water & Power Development Authority
WKPL	Welt Konnect (Pvt) Ltd
WMO	World Metrological Organization
WPP	Wind Power Project

ACKNOWLEDGMENTS

The management of Welt Konnect (Pvt) Ltd would like to express their gratitude to the support and cooperation extended by the various Government departments especially NTDC and HESCO in facilitating collection of data and information relevant to the study.

DISCLAIMERS

This document is intended for use by the Tricom Wind Power (Pvt) Ltd for understanding and effective decision making regarding 50 MW Tricom Wind Power Project in Jhimpir, Sindh-Pakistan.

The consultants Welt Konnect (Pvt) Ltd are and will not be responsible for any decision made by the intended or unintended users for any purpose.

The Client and the Consultant are and will also not be responsible for any decision made by any other person or party not being an intended user of this document whether related to such projects or not without consent of the consultant or client in this regard.

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DOCUMENT INFORMATION

The purpose of this report is to conduct analysis of the proposed interconnection scheme of the 50 MW Wind Power Project being developed by Tricom Wind Power (Pvt.) Ltd in Jhimpir, Sindh-Pakistan and provide information relevant for the concerned Government Entities to make an informed decision regarding the Power Project.

STRUCTURE OF THE DOCUMENT

The **Grid Interconnection Study Report** has been divided into the following chapters/sections:

- **Chapter 1:** Introduction
- **Chapter 2:** Technical Data
- **Chapter 3:** Study Objectives, Assumptions and Criteria
- **Chapter 4:** Proposed Interconnection Scheme
- **Chapter 5:** Load Flow Studies
- **Chapter 6:** Curtailment Load Flow Studies:
- **Chapter 7:** Short Circuit Studies
- **Chapter 8:** Transient Stability Analysis
- **Chapter 9:** Power Quality Analysis
- **Chapter 10:** Conclusions

Each Section is further sub-divided into sub-sections for ease of reviewing and understanding.

EXECUTIVE SUMMARY OF THE PROJECT

The 50 MW Tricom Wind Power Project is situated in Jhimpir, district Thatta, Sindh province of Pakistan.

The project sponsors have engaged the team of Welt Konnect (Pvt) Ltd, to conduct Grid Interconnection Study (GIS) of Tricom 50 MW WPP and to propose an interconnection scheme for evacuation of its generated power to the National Grid.

The Tricom WPP sponsors provided all the relevant technical data which was required for conducting the GIS. Furthermore, the proposed interconnection scheme is provided in Appendix-1, whereas the geographical location of the Tricom WPP is provided in Appendix-2.

Tricom WPP comprises of twenty five (25) wind turbine generators (WTG), each one is Gamesa G114-2.0 Type-3, with 2 MW gross capacity. The total gross generation capacity is 50 MW and, after deducting all losses/auxiliary consumption the total net capacity of WPP that will flow from subject plant is 48.4 MW.

The Grid Interconnection Study (GIS) of the 50 MW Tricom Wind Power Project takes into consideration the power evacuation from subject WPP in integration with other WPPs in its vicinity of the NTDC and HESCO network. This GIS report simulates and examines the results obtained from load flow analysis, contingency analysis, short circuit studies, power quality analysis and transient stability analysis of the subject power project, which have been conducted for evacuation of power from the Tricom WPP to the National Grid in compliance with the NEPRA Grid Code and other applicable standards, rules and regulations.

The base case prepared and provided by the National Transmission & Dispatch Company Limited (NTDC) was updated to account for the addition of the Tricom WPP and other upcoming power projects, taking into consideration their respective capacity, locations, and the existing/planned system network in their vicinity.

The 50 MW Tricom Wind Power Project is expected to achieve its Commercial Operational Date (COD) by the fourth Quarter of 2019. Whereby the interconnection analysis has been conducted for peak and off-peak case of 2019 and peak case of 2022 and the results are documented.

The local grid network of HESCO and the national grid at large was analyzed for load flow, short circuit/fault stability, power quality and transient stability after interconnection with the 50 MW Tricom Wind Power Plant to examine and confirm compliance with the NEPRA/NTDC Grid Code requirements.

The Load flow study has been scrutinized and processed keeping in view all the existing and upcoming WPPs in the vicinity of Tricom WPP for evaluating the adequacy of the proposed GIS for stable and reliable power evacuation from the Tricom WPP to the respective GS in coexistence with other WPP's.

The GIS results were further examined for performing the load flow studies to assess the steady state system performance under normal and N-1 contingency conditions and it has been found that all electrical parameters from the Tricom WPP and on the grid are compliant with the NEPRA grid code planning criteria.

In order to simulate and observe the short circuit current contributions by the subject project to the 132KV local network of HESCO, the maximum and minimum three phase and single phase short circuit levels of all the buses of the plant were computed at the substations located in vicinity of the project. It is evident from the short circuit analysis that the induction of Tricom WPP and its surrounding WPPs have no adverse impact on the existing and proposed substations in their vicinity.

The short circuit fault level are 8.8 kA and 7.4 kA for maximum three phase and single phase respectively at the 132 kV switchyard of Tricom WPP in the year 2022 but these are expected to rise due to future expansion and upcoming WPPs in corresponding HESCO network. Consequently, the short circuit rating of 40 kA would be adequate for the 132 kV switchyard equipment of Tricom WPP.

In order to investigate the effect of transient fault on proposed interconnection scheme, transient stability analysis has also been carried out for the Tricom WPP.

The stability of the Tricom WPP and the power system has been checked with application of different disturbances on the wind farm and at the substations in its vicinity. It has been found that the Tricom WPP and the power system remain stable with no adverse effects after subjected to faults as per Grid Code requirement.

Keeping in view the results of the above GIS analysis it is hereby concluded that the proposed interconnection scheme of the 50 MW Tricom Wind Power Plant with HESCO/NTDC networks has no adverse effect on the national grid which remains stable and robust, in compliance with the applicable Grid Code and Planning Criteria.

However it is observed from the load flow analysis that their is overloading of Jamshoro-Dadu and Dadu-Matiari 500KV transmission lines in N-1 contingency condition for cases of Peak and Off Peak summer 2019 scenarios, in order to resolve this issue, the upcoming WPPs in the vicinity of Tricom WPP should run with dispatch of 7 MW for Lake Side WPP, Nasda WPP, Uni Energy WPP, Noor WPP, Sinowell WPP, Master Green WPP, Iran Pak WPP, Norinco-2 WPP, DHA City WPP, and Tricom Wind

WPP while the power of Metro-2 is dispatched to 09 MW. There is no need of curtailment in case of 2022 due to planned commissioning of HVDC bipoles from south to mid country .

1 INTRODUCTION

The southern parts of Pakistan, which includes the area of Jhimpir and Gharo in Sindh province is blessed with a huge potential for generation of electrical power through wind energy.

In April 2016, Ministry of Water and Power in association with Alternative Energy Development Board (AEDB) and Directorate of Alternate Energy Government of Sindh (DAE-GOS) approached NTDC to plan and approve evacuation of power from a number of Wind Power Projects, each having average gross capacity of 50 MW at Jhimpir.

As part of Energy Security Action plan 2006, AEDB planned to have share of at least 5% of total National On-Grid Power generation capacity through wind energy by year 2020.

To date, about 308 MW of Wind Power Projects are injecting power in to the national grid, whereas nine further projects, with a cumulative generation capacity of 479 MW achieved financial close in March 2015 and are currently under construction.

Please find below the proposed scheme considered in this report for the interconnection of the 50 MW Tricom Wind Power Project to the National grid of Pakistan:

The power evacuation scheme comprises of having three (03) Wind Power Projects comprising of Norinco-2 50 MW, Tricom Wind 50 MW and Sinowell 50 MW connected between the Jhimphir New-1 GS and T.M.KHAN GS at 132 kV.

Other clusters connected to the Jhimphir New-1 GS at 132 kV includes the one comprising upcoming WPPS of Shaheen Foundation 50 MW, Western Energy 50 MW, Norinco 50 MW and Master 49.5 MW.

Whereas the cluster comprising the new WPP's, Jhimpir 50MW, Hawa 50MW, TGF-2 50MW and TGF-3 50MW are also connected to Jhimpir New-1.

In addition the cluster composed of the new WPP's TB-A 50MW, TB-B 50MW and TB-C 50MW are also connected to the same Grid Station at 132KV.

Further the upcoming UEPL 50MW and Hartford 50MW WPPs are also envisaged to have interconnection at Jhimpir New-1 along with the existing Tapal 50MW WPP.

While the remaining WPPs Gul Ahmad-E 50 MW, Din Energy 50 MW, Zulaikha Energy 50 MW, Noor 50MW, Indus 50MW, Shafi 50MW, DHA 50MW, Metro-2 50MW will be connected to Jhimphir New-2 GS at 132 kV as one cluster.

Whereas the WPPs namely, Cacho (Harvey) 50 MW, Artistic-2 50 MW, Act-2 50 MW, Iran-Pak 50MW, Unicol 50MW, Trans-Atlantic 50 MW, Nasda 50MW and Lakeside 50MW shall be connected as the other cluster at Jhimpir New-2.

The proposed 50MW Tricom Wind farm shall have an installed capacity of 50 MWs. The project is being developed in the private sector and the electricity generated from this project would be supplied to the national power grid.

The Tricom WPP sponsors provided all the relevant technical data which was required for conducting the GIS. Furthermore, the detailed sketch of the proposed interconnection scheme of the Tricom WP is provided in Appendix-1.

Tricom WPP comprises of twenty five 25 wind turbine generators (WTG), each being a Type-3 Gamesa G114-2.0 with 2 MW gross capacity. The total gross generation capacity is 50 MWs and after deducting all losses/auxiliary consumption the total net peak capacity of WPP that will flow from subject plant to the under-construction Jhimpir New-1 GS is 48.4 MW.

The effect of the addition of this generated power from Tricom WPP into the NTDC/HESCO network is examined in this report. Furthermore load flow, short circuit/fault analysis, power quality and transient stability analysis have been performed for the proposed evacuation scheme of the Tricom WPP keeping in mind the availability and accommodation capacity of the 132 KV and 220 KV Grid Stations in its vicinity while ensuring compliance with the NEPRA grid code planning criteria.

2 TECHNICAL DATA

The detailed generator data, WTG arrangement in wind farm, total wind farm capacity, generator step-up transformer data, proposed switchyard and the proposed reactive power compensation of the subject power project considered in this GIS are provided below:

2.1. Generator Data

- Number of WTGs = 25
- Manufacturer/Model = Gamesa G114-2.0
- Gross capacity = 2.0 MW
- Type = 3
- Voltage = 0.69 kV
- Power factor = 0.95 (Lagging/Leading)

2.2. WTG Arrangement in Wind Farm

- No. of collector groups = 4
- No. of WTGs in one collector group = 3 x 6 WTGs + 1 x 7 WTGs
- Length of each collector group with the switchyard = 3 km

2.3. Total Wind Farm Capacity

- Total gross capacity= 50 MW
- EBOP Losses = .7 MW
- Auxiliary Consumption = 0.7 MW
- Total assumed net output capacity that will flow to the grid= 48.4

2.4. Generator Step-up Transformer Data

- No. of step-up transformers = 25
- Voltage ratio = 0.69/22 kV
- MVA rating = 2.35 MVA
- Percentage Impedance = 10.5%

2.5. Proposed Switchyard of Wind Power Project

- High Voltage (HV) Level = 132 kV
- Medium Voltage (MV) Level = 22 kV
- Bus Bar Scheme = Double bus single breaker
- Proposed Breaker scheme = GIS
- Power (HV/MV) transformer:
    a. No. of transformers = 2
    b. Voltage ratio = 132/22 kV
    c. MVA rating = 31.5/40/50 MVA
    d. Percentage Impedance =10.5%
- Single line diagram attached in Appendix-1

3 STUDY OBJECTIVES, ASSUMPTIONS AND CRITERIA

3.1 Study Objectives

The primary purpose of this GIS is to evaluate the given network scenario and propose an interconnection scheme for the 50MW Tricom WPP whereby the generated power is transmitted in such a way so as to ensure stability and reliability of the national grid, while complying with the N-1 Contingency requirements and other applicable planning criteria of the Grid Code. Furthermore to investigate the impact of Tricom WPP on the adjacent HESCO Grid Stations and the other way around.

Whereas specific tasks undertaken in this GIS are stipulated below:

- To create a scheme for the interconnection at 132 KV, keeping in mind the availability of space at terminal substations.
- To conduct and scrutinize the load flow analysis of the proposed interconnection scheme under steady state, normal and N-1 contingency conditions of the system so as to ensure an efficient power evacuation scheme.
- To conduct and scrutinize the load flow analysis of the proposed interconnection scheme in curtailment settings, under steady state, normal and N-1 contingency conditions of the system so as to ensure an efficient power evacuation scheme.
- To simulate the fault current from the Tricom WPP to see its effect on the proposed Tricom WPP sub-station and determine whether it remains within the short circuit ratings of the specified equipment.
- Furthermore to model the impact of the fault current on the increase of short circuit current in the adjoining and adjacent 220KV and 132KV substations/networks and determine whether they remain within their equipment ratings.
- To conduct the transient stability analysis by applying a 3-phase fault on the network and plot various parameters to check if the transient fault dies out after five cycles and nine cycles respectively to ensure the system remains stable.

3.2 Study Assumptions

Following are some of the important assumptions that were used for this study:

- Load demand was forecasted taking into account the most recent and revised available data.
- The generation plan used for the subject study is up-to-date, as it has an important role in planning of power systems.
- In curtailment settings the power generation from the upcoming WPPs and Tricom WPP are capped 07MW each.
- The transmission expansion plans of NTDC and HESCO are the optimal ones as per load demand and generation requirements
- The transmission plans of NTDC and HESCO would be implemented as per their expected CODs, especially around the subject study region.
- The existing and already proposed shunt compensation capacitors of HESCO are considered.
- Applicable seasonal conditions and appropriate study year for the subject System study are taken, which is peak load scenario 2019 and 2021.
- Considered the interconnection arrangements of upcoming and existing WPPs at Jhimpir and Gharo, district Thatta, Sindh. While under-construction 220/132 kV GS consisting Jhimpir New-1, Jhimpir New-2 and Gharo New are assumed to have allied transmission lines commissioned.
- The total gross and net capacity of Tricom WPP have been assumed as 50 MW and 48.4 MW respectively.
- The modeling and simulations of 50 MW Tricom WPP in PSS@E 34 software has been made as under:

  1) Twenty five WTGs and four collector groups in the wind farm with each WTG having gross capacity of 2 MW and generating power at 0.69 kV which has been stepped up to 22 kV through 2.35 MVA transformer.

  2) Out of four collector groups, three collector groups comprising of 6 WTGs have been modeled with 2x6=12 MW capacity each and equivalent 0.69/22 kV transformers and one collector group

comprising of 7 WTGs has been modeled with 2x7=14 MW capacity and equivalent 0.69/22 kV transformer.

3) Each of the four collector groups have been connected through individual 22 kV cables with 22 kV bus bar of the 132/22 kV substation.

4) At 132/22 kV substation, 2 no. 132/22 kV transformers have been modeled separately. The percentage impedance voltage of 132/22 kV transformer has been assumed as 10.5% each.

- The modulations of adjacent WPPs in the vicinity of Tricom WPP is done according to their WTG capacities and collector group configurations.

3.3 Study Criteria

The Tricom WPP GIS has been conducted while considering the following system operating criteria/limits in compliance with the NEPRA Grid Code:

Voltage Limits	±5% under normal and ±10% under contingency conditions. However, voltages at some generation buses and some substations may be kept up to +8% under normal operating conditions as per network configuration and/or system requirements.
Transmission Line Loading Limits	80% under normal and 100% under N-1 contingency conditions.
Transformer Loading Limits	80% under normal and 110% under N-1 contingency conditions.
Frequency Limits	49.8 – 50.2 Hz under normal condition and 49.4 – 50.5 Hz under N-1 condition.
Stability Criteria	System stability must be maintained after subjected to the following disturbances • 3-phase fault at bus bar cleared in 5-cycles/ 100 ms (normal clearing condition) and tripping of the associated circuit.

- 3-phase fault at bus bar cleared in 9 cycles/180 ms (delayed clearing or stuck breaker condition) and tripping of the associated circuit.

Low Voltage Ride Through (LVRT) Requirements	A wind power plant must withstand a voltage dip down to 30% of retained voltage for a duration of at least 100 ms for a normal clearing case, and at least 180 ms in the case of stuck breaker contingency event. The wind power plant shall manage active power restoration, after the voltage recovery, at a rate of at least 20% of nominal output power per second, subject to availability of adequate wind speed at site.

4 PROPOSED INTERCONNECTION SCHEME

The proposed integrated interconnection scheme provided below has been engineered and designed while considering the existing and upcoming WPPs (while also taking into account the Tricom Solar Power Project lying in Jhimpir) keeping in view their generation capacities, locations and the existing/planned system networks in its vicinity, for reliable dispersal of power from the 50 MW Tricom WPP to the National Grid.

Proposed Interconnection Scheme:

- The interconnection scheme of Tricom WPP includes 132 kV S/C transmission line, on greeley conductor. The Tricom WPP is located between the upcoming 50 MW Sinowell and 50 MW Norinco 2 WPP's, whereas the distance of both power projects from the subject project is approximately 5.5 Km each for looping in/out.

- All other wind power generation plants evacuating their power to Jhimpir-1 and Jhimpir-2 grid stations are also included in the simulation as per proposed inter-connection scheme

The transmission line lengths of the proposed interconnection scheme are approximated.

Furthermore, the proposed interconnection scheme of the 50 MW Tricom WPP is provided in Appendix-1, whereas the geographical location is provided in Appendix-2.

INTERCONNECTION SCHEME FOR POWER EVACUATION OF 50 MW TRICOM WIND POWER PROJECT

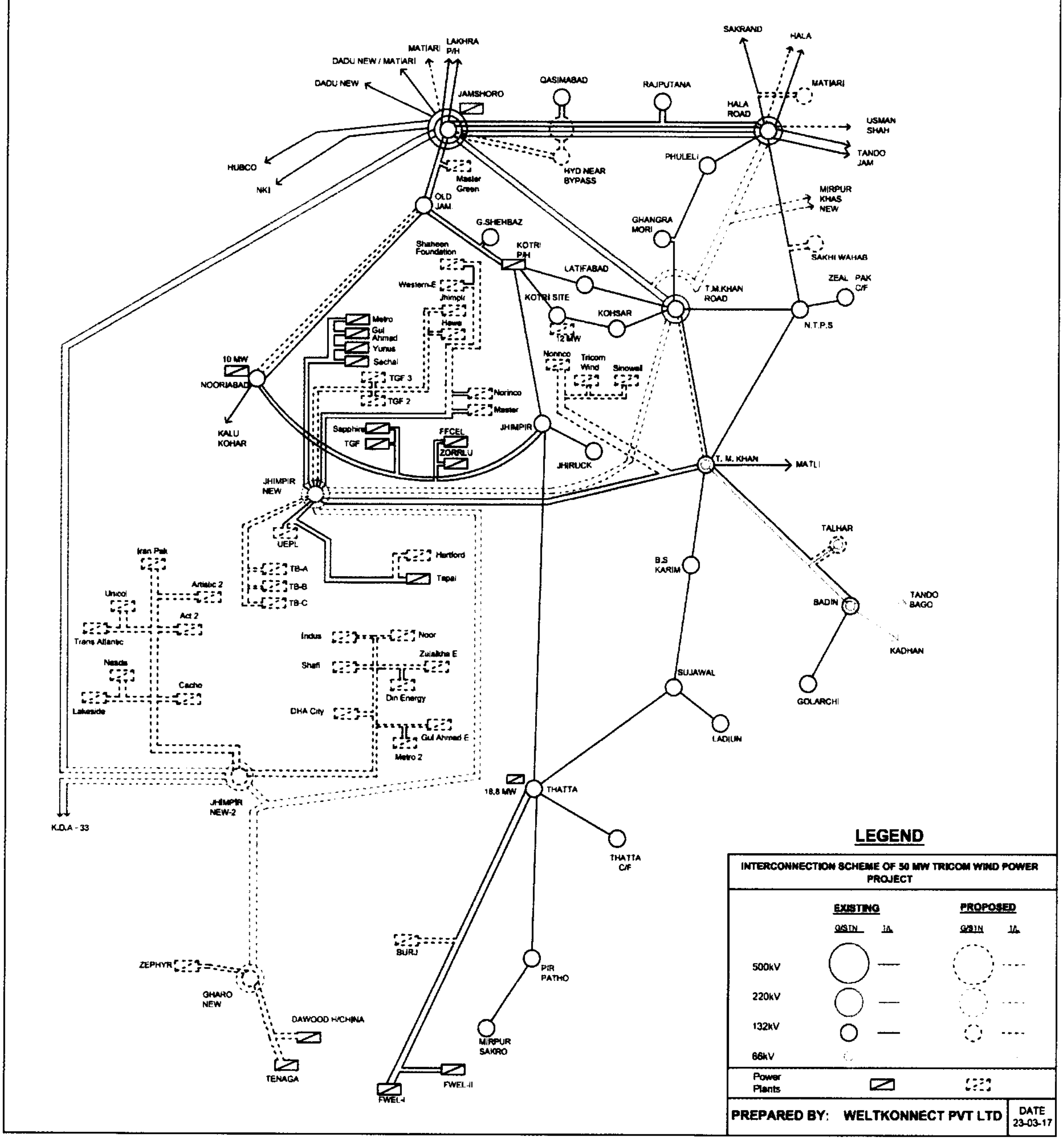

Figure 4.1 Power Evacuation Scheme

5 LOAD FLOW STUDIES

The proposed GIS results were examined by performing thorough load flow analysis under various operating scenarios with maximum dispatch from all the upcoming and already existing WPPs in the vicinity of Jhimpir and Gharo regions to investigate and ensure reliable power evacuation from the 50 MW Tricom WPP to the National Grid.

Herein system simulations and modulations were done for peak load conditions for years 2019 and 2022 to evaluate the consistency of the proposed interconnection scheme and reliable performance of Tricom WPP under normal and N-1 contingency conditions. Furthermore, the load flow studies have also been conducted for off-peak load condition in 2019.

The load flow studies Exhibits as covered in this sections are provided in Appendix-3. Whereas the results obtained after doing detailed load flow analysis for dispersal of power from Tricom WPP to the National Grid are discussed below:

5.1 Peak Load 2019 Scenario

Load flow analysis for the year 2019 has been conducted for the peak load condition under normal system conditions with a net output of 48.4 MW from the Tricom WPP as provided in Exhibit # 1.0. The power flow through the transmission lines, transformers, WPPs including Tricom WPP and surrounding network is presented in this simulation and the result summarized below.

Load flow analysis under the proposed evacuation scheme shows that the active power (MW) and reactive power (MVA) flowing from Tricom WPP and WPPs in its vicinity remain within prescribed limits.

5.1.1 **N-1 Contingency Analysis**

The load flow analysis during peak load scenario of 2019 have been conducted for N-1 contingency conditions. Whereas the summarized results of contingency simulations are provided as Exhibit# 1.1 to 1.13 below:

EXHIBIT #	Contingency Conditions
1.1	One collector group

1.2	Switchyard Transformer at Tricom WPP
1.3	Tricom WPP to Norinco-2 S/C out
1.4	Tricom WPP to Sinowell S/C out
1.5	Sinowell to T.M Khan S/C out
1.6	Shaheen F to Jhimpir-1 S/c out
1.7	Norinco-2 to Jhimpir-1 S/C out
1.8	Western-E to Norinco S/C out
1.9	220/132 kV Transformer at Jhimpir-1 132 kV S/C
1.10	TM.KH.RD to Jhimpir-1 S/C out
1.11	Jhimpir-2 to Jhimpir-1 S/C
1.12	Jhimpir to Thatta S/c out
1.13	Dadu to Jamshoro S/c out
1.14	Dadu to Matiari S/c out

Table 5.1.1.1 Contingency Conditions Peak Load Case 2019

5.1.2 Comments on Normal and N-1 Contingency Analysis

After performing detailed load flow simulations under normal and N-1 conditions it can be concluded that Dadu-Jamshoro and Matiari-Dadu 500 kV transmission lines overloaded in N-1 contingency of Matiari - Dadu and Dadu - Jamshoro 500 kV transmission lines. In order to resolve these overloading curtailment of Peak 2019 has to be conducted.

5.2 Off-peak Load 2019 Scenario

Load flow analysis for the year 2019 has been conducted for the off-peak load condition under normal system conditions with a net output of 48.4 MW from the Tricom WPP as provided in Exhibit # 2.0. The power flow through the transmission lines, transformers, WPPs including Tricom WPP and surrounding network is presented in this simulation and the result summarized below.

Load flow analysis of proposed interconnection scheme under off-peak conditions shows that the active power flow (MW) and reactive power flow (MVA) from Tricom WPP and WPPs in its vicinity remain within prescribed limits.

5.2.1 N-1 Contingency Analysis

The load flow analysis during off-peak load scenario of 2019 have been conducted for N-1 contingency conditions. Whereas the summarized results of contingency simulations are summarized below from Exhibit# 2.1 to 2.13:

EXHIBIT #	Contingency Conditions
2.1	One collector group
2.2	Switchyard Transformer at Tricom WPP
2.3	Tricom WPP to Norinco-2 S/C out
2.4	Tricom WPP to Sinowell S/C out
2.5	Sinowell to T.M Khan S/C out
2.6	Shaheen F to Jhimpir-1 S/c out
2.7	Norinco-2 to Jhimpir-1 S/C out
2.8	Western-E to Norinco S/C out
2.9	220/132 kV Transformer at Jhimpir-1 132 kV S/C
2.10	TM.KH.RD to Jhimpir-1 S/C out
2.11	Jhimpir-2 to Jhimpir-1 S/C
2.12	Jhimpir to Thatta S/c out
2.13	Dadu to Jamshoro S/c out
2.14	Dadu to Matiari S/c out

Table 5.2.1.1 Contingency Conditions Off-Peak Load Case 2019

5.2.2 Comments on Normal and N-1 Contingency Analysis

After performing detailed load flow simulations under normal and N-1 conditions it can be concluded Dadu-Jamshoro and Matiari-Dadu 500 kV transmission lines overloaded in N-1 contingency of Matiari - Dadu and Dadu - Jamshoro 500 kV transmission lines. In order to resolve these overloading curtailment of Off Peak 2019 has been conducted.

5.3 Peak Load 2022 Scenario

Load flow analysis for the year 2022 has been conducted for the peak load condition under normal system conditions with a net output of 48.4 MW from the Tricom WPP as provided in Exhibit # 3.0. The power flow through the transmission lines, transformers, WPPs including Tricom WPP and surrounding network is presented in this simulation and the result summarized below.

Load flow analysis of proposed interconnection scheme under peak load conditions shows that the active power flow (MW) and reactive power flow (MVA) from Tricom WPP and WPPs in its vicinity remain within prescribed limits.

5.3.1 N-1 Contingency Analysis

The load flow analysis during peak load scenario of 2022 have been conducted for N-1 contingency conditions. Whereas the summarized results of contingency simulations are summarized below from Exhibit# 3.1 to 3.13:

EXHIBIT #	Contingency Conditions
3.1	One collector group
3.2	Switchyard Transformer at Tricom WPP
3.3	Tricom WPP to Norinco-2 S/C out
3.4	Tricom WPP to Sinowell S/C out
3.5	Sinowell to T.M Khan S/C out
3.6	Shaheen F to Jhimpir-1 S/c out
3.7	Norinco-2 to Jhimpir-1 S/C out
3.8	Western-E to Norinco S/C out
3.9	220/132 kV Transformer at Jhimpir-1 132 kV S/C
3.10	TM.KH.RD to Jhimpir-1 S/C out

3.11	Jhimpir-2 to Jhimpir-1 S/C
3.12	Jhimpir to Thatta S/c out
3.13	Dadu to Jamshoro S/c out
3.14	Dadu to Matiari S/c out

Table 5.3.1.1 Contingency Conditions Peak Load Case 2022

5.3.2 **Comments on Normal and N-1 Contingency Analysis**

After performing detailed load flow simulations under normal and N-1 conditions it can be concluded that the power flows on transmission lines and transformers around the 50 MW Tricom WPP are within rated limits. Whereas the proposed interconnection scheme considering system and switchyard of WPP will remain with in rated voltage limits. Furthermore there would be no transmission system constraints in the load flow of Tricom WPP on the adjacent HESCO Grid Stations.

5.4 Conclusions of Load Flow Analysis

The results obtained after conducting load flow analysis of peak and off-peak load conditions with normal and N-1 contingency conditions shows that the proposed interconnection scheme for evacuation of power from the 50 MW Tricom WPP to the HESCO network and National Grid at large, has been found reliable in various operating scenarios and fulfills the requirements of the NEPRA Grid Code and other applicable Planning Criteria.

However it is observed that Jamshoro - Dadu and Dadu - Matiari 500 KV transmission lines are overloaded in N-1 contingency conditions of Jamshoro - Matiari and Jamshoro - Dadu 500 KV transmission lines.

6 CURTAILMENT LOAD FLOW STUDIES

Further to the analysis conducted in Chapter 5, the proposed evacuation scheme has been examined by performing thorough load flow analysis under a curtailment operating scenario in order to resolve the issue of overloading of Jamshoro-Dadu and Dadu-Matiari 500KV transmission lines in N-1 contingency condition for cases of Peak and Off Peak 2019, with dispatch of 7 MW for upcoming Lake Side WPP , Nasda WPP, Uni Energy WPP, Noor WPP, Sinowell WPP, Master Green WPP, Iran Pak WPP, Norinco-2 WPP, DHA City WPP, and Tricom Wind WPP while the power of Metro-2 is dispatched to 09 MW.

The load flow studies Exhibits as covered in this sections are provided in Appendix-4. Whereas the results obtained after doing detailed load flow analysis for dispersal of power from Tricom WPP to the National Grid are discussed below:

6.1 Peak Load 2019 Scenario under N-1 contingency condition

Load flow analysis for the year 2019 has been conducted for the peak load condition under N-1 system conditions with a net output of 6.2 MW from the Tricom WPP. The power flow through the transmission lines, transformers, WPPs including Tricom WPP and surrounding network is presented in this simulation and the result summarized below in Exhibit# 4.1 to 4.2.

Load flow analysis under the proposed evacuation scheme shows that the active power (MW) and reactive power (MVA) flowing from Tricom WPP and WPPs in its vicinity remain within prescribed limits.

EXHIBIT #	Contingency Conditions
4.1	Dadu to Jamshoro S/c out
4.2	Dadu to Matiari S/c out

Table 6.1.1 Curtailment Contingency Conditions Peak Load Case 2019

6.1.1 Comments on N-1 Contingency Analysis

After performing detailed load flow simulations in Peak Load 2019 under N-1 conditions under a curtailment operating scenario with dispatch of wind power plants mentioned above, the overloading of transmission line from Jamshoro 500 KV to Dadu

500 KV by conducting N-1 contingency from Dadu 500 KV to Matiari 500 KV transmission line and the overloading of 500 kV transmission lines i.e. Dadu – Matiari and Jamshoro - Dadu has been resolved.

6.2 Off-peak Load 2019 Scenario under N-1 contingency condition

Load flow analysis for the year 2019 has been conducted for the off-peak load condition under N-1 system conditions with a net output of 6.2 MW from the Tricom WPP. The power flow through the transmission lines, transformers, WPPs including Tricom WPP and surrounding network is presented in this simulation and the result summarized below in Exhibit# 5.1 to 5.2:

Load flow analysis of proposed interconnection scheme under off-peak conditions shows that the active power flow (MW) and reactive power flow (MVA) from Tricom WPP and WPPs in its vicinity remain within prescribed limits.

EXHIBIT #	Contingency Conditions
5.1	Dadu to Jamshoro S/c out
5.2	Dadu to Matiari S/c out

Table 6.2.1 Curtailment Contingency Conditions Off-Peak Load Case 2019

6.2.1 Comments on Normal and N-1 Contingency Analysis

After performing detailed load flow simulations in Peak Load 2019 under N-1 conditions under a curtailment operating scenario with dispatch of wind power plants mentioned above, the overloading of Jamshoro – Dadu and Dadu – Matiari 500 KV transmission lines in N-1 contingency of Dadu – Matiari and Jamshoro – Dadu 500 KV transmission lines respectively has been resolved.

6.3 Conclusions of Load Flow Analysis

The results obtained after conducting curtailed load flow analysis of peak and off-peak load under N-1 contingency conditions shows that the proposed interconnection scheme for evacuation of power from the 50 MW Tricom WPP to the HESCO network and National Grid at large, has been found reliable in various operating scenarios and fulfills the requirements of the NEPRA Grid Code and other applicable Planning Criteria.

From the above Load flow analysis it is concluded that there is need of curtailment in case of Peak and Off Peak Load scenarios of 2019 to overcome the issue of overloading Jamshoro – Dadu and Dadu – Matiari 500 KV transmission lines in N-1 contingency condition.

However there is no need of curtailment in case of 2022 and power flow may be controlled via two planned HVDC bipoles from south to mid country.

7 SHORT CIRCUIT STUDIES

In order to simulate and observe the short circuit current contributions by the subject project to the 132KV local network of HESCO, the maximum and minimum three phase and single phase short circuit levels of all the buses of the plant were computed at the substations located in vicinity of the project. It is evident from the short circuit analysis that the induction of Tricom WPP along with the surrounding WPPs has no adverse impact on the existing and proposed substations in their vicinity.

7.1 Methodology and Assumptions

The IEC 60909 methodology provided in PSSE V.34 was applied while conducting the short circuit analysis of the Tricom WPP. Under IEC 60909 the following assumptions are deployed during the calculation of the maximum and minimum short circuit currents:

- The tap ratios set to unity
- The line charging set to Zero
- The shunt set to zero in positive sequence
- Set voltage magnitude at bus bars equal to 1.10 p.u for maximum short circuit analysis and 0.9 p.u for minimum short circuit analysis.

For conducting short circuit analysis of the proposed grid interconnection scheme of Tricom WPP, the parameters of generator and step-up transformer assumed as described in Chapter #2. The summarized results of maximum and minimum short circuit analysis are provided in Appendix-5.

7.2 Short Circuit Study Results

Evaluation of the maximum three phase and single phase short circuit levels at the switchyard of Tricom WPP and adjacent Grid Stations, has been conducted for the proposed grid interconnection scheme by using the parameters for generator and step-up transformers in its vicinity. The studies have been carried out for the year 2022 with all the existing and planned generation in operation and with interconnected transmission system. The summarized simulations of maximum short circuit studies for the year 2022 are tabulated as below:

S no	Name of Faulted Bus Bars	Maximum Short Circuit Levels	
		Three Phase (kA)	Single Phase (kA)
1	Tricom WPP 132 kV	8.8	7.4
2	Sinowell WPP 132 kV	8.1	7.1
3	Norinco 2 WPP 132 kV	9.05	7.4
4	T.M.KHAN 132 kV	13.5	12.9
5	Jhimpir-1 220Kv	20.8	16.3
6	TM.KH.RD 220Kv	20.9	17.2
7	Jhimpirr-2 220 Kv	26.8	19.7
8	Shaheen-F 132KV	7.7	6.9
9	Jhimpir 132Kv	10.4	9.6
10	Thatta 132 Kv	6.07	5.9
11	Dadu 500 Kv	20.5	7.5
12	Hala Road 220 Kv	26.9	20.7
13	Hub 500 Kv	17.8	16.7
14	Jamshoro 500 Kv	36.1	29.5
15	Matiari cs 500 KV	38.1	24.8
16	Niki 500 Kv	18	14.5

Table 7.2.1 Maximum Short Circuit Levels

7.3 Conclusions of Short Circuit Analysis

After analyzing the results obtained from short circuit analysis of the proposed interconnection scheme, it is concluded that the 50 MW Tricom WPP and its surrounding WPPs have no adverse impact on the existing and proposed substations in their vicinity as far as short circuit levels are concerned. The observed short circuit fault levels are 8.8 kA and 7.4 kA for maximum three phase and single phase respectively at the 132 kV switchyard of Tricom WPP in the year 2022. However these values are expected to rise due to future expansion and upcoming WPPs in the corresponding HESCO network. Therefore, the short circuit rating of 40 kA would be suitable for the 132 kV switchyard equipment of 50 MW Tricom WPP.

8 TRANSIENT STABILITY STUDIES

Transient stability studies have been carried out with the proposed interconnection scheme to evaluate the dynamic response of generators and the power system after occurrences of faults. The transient stability simulations are used to check in time domain whether the generators at and in the vicinity of Tricom WPP as well as the power system remain stable after subjected to severe disturbances as per the Grid Code requirement.

8.1 Study Methodology

The dynamic simulation model of the entire network has been developed in the PSS/E software. The dynamic model parameters of WTG Type-3 used for Tricom WPP, in the studies are attached in Appendix-6.

However there are suspects in dynamic simulation by using WT3G2 model to avoid this issue WT3G1 model is assumed.

On the other hand, the dynamic models/parameters of generators, exciters and governors of all the other power plants, already available in Planning (Power) NTDCL, have been used in the analysis.

The two severe types of disturbances simulated to assess the stability of the Tricom WPP and the power system as per the applicable NEPRA grid code criteria are given as under:

- 3-phase fault at bus bar cleared in 5-cycles (100 ms) and tripping of the associated circuit.
- 3-phase fault at bus bar cleared in 9 cycles (180 ms) (delayed clearing or stuck breaker condition) and tripping of the associated circuit.

The simulations have been run in the time domain in the following sequence:

- Running simulation for initial one second for pre-fault steady state condition.
- Fault application at 1.0 second and running the simulation up to 1.1 second for 5 cycle fault (up to 1.18 second for 9 cycle fault).
- Fault clearance at 1.1 second for 5 cycle fault (1.18 second for 9 cycle fault) and tripping of the associated circuit.
- Running simulation up to 10 seconds after fault clearance.

The following generator and network parameters are monitored in the simulations and have been presented in the report through the following stability plots for each type of disturbance:

i. Bus frequency and voltage
ii. WTG (Pmechanical, Speed, Speed Deviation, Pitch, Aero Dynamic Torque, Paero, angle, active and reactive power output)
iii. Line power flows, i.e., P (MW) & Q (MVAR)

In order to interpret the stability plots, the bus numbers assigned to the bus bars and the voltage levels, are given as under:

BUS NUMBER	BUS NAME/VOLTAGE
81134	Tricom Wind 132 kV
811210	Tricom Wind MV
811217	Tricom Wind LV
9428	Jhimpir 1 132 KV
9220	TM Khan 132 KV

Table 8.1.1 Stability Analysis

8.2 Transient Stability Analysis Results

The transient stability analysis for Tricom WPP with the proposed interconnection scheme has been carried out for peak load 2019 scenario. The stability of the Tricom WPP and the power system has been tested with application of different disturbances on the wind farm and at the substations in its vicinity. The plotted results of the stability simulations are attached in Appendix-6 and described as under:

8.2.1. For Normal Clearing Time (100 ms)

The transient stability studies for faults with normal clearing time of 100 ms corresponding to 5 cycles, have been carried out. The details of the faults & the associated outages, monitored variables, respective exhibits and stability behavior of Tricom WPP & other generators as well as the power system are mentioned and presented in the following table:

Fault Location	Circuit Outage	Exhibit #	Monitored Variable
Tricom WPP 132kV Bus	Tricom Wind to Norinco 2	1.1	Bus Frequency
		1.2	Bus Voltage
		1.3	WTG Collector Group Output (P)
		1.4	WTG Collector Group Output (Q)
		1.5	Pmech
		1.6	Speed of WTG
		1.7	Power Flow from Tricom Wind to Sinowell
		1.8	Power Flows (Q)
Tricom Wind MV	One Collector Group Out at Tricom WPP 132kV S/C	1.9	Bus Frequency
		1.10	Bus Voltage
		1.11	WTG collector group Output (P)
		1.12	WTG collector group Output (Q)
		1.13	Pmech
		1.14	Power Flows (P)
		1.15	Power Flows (Q)
		1.16	Speed of WTG
Tricom Wind LV	Tricom Wind to Sinowell	1.17	Bus Frequency
		1.18	Bus Voltage
		1.19	WTG collector group Output (P)

Fault Location	Circuit Outage	Exhibit #	Monitored Variable
		1.20	WTG collector group Output (Q)
		1.21	Pmech
		1.22	Power Flows (P)
		1.23	Power Flows (Q)
		1.24	Speed of WTG
Jhimpir 1 220 KV	Jhimpir-1 to Jhimpir- 2 220 KV circuit	1.25	Bus Frequency
		1.26	Bus Voltage
		1.27	WTG collector group Output (P)
		1.28	WTG collector group Output (Q)
		1.29	Pmech
		1.30	Power Flows (P)
		1.31	Power Flows (Q)
		1.32	Speed of WTG
TM Khan 132 KV	TM Khan to Jhimpir- 1 New 132 kV circuit	1.33	Bus Frequency
		1.34	Bus Voltage
		1.35	WTG collector group Output (P)
		1.36	WTG collector group Output (Q)
		1.37	Pmech
		1.37	Power Flows (P)
		1.38	Power Flows (Q)
		1.39	Speed of WTG

Table 8.2.1.1 Stability Analysis for 5 cycles

It is evident from the above stability Exhibits that Tricom WPP meets LVRT requirements as mentioned in the NEPRA Grid Code Addendum for WPPs.

8.2.2. For Delayed Clearing Time (180 ms)

The transient stability studies for faults with delayed clearing time of 180 ms corresponding to 9-cycle fault (stuck breaker condition) have been carried out. The details of the faults & the associated outages, monitored variables, respective exhibits and stability behavior of Tricom WPP & other generators as well as the power system are mentioned and presented in the following table:

Fault Location	Circuit Outage	Exhibit #	Monitored Variable
Tricom WPP 132kV Bus	Tricom Wind to Norinco 2 132kV	2.1	Bus Frequency
		2.2	Bus Voltage
		2.3	WTG Collector Group Output (P)
		2.4	WTG Collector Group Output (Q)
		2.5	Pmech
		2.6	Speed of WTG
		2.7	Power Flow from Tricom Wind to Sinowell
		2.8	Power Flows (Q)
Tricom Wind Mv	One Collector Group Out at Tricom WPP 132kV	2.9	Bus Frequency
		2.10	Bus Voltage
		2.11	WTG collector group Output (P)
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		2.13	Pmech
		2.14	Power Flows (P)
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		2.16	Speed of WTG
Tricom Wind LV	Tricom Wind to Sinowell	2.17	Bus Frequency
		2.18	Bus Voltage
		2.19	WTG collector group Output (P)

Fault Location	Circuit Outage	Exhibit #	Monitored Variable
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		2.29	Pmech
		2.30	Power Flows (P)
		2.31	Power Flows (Q)
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		2.34	Bus Voltage
		2.35	WTG collector group Output (P)
		2.36	WTG collector group Output (Q)
		2.37	Pmech
		2.37	Power Flows (P)
		2.38	Power Flows (Q)
		2.39	Speed of WTG

Table 8.2.2.1 Stability Analysis for 9 cycles

It is evident from the above stability Exhibits that Tricom WPP meets LVRT requirements as mentioned in the NEPRA Grid Code Addendum for WPPs.

8.3 Conclusions of Transient Stability Analysis

The results of transient stability analysis indicate that Tricom WPP & other generators in its vicinity and the power system remain stable with no adverse effects after subjected to severe disturbances either on Tricom WPP or at the other substations in its vicinity. The stability simulations also proved that the proposed Tricom WPP fulfills the LVRT criteria as mentioned in the NEPRA's Grid Code Addendum for WPPs.

9 POWER QUALITY ANALYSIS

In the grid interconnection study of any power plant as in the case of Tricom WPP, Power quality analysis has immense importance for investigating the distortions in the power supply.

Flickers and distortions became more prominent in power systems having low short circuit strength leading to significant problems. Therefore power quality analysis including the investigation of voltage unbalance and flicker effects on the power system has been carried out. This analysis has been carried out for the prescribed interconnection scheme for evacuation of power from the 50MW Tricom WPP. The worst case scenario with the minimum short circuit levels for 2019 has been considered for this purpose.

9.1 Flicker

In order to calculate flicker levels of steady state continuous operations IEC61400-21 standard have been followed. Following formula has been assumed and calculated for the probability of 99th percentile flicker emission from a single inverter during continuous operation for short time $P_{st\Sigma}$ and long-time flicker level $P_{lt\Sigma}$.

$$P_{st\Sigma} = P_{lt\Sigma} = \frac{1}{S_k} \cdot \sqrt{\sum_{i=1}^{N_{wt}} (c_i(\psi_k, \upsilon_a) . S_{n,i})^2} \qquad \text{(A)}$$

Where

- Sn = rated apparent power of the WTG
- Sk = short-circuit apparent power at PCC
- Nwt = number of WTGs connected to the PCC

The value of c (ψk) may not be greater than 1, therefore for the present analysis, the value of 1 for the worst case has been assumed. The point of common coupling (PCC), which is 132 kV bus of the switchyard of 50 MW Tricom WPP.

For this analysis, the surrounding network of the 50MW Tricom WPP has been modeled with the minimum generation in operation. The short circuit calculations have been carried out at 0.9 p.u. voltage. Following below are the values used for flicker calculation of proposed power plant.

- Sn = 2.1 MVA
- NWT = 25
- Sk = 1671 MVA

Using the above data in Equation (A), we get

- $P_{St\Sigma} = P_{lt\Sigma} = 0.0062 = 0.62$ %

The tolerable limit in the IEC standard is less than 4%. Hence the flicker level remains far below the maximum allowed limit. So the inverters at the subject power project will not be causing any flicker problem during normal operation of the plant.

9.1.1 Switching Operation

Following condition must be met for conducting switching operations.

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

As per IEC61400-21, flicker emission of many machines from the WPP has been calculated.

$$P_{st\,\Sigma} = \frac{18}{S_k}\,(\sum_{i=1}^{N_{wt}} N_{10,i}\,(k_{f,i}(\psi_k)\,S_{n,i})^{3.2})^{0.31}$$

$$P_{it\,\Sigma} = \frac{8}{S_k}\,(\sum_{i=1}^{N_{wt}} N_{120,i}\,(k_{f,i}(\psi_k)\,S_{n,i})^{3.2})^{0.31}$$

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.

N_{10} and N_{120} are based on field measurement and provided by the manufacturers but if these are not available then IEC61400-21 proposed values are used.

For switching conditions of (a) and (b)

$$N_{10,i} = 10$$
$$N_{120,i} = 120$$

For switching conditions of (c)

$$N_{10,i} = 1$$
$$N_{120,i} = 12$$

After the field and factory measurements, the value of flicker step factor $k_{f,i}(\psi_k)$ is also provided by the manufacturer but for conducting analysis we assume it to be equal to 1.

After substituting and calculating the values as provided in the above equations, we find for switching conditions of (a) and (b) as follows

$$P_{st\,\Sigma} = 0.1178$$

$$P_{it\,\Sigma} = 0.1137$$

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

9.2 Voltage Unbalance

9.2.1 **Voltage Step-Change**

A step change in voltage results from the energization of one a single wind turbine generator. The impedance of the network from the connection point to PCC determines the value of this voltage change. The maximum voltage change should remain less than or equal to 3%. This condition is evaluated through following formula:

$$\Delta V = \sum Swka\left[\left(\frac{1}{Ske}\right) - \left(\frac{1}{Skss}\right)\right] \leq 3\% \qquad \text{(B)}$$

Where

- Swka is the MVA rating of the inverter
- Ske is the Short Circuit MVA at connection point
- Skss is the Short circuit MVA at PCC

The values used in the calculation of voltage step-change are as below:

- Swka = 2.1 MVA
- Ske = 675 MVA

- Skss = 1671 MVA

Using the above data in Equation (B), we get

- ΔV = 0.0018 = 0.18 %

Hence the voltage step change at the wind turbine generator is far less than 3%. Therefore, the wind turbine generator of the Tricom WPP will not cause any voltage step-change problem.

9.2.2 Voltage Fluctuation

The voltage fluctuation is given by the following formula. This is also calculated by considering only one wind turbine generator in operation.

$$Volatge\ Fluctuation = \sqrt{\sum(\frac{Pwka}{Ske})^2} \leq 1/25 \quad \text{or} \quad 4\% \qquad \text{(C)}$$

Where

- P_{wka} is the MW rating of WTG
- Ske is the Short Circuit MVA at PCC

The values used in the calculation of voltage fluctuation are as below:

- Pwka = 2 MW
- Ske = 675 MVA

Using the above data in Equation (C), we get

- Voltage Fluctuation = 0.002962 = 0.2962 %

The maximum allowed voltage fluctuation limit is 4%. The obtained value of voltage fluctuation is far less than the maximum allowed limit so the wind turbine generators of the Tricom Wind power project will not cause any problem.

9.3 Conclusions of Power Quality Analysis

The important parameters examined in this analysis including flicker and voltage unbalance remain within the limits in compliance with the applicable IEC standards. The results show that the flicker and the voltage unbalance are within the limits after the interconnection of the subject wind power plant.

Furthermore, the installation of any required or necessary compensating equipment at the switchyard of the subject power plant is the responsibility of the developer to meet the requisite power quality standards as prescribed in the NEPRA grid code addendum for wind power projects.

10 CONCLUSIONS

Taking into consideration all applicable standards under the prevailing rules and regulations, equipment specifications and system requirements an interconnection scheme has been proposed for the 50 MW Tricom Wind Power Project with the national grid through the local HESCO network.

The proposed integrated interconnection scheme has been conducted while considering existing and upcoming WPPs keeping in view their generation capacities, locations and the existing/planned system network in its vicinity, for reliable dispersal of power from the 50 MW Tricom WPP to the National Grid:

Proposed Interconnection Scheme:

- The interconnection scheme of Tricom WPP includes 132 kV S/C transmission line, on greeley conductor. The Tricom WPP is located between the upcoming 50 MW Sinowell and 50 MW Norinco 2 WPP's, whereas the distance of both power projects from the subject project is approximately 5.5 Km each for looping in/out.

- All other wind power generation plants evacuating their power to Jhimpir-2 grid stations are also included in the simulation as per proposed inter-connection scheme

The 50 MW Tricom Wind Power Project is expected to achieve its Commercial Operational Date (COD) by the fourth Quarter of 2019. Whereby the interconnection analysis has been conducted for peak and off-peak case of 2019 and peak case of 2022 and the results are documented.

The GIS results were further examined for performing the load flow studies to assess the steady state system performance under normal and N-1 contingency conditions and it has been found that all electrical parameters from the Tricom WPP and on the grid are in compliance with the NEPRA grid code planning criteria.

After analyzing the results obtained from short circuit analysis of the proposed interconnection scheme, it is concluded that the 50 MW Tricom WPP and its surrounding WPPs have no adverse impact on the existing and proposed substations in their vicinity as far as short circuit levels are concerned. The observed short circuit fault levels are 8.8 kA and 7.4 kA for maximum three phase and single phase respectively at the 132 kV switchyard of Tricom WPP in the year 2022. However these values are expected to rise due to future expansion and upcoming WPPs in the corresponding HESCO network. Therefore, the short circuit rating of 40 kA would be suitable for the 132 kV switchyard equipment of 50 MW Tricom WPP.

The important parameters examined in this analysis including flicker and voltage unbalance remain within the limits in compliance with the applicable IEC standards. The results show that the flicker and the voltage unbalance are within the limits after the interconnection of the subject wind power plant.

Hence it can be seen that there are no constraints with respect to the technical Analysis performed under steady state load flow, contingency load flows, short circuit currents, transient stability and power quality analysis, thus this proposed Grid Interconnection Scheme of 50 MW Tricom WPP fulfils all the criteria of stability and reliability, and is recommended to be adopted.

APPENDICES

Appendix-1	Proposed Interconnection Scheme & Single Line Diagram
Appendix-2	GIS Location Map of the subject project
Appendix-3	Load Flow Analysis Sketches
Appendix-4	Curtailment Load Flow Analysis Sketches
Appendix-5	Short Circuit Analysis Results
Appendix-6	Transient Stability Analysis Results
Appendix-7	Dynamic Data For Transient Analysis

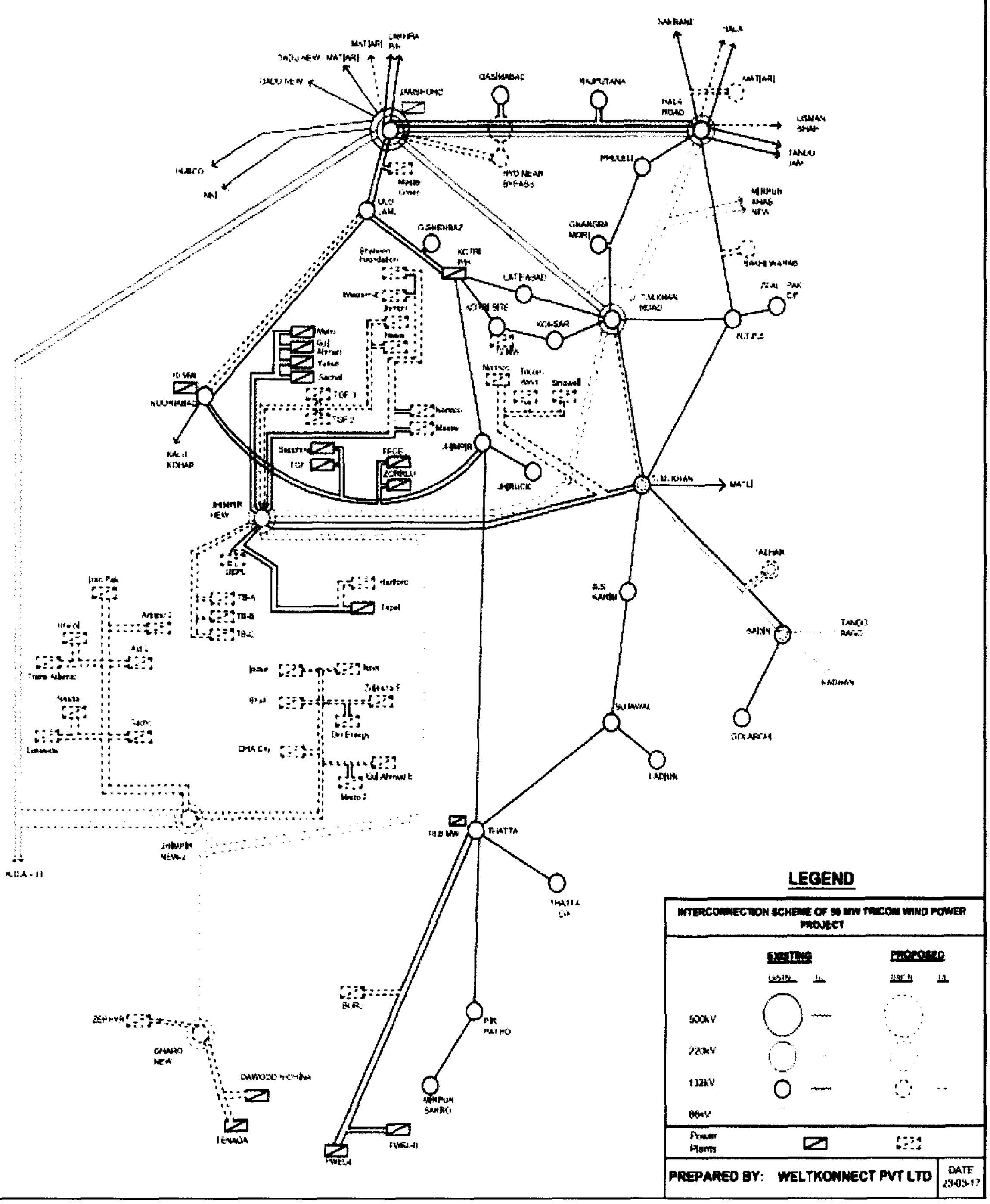
APPENDIX-1

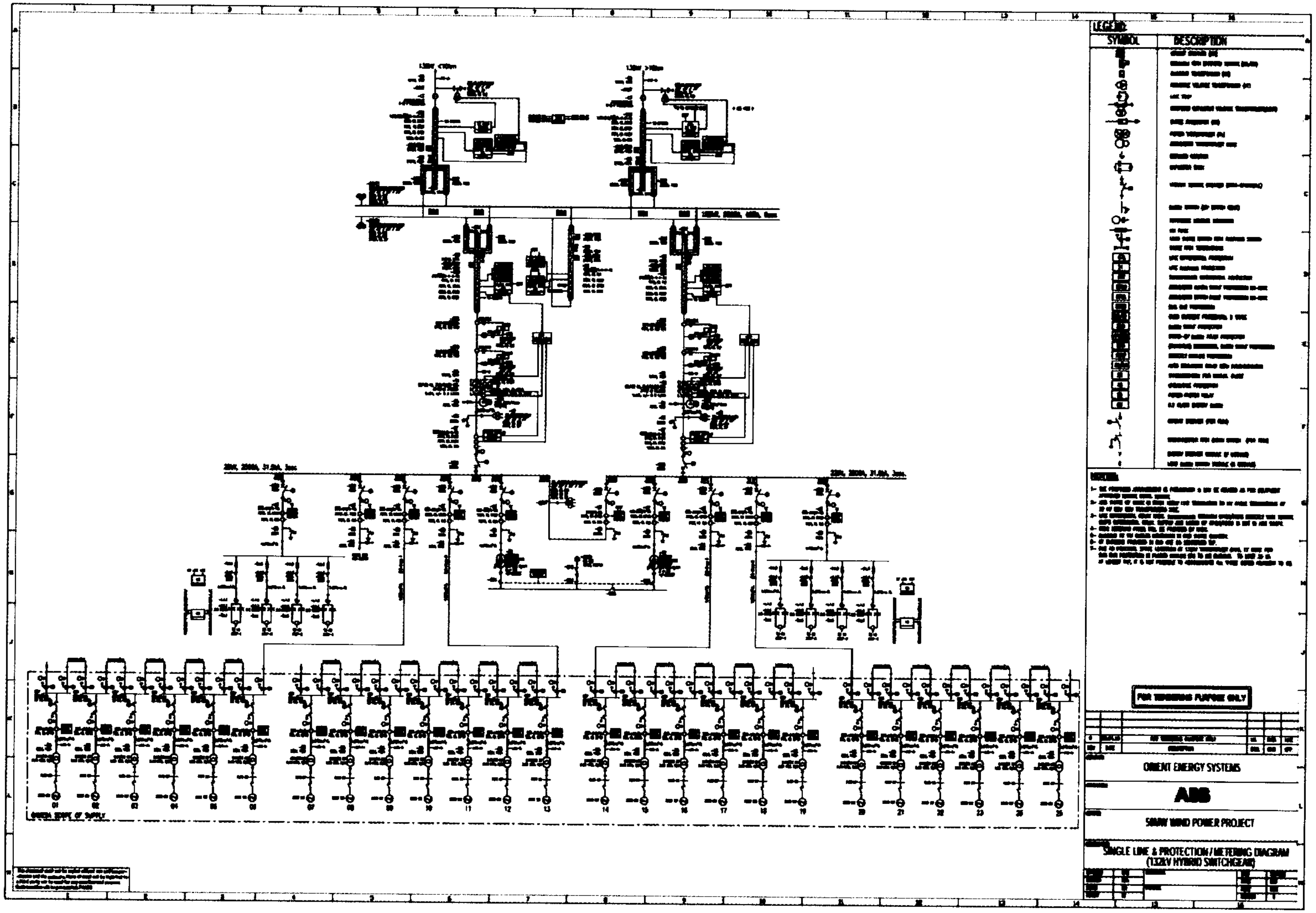
PROPOSED INTERCONNECTION SCHEME

&

SINGLE LINE DIAGRAM

INTERCONNECTION SCHEME FOR POWER EVACUATION OF 50 MW TRICOM WIND POWER PROJECT

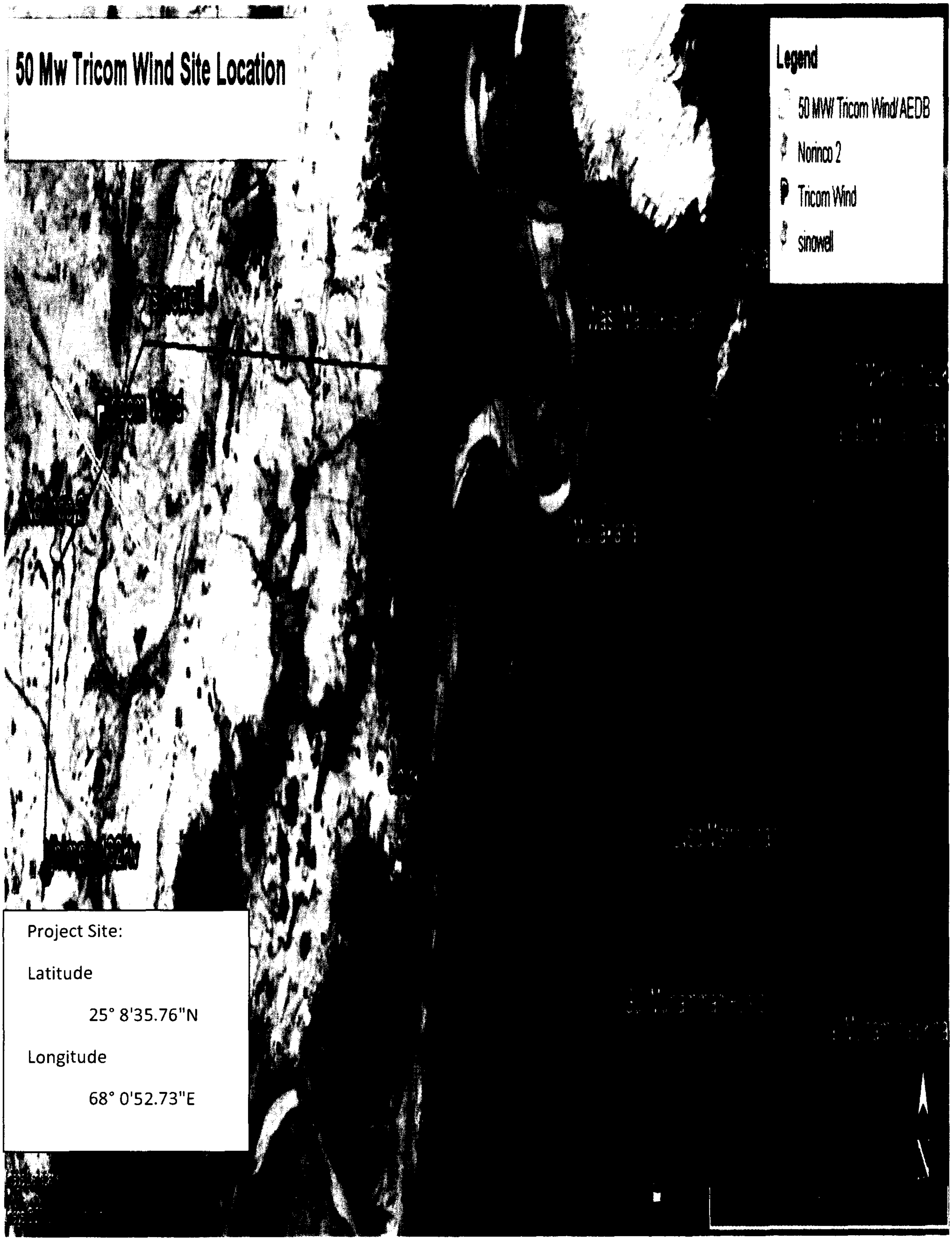




LEGEND
SYMBOL
DESCRIPTION
NOTES
FOR TENDERING PURPOSE ONLY
ORIENT ENERGY SYSTEMS
ABB
50MW WIND POWER PROJECT
SINGLE LINE & PROTECTION / METERING DIAGRAM
(132kV HYBRID SWITCHGEAR)

APPENDIX-2

GIS LOCATION MAP OF THE SUBJECT PROJECT



50 Mw Tricom Wind Site Location
Legend
50 MW Tricom Wind/ AEDB
Norinco 2
Tricom Wind
sinowell
Project Site:
Latitude
25° 8'35.76"N
Longitude
68° 0'52.73"E

ANNEX – V

Initial Environmental Examination (IEE) Report

Reference No EPA/ 2016/04/12/IEE/62

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF SINDH

Plot # ST-2/1, Sector 23, K.A, Karachi 74900
Ph: 5065950, 5065598, 5065637
5065532, 5065946, 5065621
epasindh@cyber.net.pk
Facsimile: 5065940

Dated: 05th September, 2016

SUBJECT: DECISION ON INITIAL ENVIRONMENTAL EXAMINATION (IEE)

1.	**Name & Address of Proponent:**	Director Operations. Tricom Wind Power (Pvt) Limited Office 8, Ground Floor, Evacuee Trust Complex, F-5/1, Islamabad.
2.	**Description of Project:**	Establishment of 50 MW Tricom Wind Energy Project
3.	**Location of Project:**	Project site is located in Jhimpir about 80 km Northeast of Karachi.
4.	**Date of Filing of IEE:**	05-03-2016

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

i) All mitigation measures recommended in IEE report should be complied with, for achieving negligible impacts on physical, biological, environmental and socio-economic resources of the area. Sindh Environmental Quality Standards (SEQS) shall be followed in letter and spirit.

ii) A complete code of Health, Safety and Environment (HSE) shall be developed which should include efficient parameters at specific work place. For this purpose HSE setup should be established and supervised by a designated HSE officer at the senior level with sufficient administrative and technical authority to perform the designated functions. Proponent will make sure that the operating instructions and emergency actions are made available to every worker/labor at the site. Environmental management system shall be made in place during the operation of the project needing towards third party environmental audit and for achievement of ISO14000 standards.

iii) The proponent shall also appoint a reputable research institute or organization to conduct a detailed *cumulative* noise mapping/modeling study of the wind projects in the macroenvironment of project area and its impact on the **sensitive receptors**, if any and same will be submitted to SEPA.

iv) The proponent shall be under obligation to compensate for any significant adverse short term, long term and irreversible impact occurred due to windfarm operations. During the project execution, safe distances of the under mentioned environmental sensitivities will be maintained:

- 500m from communities, industries and main transport network
- 300m from community water well
- 500m from archaeological / cultural site / monument
- Distance will be measured from the tip blade of turbines or / and transmission power lines associated.
- Project activity will not be carried out within buffer zone of any projected area designated under Sindh wildlife protection act.

v) Employment should be provided to local people and assured for unskilled jobs. Skilled jobs shall be given to locals after providing them proper field training, where a minimum training is required. Local people should be informed and explained well in advance about the operation. Compensation should be provided to inhabitants in case of loss of agriculture land, crop property, etc., in accordance with the rates, that are agreed upon. All conflicting issues regarding compensation etc should be settled in advance prior to the start of activity. Benefits to local people will be offered under Corporate Social Responsibility (CSR) policy, community development schemes will be decided in consultation with local communities and may be facilitated by involving district / local Government office.

vi) Local people should be provided with community welfare schemes i.e., draught relief programmes, educational programmes, and establishment of health units, veterinary/live stock care unit etc., which should benefit them and develop mutual trust. Sustainability of these facilities should be ensured.

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

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

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

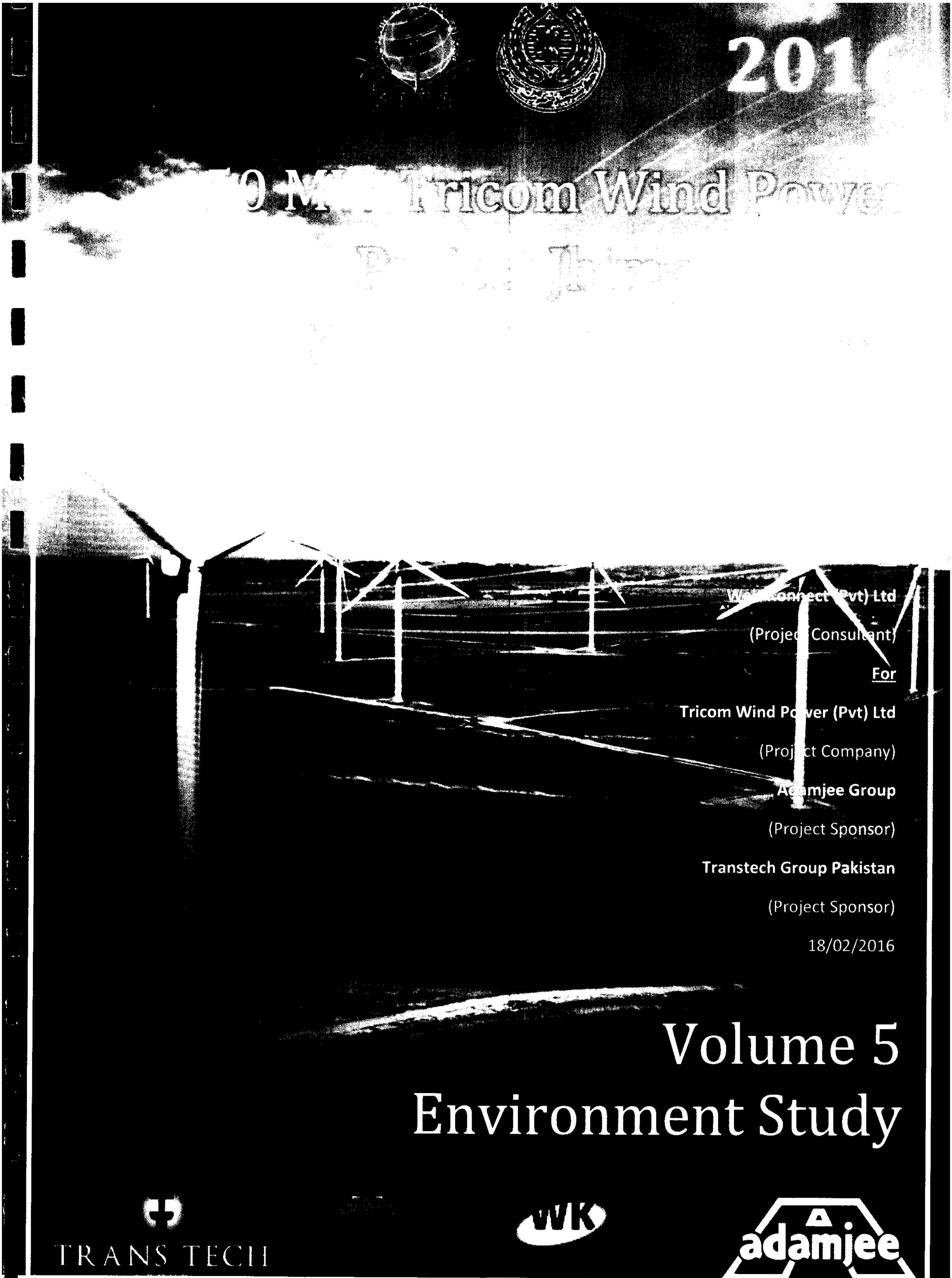
x) The project shall be constructed in the prescribed time strictly as per schedule, which shall be submitted to this office at the start of construction activity.

xi) Compensation will be provided to the inhabitants in case of loss of agriculture land, crop property, etc., in accordance with the rates, that are agreed upon.

xii) The proponent shall appoint an Independent Monitoring Consultant (IMC) whose responsibility shall be to monitor the project activities. The IMC shall ensure that the activities at project site are undertaken in environment friendly manner and the mitigation measures are implemented as per the recommendations of IEE. The report shall include pollutants measurement and analysis reports along with photographic records showing therein the environmental conditions at site during the construction and operation stages of project. The proponent shall be liable to submit monthly environmental monitoring reports to EPA Sindh.

6. This approval shall be treated cancelled if any of the conditions, mentioned in para-5 above is violated. In follow up of the cancellation of this approval prosecution under the provision of Sindh Environmental Protection Act, 2014 will be initiated against the proponent.
7. This approval does not absolve the proponent of the duty to obtain any other approval or consent that may be required under any other law in force.
8. The IEE report is meant only for proposed activities described in IEE only. Proponent should submit separate approval required under regulations, along with site specific Environment Management Plan for any consequent and subsequent activity for approval of EPA, Sindh.

Muhammad Imran Sabir
Deputy Director (Technical)



Windconnect (Pvt) Ltd

(Project Consultant)

For

Tricom Wind Power (Pvt) Ltd

(Project Company)

Adamjee Group

(Project Sponsor)

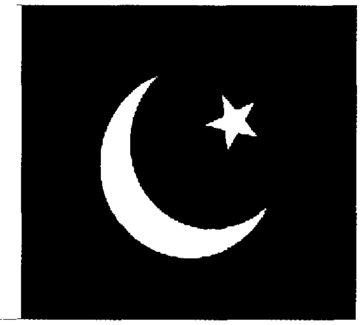
Transtech Group Pakistan

(Project Sponsor)

18/02/2016

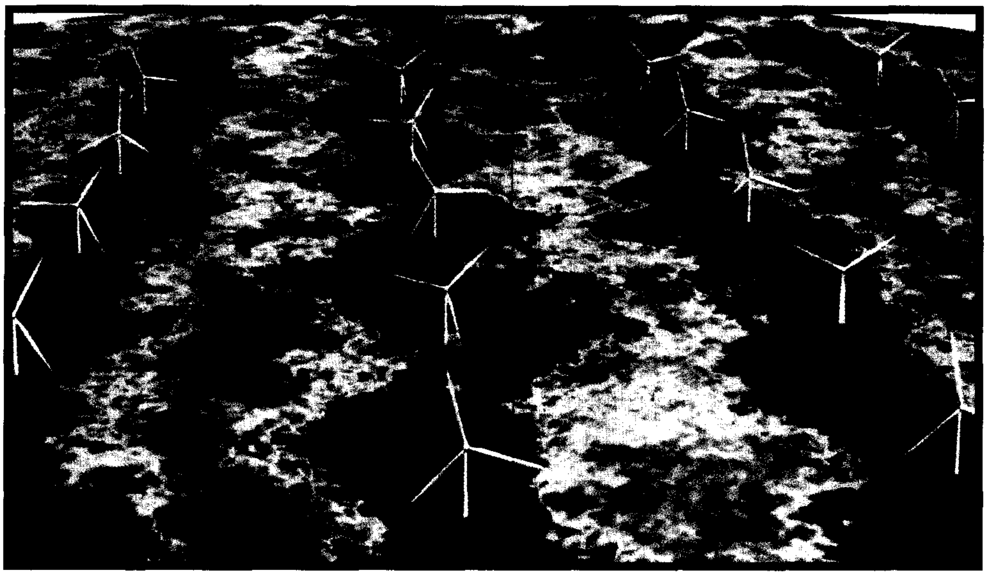
Volume 5
Environment Study

TRANS TECH



Feasibility Study Report
50 MW Wind Power Project In Jhimpir, Sindh, Pakistan

February, 2016



Volume 5
Environment Study

TRICOM WIND POWER (PVT) LTD

A PROJECT COMPANY SPONSORED

BY

adamjee & TRANS TECH GROUP

APPROVAL SHEET

TITLE : Feasibility Report
50 MW Wind Power Project in Jhimpir

DOCUMENT NUMBER : 154-0786-02

CLASSIFICATION : **Un-Classified**

SYNOPSIS

This document is a feasibility study report of a 50 MW Wind Power Project sponsored by the Adamjee Group and Transtech Group Pakistan through the project company Tricom Wind Power (Pvt) Ltd. It is divided into 7 Volumes for ease of review and approvals.

Volume 1: Main Report Part 1: of this report contains detailed information regarding the geographic features of Pakistan, along with the insight to Pakistan's Energy and Electricity market. After discussing the wind energy industry and carbon credit details for information purposes, the volume focuses on mentioning the regulatory regime of the country that is applicable to the project and all legal requirements. The volume also summarizes the salient features of the project.

Volume 2: Main Report Part 2: of the report focuses entirely on the specific details of the project. It provides information on the selected site, the description of the technical equipment and the layout of plant. The report further includes the basis for calculations and designing, by giving details of the grid connections available and yield of power. Prior to conclusion, the report also gives details of the policies and procedures for O&M, Project Management, and tariff calculation. The report concludes with details of the ecological and socio-economic benefits of the project.

Volume 3: Geo-Technical Study Topographic Survey: of the Project Site, with detailed analysis.

Volume 4: Geo-Technical Investigation Report: for the Project Site, including Soil Testing

Volume 5: **Environmental Study:** contains the Initial Environmental Examination Report (IEE), submitted to the Environmental Protection Agency (EPA) of Sindh.

Volume 6: Clean Development Mechanism: is currently under preparation and shall be composed of the Project Idea Note (PIN's), the Letter of Intent (LOI) issued by the Designated National Authority (DNA) the Clean Development Mechanism Cell of Pakistan, Ministry of Climate Change, followed by the Prior Consideration form, the Project Design Document (PDD's) and the Host Country Approval (HCA) by the DNA.

Volume 7: Grid Interconnection Study is being conducted and shall be duly submitted for approval to the National Transmission Dispatch Company (NTDC).

DATE: 18th February 2016

TABLE OF PROFESSIONALS

Sr. No.	Work Scope	Reviewed By	Designation	Approved By
1	Project Management, Economic Evaluation and FSR Compilation	Haseen ullah Khan	Projects and Investment Expert	Habil A. Khan
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10	Engineering Electrical and Instrument Controls	Noman Naseer	Electronics Engineer	Yousuf Khan
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14	Engineering and Vendor Selection for WTG's, Inverters and Equipment	Naveed Ahmed	Electronics Engineer	Yousuf Khan
15	Engineering Geology	Daniyal Haider	Electronics Engineer	Yousuf Khan
16	Engineering task force analysis	Adil Mustafa	Electronics Engineer	Yousuf Khan
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PREPARED BY: **Mr. Zeeshan Ahmed**
Mr. Yousuf Khan

REVIEWED BY: **Mr. Habil Ahmed Khan**

APPROVED BY: **Mr. Fiaz Ahmad**

Revisions

S#	REV. #	DATE	VOL #	SECTION	DESCRIPTION OF CHANGE

DISTRIBUTION

1. Directorate of Alternate Energy, Energy Department, Government of Sindh (DAE GOS)
2. Panel of Experts Assembled by DAE GOS
3. Tricom Wind Power (Pvt) Ltd
4. Adamjee Group
5. Transtech Group Pakistan
6. Welt Konnect (Pvt) Ltd

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LIST OF EXTRACTS

LIST OF ABBREVIATIONS

ADG	Adamjee Group
AC	Alternate Current
DAE GOS	Alternative Energy Development Board
Approx.	Approximately
BM	Build Margin
BOO	Build Own and Operate
BOR	Board of Revenue
CDA	Cholistan Development Authority
CDM	Clean Development Mechanism
CDMA	Code division multiple access
CERs	Certified Emission Reductions
cm	Centimeter
CM	Combined Margin
CMA	Certified Management Accountant
CNG	Compressed natural Gas
CO2	Carbon dioxide
COD	Commercial Operational Date
CoP	Conference of the Parties

CPPA	Central Power Purchasing Agency
DAE	Directorate of Alternative Energy, Energy Dept. Govt. of Sindh
DC	Direct Current
DCO	Deputy Commissioner Office
deg	Degree
DG	Diesel Generator
DGPs	Dual Global Positioning System
DISCOs	Distribution Companies
DNA	Designated National Authority
DOE	Designated Operational Entity
EE	Energy Efficiency
EF_y	Baseline Emission Factor
EIA	Environmental Impact Analysis
EMC	Electromagnetic Compatibility
EMP	Environment Management Plan
EPA	Energy Purchase Agreement
EPC	Engineering Procurement Construction
EU	European Union
FDI	Foreign Direct Investment

FSR	Feasibility Study Report
GDP	Gross Domestic Product
GENCOs	Generation Companies
GHG	Green House Gas
GIS	Geographic Information System
GoP	Government of Pakistan
GoS	Government of Sindh
GPS	Global Positioning System
GSM	Global System for Mobile Communications
GTZ/GIZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HAWT	Horizontal Axis Wind Turbine
HCA	Host Country Approval
HESCO	Hyderabad Electric Supply Corporation
HFCs	Hydro Fluorocarbons
HOMER	Hybrid Optimization Model for Electric Renewables
HSE	Health Safety and Environment
HSHD	Hard Surface High Duty
Hz	Hertz
IA	Implementation Agreement

IDC	Interest During Construction
IEA	International Energy Agency
IEE	Initial Environmental Examination
IEEE	Institute of Electrical and Electronic Engineers
IFC	International Finance Cooperation
IPPs	Independent Power Producers
IRR	Internal Rate of Return
JEDI	Jobs and Economic Development Impact
JI	Joint Implementation
JRC	(European) Joint Research Centre
Km	Kilometer
KV	Kilovolt
KW	Kilowatt
LIBOR	London Interbank Offered Rate
LNG	Liquefied Natural Gas
LOI	Letter of Intent
LOS	Letter of Support
LPG	Liquefied Petroleum Gas
LUC	Local Control Unit

m^2	Meter Square
m^3/h	Meter cube per hour
mm	Millimeters
mmcft	Million Cubic Feet
MoU	Memorandum of Understanding
MTDF	Medium Term Development Framework
MVA	Million Volt-Ampere
MW	Megawatt
N_2O	Nitrous Oxide
NASA	National Aeronautics and Space Administration
NCS	National Conservation Strategy
NEC	National Energy Conservation
NEPRA	National Electricity Power Regulatory Authority
NEQs	National Environmental Quality Standards
NGOs	Non-Government Organizations
NOCs	No Objection Certificate
NOCT	Nominal Operating Cell Temperature
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Dispatch Company

O & M	Operation & Management
OECD	Organization for Economic Cooperation and Development
OEMs	Original Equipment Manufacturer
OHL	Overhead Lines
OLTC	On-Load Tap Changer
OM	Operating Margin
OSHA	Occupational Safety and Health Administration
PAEC	Pakistan Atomic Energy Commission
PCM	Pulse Code Modulation
PCRET	Pakistan Council of Renewable Energy and technology
PDD	Project Design Document
PEPA	Pakistan Environment Protection Act
PINs	Project Idea Note
PLC	Programmable Logic Control
PMD	Pakistan Meteorological Department
POE	Panel of Experts
PPIB	Private Power Infrastructure Board
QC	Quality Control
R & D	Research and Development

RE	Renewable Energy
RFP	Request for Proposal
RFQ	Request for Quotation
RMP	Risk Management of Project
ROC	Return on Capital
ROE	Return on Equity
RQD	Rock Quality Designation
SECP	Security Exchange of Pakistan
SWGL	Sinovel Wind Group Co., Ltd
SOP	Standard Operating Procedure
SPT	Standard Penetration Test
SRA	Solar Resource Assessment
SRO	Statutory Regulatory Order
TWP	Tricom Wind Power (Pvt) Ltd
TOE	Tons Oil Equivalent
tsf	Tones/square foot
TTG	Trans Tech Group Pakistan
TTP	Trans Tech Pakistan
UNFCCC	United Nations Framework Convention on Climate Change

UPS	Uninterruptible Power Supply
WAPDA	Water & Power Development Authority
WK	Welt Konnect (Pvt) Ltd
WMO	World Metrological Organization

ACKNOWLEDGMENTS

The management of Tricom Wind Power (Pvt) Ltd would like to express their gratitude to the support and cooperation extended by the dedicated team of the Directorate of Alternative Energy (DAE), Energy Department and Board of Revenue (BOR) Government of Sindh in the development activities of the project.

We are also thankful to the Ministry of Water and Power for the generous support throughout all stages of project development.

We hope for and look forward to the continued cooperation of all relevant Government Organizations, Bodies and officials for further advancement in implementing the Project and further strengthening the Wind Power Sector in Pakistan.

DISCLAIMERS

This document is intended for use by the Stake Holders and relevant Government Authorities for understanding and effective decision making regarding this Project.

The Company and the sponsors are and will not be responsible for any decision made by the intended or unintended users for any other purpose except in relation to this project.

The Company and the Sponsors are and will also not be responsible for any decision made by any other person or party not being an intended user of this document whether related to this project or not without consent of the Company or Sponsors in this regard.

Further, this is not intended to be a business or operational plan for the project.

COPY RIGHT NOTICE

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DOCUMENT INFORMATION

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

This document presents the technical, financial and commercial viability of this project within Pakistan's economic and regulatory framework.

STRUCTURE OF THE DOCUMENT:

The Feasibility Study has been divided into 2 main parts/volumes followed by supporting Volumes 3 to 7 composed of essential studies:

- Volume 1: is composed of the Executive Summary, Introduction and Overview of the Project along with the relevant regulatory framework and policies.
- Volume 2: contains the Technical and Financial Studies, including Engineering Drawings and Plant layout.
- Volume 3: is composed of the Topographic Survey Report.
- Volume 4: is the Geo-Technical Investigation Report.
- **Volume 5:** is the Initial Environment Examination (IEE) Study.
- Volume 6: is currently under preparation and shall contain all documents relevant to the Clean Development Mechanism of the UNFCCC.
- Volume 7: Grid Interconnection Study is being conducted and shall be duly submitted for approval to the National Transmission Dispatch Company (NTDC).

Each Volume is further sub-divided into chapters for ease of reviewing and understanding the project. Information in the document is supplemented by Annexures attached at the end of each volume.

EXECUTIVE SUMMARY OF THE PROJECT

The Adamjee name has been a prominent and highly reputed name amongst the business circles of the Indian Subcontinent throughout the 20th century.

Probably, one of the oldest business groups of the region, Adamjee today symbolizes the "Business House" of the yester years, which is traditionally passed on down from generation to generation. Presently the fourth generation of Adamjee holds key managerial positions in the group and have identified three focal points of management. Human Resource Development & Professionalism, Independent shareholding & Entrepreneurial Freedom, and Consolidation or core businesses.

The Adamjee Group has founded several leading institutions including aviation (Orient Airways), banking (MCB Bank), Insurance (Adamjee Insurance) and Pakistan's largest mutual fund (NIT) with an AUM of close to 1Billion USD, the group is well diversified and manages numerous other businesses. The Adamjee name enjoys house hold recognition and commands premium in the various products the group manufactures and trades in.

The Adamjee group has setup and managed over forty industrial and financial enterprises in Pakistan, Burma, Thailand, Malaysia, Lebanon and United Kingdom.

Whereas the Trans Tech Group is a multipurpose engineering concern and actively engaged in various Civil Engineering, Railway, Telecommunication and Renewable Energy Projects in Pakistan since 1991. TTG is committed to professional excellence and is playing its due role in the national progress and development of Pakistan.

Trans Tech Group incorporates technical, ecological and economical optimization in its solutions and ensures an efficient and effective implementation of its projects. The man power resource pool of TTG consists of manager, engineers, planners, computer professionals, economists, support staff and skilled technicians.

The Group has been working in Pakistan for the past 25 years and has played a key role in the development of a number of projects in the Infrastructure Sector including but not limited to the Construction of Roads, Bridges, Highways and Motorways. In addition the Group has also been actively involved in the development of projects in the Power Sector of Pakistan in all fields of Renewable Clean Energy including Hydro, Hydel, Solar and Wind Power. The Group in association with its invaluable foreign partners is currently undertaking large scale power projects in Pakistan.

Whereas Welt Konnect (Pvt) Ltd is a Project Development and Services Company operating in Pakistan and Germany. Its niche in the Energy Sector lies in the provision of Renewable Energy Engineering solutions particularly for Wind & Solar Power Projects as Independent Power Producers (IPP's) under the Clean Development

Mechanism of the UNFCCC. These integrated solutions and systems are designed, simulated and tested by its team of experts and engineers' using the most advanced software's and tools the industry has to offer at this time. WK believes in doing top quality engineering works and takes immense pride in being one of the few companies in Pakistan to have achieved this level of competence in the ever growing and critical field of Renewable Energy.

In accordance with the development strategy of the Adamjee House in line with the vision of its honorable founder Sir Adamjee Haji Dawood of bringing robust growth and economic progress in Pakistan through projects of ground breaking potential and the ideals of the Trans Tech Group under the visionary leadership of its honorable Chairman Mr. Fiaz Ahmad of fulfilling the national agenda of economic self-reliance in infrastructure development with a particular emphasis on Energy Security, both Groups joined hands for the development of the subject 50MW Wind Power Project in the wind corridor of Jhimpir, District Thatta, Sindh, through the Project Company Tricom Wind Power (Pvt) Ltd, duly incorporated under the Companies Ordinance of 1984 (XLVII of 1984) and registered with the Securities Exchange Commission of Pakistan (SECP). Whereas Welt Konnect (Pvt) Ltd has been appointed as the Project Consultants

The project pre-feasibility study was completed by early 2015. After submission of the Project Proposal on 3rd April 2015, to the Directorate of Alternative Energy, Energy Department, Government of Sindh (DAE GoS) along with the Pre-Feasibility Report, the DAE GoS sent notification to the Sponsors vide Letter No. DAE/Wind/85/2015 dated 14th July 2015, for issuance of the subject Letter of Intent (LOI) pursuant to submission of the requisite Bank Guarantee, Registration Fee and Administrative Fee.

Subsequently the Sponsors submitted the requisite Registration Fee of USD. 100/- (in equivalent Rs. 10,200/-) through Pay Order No. 08952222 dated 27th July and Project Facilitation fee of USD. 10,000/- (in equivalent Rs. 1,020,000) through Pay Order No. 08952221 dated 27th July 2015, followed by the Bank Guarantee No. HMB/LG/11490/2015 dated 30th July, in the sum of USD 25'000/- (US Dollars twenty five thousand only) (**Volume 1 Annexure 1**: Bank guarantee, Registration Fee and Administrative Fee), where after the Project Company Tricom Wind Power (Pvt) Ltd (TWP) successfully obtained a Letter of Intent (LOI) No. DAE/Wind/85/2015/32 from the DAE GOS on 28th August 2015, duly signed and accepted by both parties (**Volume 1 Annexure 2**: LOI), with due government support.

Teams were then immediately deployed to initiate work on the feasibility analysis of the project, and at the same time to search for a suitable site. Several site surveys were conducted at this time by the team of experts of Tricom Wind Power (Pvt) Ltd with commendable support of competent officers of the Energy Department of Sindh, Board of Revenue Sindh (BORS), and Land Unit Deputy Commissioner Office (LU DCO) Thatta, leading to the identification of a few potential sites in the region of Thatta. The sites identified lay in the area of Jhimpir, Thatta in Southern Sindh, north east of

Karachi and possess the required minimum infrastructure, including sufficiently high wind speed levels and annual wind potential necessary for such a project.

Later after due processing and appraisal of all available sites/land for Renewable Energy Projects by the Land Committee constituted under the current Land Policy comprising officials from the DAE GoS, BORS and LU DCO, the Land Strip encompassing 347 Acres in Jhimpir with coordinates 25.143266 N 68.014648 E, 25.142266 N 68.013943 E, 25.092657 N 68.094742 E, 25.093775 N 68.095583 E was recommended in favor of Tricom Wind Power (Pvt) Ltd for development of the subject 50MW Wind Power Project vide Land Allotment Letter No. 01-60-2015/SO-VI/32/16 dated 16th January 2016, presented by the Honorable Chief Minister of Sindh Mr. Qaim Ali Shah at the Chief Minister House Karachi, Sindh. (**Volume 1 Annexure 3:** Site Allocation Letter dated 16th January 2016).

The Selcted Site is located near the Jhimpir and Nooriabad Grid Stations, with an approximate distance of about 95 km north east from Karachi, 35 km north from Thatta City the nearest urban city and approximately 20 km northwest of Lake Kalri.

The location enjoys a flat terrain with innocuous sand/clay surface in the peripheral, scarce plant cover, rich wind speeds, availability of water, nearby government & private guest houses, with immediate access to the M9 high-level highway and Thatta-Thano bula Khan Highway, thus rendering itself a technically and logistically feasible location for the setup of the 50MW Wind Power Station.

Meanwhile in parallel, a viable financial and economic model was developed for the project. Various financial institutions and carbon funding agencies were identified and engaged for the purpose. On the other hand search for suitable wind power projects equipment suppliers was initiated, with a special emphasis on the quality of the products. Various technologies for Wind Turbine Generators (WTG's) were considered before making a recommendation, the analysis of which has been presented in the feasibility study.

Immediately after finalization of the selected site with coordinates 25.143266 N (Latitude), 68.014648 E (Longitude), competent teams of Engineers & Specialists were deployed for conducting the Topographic Survey, Soil Testing and layout design activities, amongst other studies, which have been successfully completed and compiled in various volumes of the Feasibility Study Report which is being submitted to DAE GOS within the time period stipulated in the LOI for review by the Panel of Experts (POE).

Whereas the Initial Environment Examination (IEE) of the proposed project has been conducted in accordance with the stipulations of Pakistan's environmental laws and the environmental guidelines of the International Finance Corporation (IFC).

The studies reveal no environmental hazards related to the Project. The minor adjustments required during construction phase have been addressed and mitigation plan provided in the FSR Volume 5: Environmental Studies. Furthermore it is worth mentioning there are no settlements within 05-08 Km of the Project Site, which further supports the Project in this location.

Whereas NTDC was requested by TWP, through its Letter No. TWP/NTDC/RFD/2015-01 dated 16th October 2015 to provide data of the network in the vicinity of the proposed power plant, existing and future, to enable the Project Consultant to perform the Grid Interconnection Study in order to propose the interconnection scheme for evacuation of power from the 50MW wind power plant to the system network. While CPPA-G was requested by TWP vide its Letter No. TWP/CPPA-G/RFD/2015-02 dated 21st October 2015 to allow NTDC to render such necessary data for the Grid Interconnection Study.

Following which Manager (Tech – IV) CPPA(G) Ltd requested General Manager Planning (Power) NTDC to make available the requisite data to the Project Consultant and Sponsor. Subsequently a direct request to GM Planning (Power) NTDC has also been made by the Project Consultants WKPL vide Letter No. WK/NTDC/RFD/2015-03 dated 16th October 2015, whereby on provision of the subject data WKPL shall conduct the Grid Interconnection Study for the Project, draft of which is provided in Volume 7 of the Feasibility Study Report (**Volume 1 Annexure 4:** Grid Study Data Related Correspondence Record).

TWP has also completed substantial work on the financial modeling for the project. The JV believes that keeping in view the recent improvement and trend in the viability of the technology, possibility of fast track implementation and current energy crises, this project is of paramount importance for Pakistan and will further strengthen the Wind Power industry, paving the way for future progress in this ever growing field and at the same time provide a viable profitable investment opportunity to all stake holders of the country.

In addition the work is underway to develop the project under the Clean Development Mechanism (CDM) of the UNFCCC under the Kyoto Protocol.

TWP is now pleased to make submission of the Feasibility Study Report conducted on a fast track basis in accordance to the milestones stipulated in the LOI to the good office of the DAE GoS for approval by the Panel of Experts (POE) to be duly constituted at the earliest. After sanctioning of which the competent company in the field of Wind Energy selected through a Criteria based on Experience, Financial And Technical Competencies of such firms in development & construction of Power Projects and Project Management, shall initiate preparations for execution of the Engineering Procurement & Construction (EPC) Contract.

In parallel a petition for Generation License and a petition for tariff would simultaneously be filed with the National Electric Power Regulatory Authority (NEPRA) for the upfront Wind tariff, before request for issuance of the LOS (Letter Of support) from AEDB and DAE GOS.

As can be seen from the summary of project development milestones provided above, TWP has been relentlessly putting in a lot of hard work and efforts in the development of the subject Wind Power Project on a fast track basis and has left no stone unturned in trying to achieve the milestones stipulated in the LOI at the earliest and overcome any difficulties in its path.

We hope Sindh Environment Protection Agency (SEPA), DAE GOS and other concerned departments shall appreciate the sheer hard work, efforts, determination and resolve shown by TWP in the fast track development of the subject Wind Power Project which will surely contribute towards self-reliance of Pakistan in the energy sector.

We look forward to the good support and cooperation of the Sindh Environment Protection Agency (SEPA) in further development and commissioning of the subject Project on a fast track basis.

1 INTRODUCTION

I. WIND POWER GENERATION

One of the most important feature of Wind systems is that there are no emissions of carbon dioxide - the main gas responsible for global climate change - during their operation. Although indirect emissions of CO2 occur at other stages of the lifecycle, these are significantly lower than the avoided emissions. Wind does not involve any other polluting emissions or the type of environmental safety concerns associated with conventional generation technologies. There is no pollution in the form of exhaust fumes or noise.

Decommissioning a system is unproblematic. Although there are no CO2 emissions during operation, a small amount does result from the production stage. WIND only emits 21.65 grams CO2/kWh, however, depending on the WIND technology. The average emissions for thermal power, on the other hand, are 900g CO2/kWh. By substituting WIND for thermal power, a saving of 835879 g/kWh is achieved.

The benefit to be obtained from carbon dioxide reductions in a country's energy mix is dependent on which other generation method, or energy use, Wind power is replacing. Where off-grid systems replace diesel generators, they will achieve CO2 savings of about 1 kg per kilowatt-hour. Due to their tremendous inefficiency, the replacement of a kerosene lamp will lead to even larger savings, of up to 350 kg per year from a single 40 Wp turbine, equal to 25kg CO2/kWh. For consumer applications and remote industrial markets, on the other hand, it is very difficult to identify exact CO2 savings per kilowatt-hour.

Recycling of WIND turbines is possible and raw materials can be reused. As a result, the energy input associated with WIND will be further reduced. If governments adopt a wider use of WIND in their national energy generation, Wind power can therefore make a substantial contribution towards international commitments to reduce emissions of greenhouse gases and their contribution to climate change. Natural gas is the most environmentally sound of the fossil fuels, because it produces roughly half as much carbon dioxide as coal, and less of other polluting gases. Nuclear power produces very little CO2, but has other major safety, security, proliferation and pollution problems associated with its operation and waste products

II. PROJECT OVERVIEW

The subject Wind Farm is a 50 MW electricity generation plant designed to produce electricity by Wind energy in Jhimper, in the province of Sindh, Pakistan. It employs Wind Turbine (WIND) technology that converts Wind energy directly into electricity, while emitting zero greenhouse gases (GHG) into the atmosphere. The project is planned to be implemented in phases of 10 MW each and would become operational and start generating CERs right after the completion of the first phase of the project, with work on the other phases continuing. The generated electricity will be supplied to the national grid.

The project conforms to the government policy that promotes development of renewable energy technology and contributes to lowering dependence on electricity generation by fossil fuels which is over 66% of total generation in Pakistan. It is expected to help alleviate the huge energy deficit in Pakistan.

The area of this project will be about 347 Acres and annual amount of electricity going to the grid will be about 190,124.5 MWh/yr. As a result over 77,000 tons of CO_2 emissions will be abated per year.

III. PROJECT PROPONENTS

The Adamjee name has been a prominent and highly reputed name amongst the business circles of the Indian Subcontinent throughout the 20th century.

Probably, one of the oldest business groups of the region, Adamjee today symbolizes the "Business House" of the yester years, which is traditionally passed on down from generation to generation. Presently the fourth generation of Adamjee holds key managerial positions in the group and have identified three focal points of management. Human Resource Development & Professionalism, Independent shareholding & Entrepreneurial Freedom, and Consolidation or core businesses.

The Adamjee Group has founded several leading institutions including aviation (Orient Airways), banking (MCB Bank), Insurance (Adamjee Insurance) and Pakistan's largest mutual fund (NIT) with an AUM of close to 1Billion USD, the group is well diversified and manages numerous other businesses. The Adamjee name enjoys house hold recognition and commands premium in the various products the group manufactures and trades in.

Sir Adamjee Haji Dawood was the founder of the Adamjee Group.

He started by trading in gunny bags in Burma and extended his business activities successfully to other countries. Subsequently, he moved to Calcutta, India where, between the two World Wars, he set up a major trading and manufacturing organization of jute and gunnies.

His success earned him the title of the 'King of Gunnies'. It was during this period that Sir Adamjee Haji Dawood was knighted by the British Government and he was one of the few locals of British India to achieve this honor.

Not only was he a man of extra-ordinary vision and business acumen, but also an eminent philanthropist. When Pakistan came into being in 1947, the Adamjee family moved to Pakistan and played a very important role in the industrialization of the country.

The Adamjee group has setup and managed over forty industrial and financial enterprises in Pakistan, Burma, Thailand, Malaysia, Lebanon and United Kingdom.

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The Adamjee group has setup and managed over forty industrial and financial enterprises in Pakistan, Burma, Thailand, Malaysia, Lebanon and United Kingdom.

The family also operates Adamjee Foundation, one of the largest charitable trust in Pakistan. Some of the notable institutions built by the foundation include Adamjee science college (largest science college in Pakistan), Adamjee cantonment college Dhaka, Bangladesh, Lady Mariam Adamjee girl's school, Karachi, Adamjee high school, Dhaka, Adamjee public school, Karachi, Sir Adamjee Institute of Technology and the Adamjee academic center Karachi.

To pay respect and recognition to Sir Adamjee (Knighted by the British Government in 1938), the founder of the family, and the governments of Bangladesh and Pakistan named various streets and neighborhoods in Dhaka, Karachi, Peshawar and Rawalpindi after him. In the year 2000 the Government of Pakistan initiated issued postage stamps with the image of Sir Adamjee.

Whereas the Transtech Group (TTG) was founded in 1991 as a multipurpose engineering concern, actively engaged in development of various Infrastructure, civil engineering, railway, telecommunication and renewable energy projects in Pakistan.

Over the past 25 years TTG has played a key role in the development of a number of projects in the Infrastructure Sector including but not limited to the Construction of Roads, Bridges, Highways and Motorways. In addition the Group has also been actively involved in the development of projects in the Power Sector of Pakistan in all fields of Renewable Clean Energy including Hydro, Hydel, Solar and Wind Power. The Group in association with its invaluable foreign partners is currently undertaking large scale power projects in Pakistan.

As a company with a vision for clean energy, TTG's main businesses include, development and construction of renewable power projects in the related relevant technology sectors. For which purposes TTG has now expanded the scope of its business to include power generation from wind, solar and hydro energy.

The Transtech Group is now in the process of establishing itself as a global player taking an active role in project development all over the world, realizing its vision of being one of the 'World's Best'. Having achieved amazing growth in the 25 years since its inception, the Transtech Group is now soaring toward a new decade. With a definite goal, a clear strategy and superb human resources, the Transtech Group will solidify its position as one of the world's leading project development enterprise. The Transtech Groups true success story begins now.

TTG has grown at a rate that has far exceeded everyone's expectations. This remarkable success can be attributed to its spirit of creativity and challenge, coupled with its desire to create a better future by embracing new opportunities. Along with its core businesses in the Infrastructure Development & Automobiles Sector & Trading areas, TTG is now establishing a strategic business portfolio by developing its new capabilities in the Energy, Oil & Gas, as well as the Food & Beverages sector. TTG will make a fresh leap forward in order to make a new and amazing future.

After establishing itself as a leading Project Developer in Pakistan with more than 100 successfully completed and initiated infrastructure projects, TTG is now using its established global networks consisting of about 50 overseas corporations and offices in 6 regions around the world to consolidate its position in Europe and America by initiating clean energy projects, particularly in the Wind and Solar Power Sectors. In addition, TTG is concentrating its capabilities on advancing into resource-rich countries with high growth potential, and expanding its global economic territory. TTG Lead's Pakistan's infrastructure development sector along with its valuable partners with a current portfolio of projects including the oil & gas, natural resources, energy and transportation and food sectors.

With the vision of being the World's largest clean energy group specializing in project development, project management and operations; TTG is proactively developing Wind Power, Solar Power and other forms of renewable energy; steadily expanding and exploring avenues of overseas business.

TTG has been part of a number of remarkable mega projects that have earned it a reputation of being one of Pakistan's largest Project Developers, such as the Rehabilitation & Upgradation of the Karakoram Highway in one of the World's highest mountain range in the Himalayas composed of one of the most difficult & unforgiving terrain, the Mangla Dam Raising Project, Dhan Gali Bridge and KPT Deep Sea Dredging Project. In addition, TTG has surprised the Energy Sector by being the first to initiate development of a 50MW Solar PV Power Plant in the Cholistan Desert of Pakistan resulting in development of one of the world's largest independent Solar Parks in the shape of the Quaid-E-Azam Solar Park (QASP), as well as working on Hydro Power Projects with and supporting its valuable Foreign Partners including the Kohala Hydropower Project. As a result of these achievements, TTG is solidifying its Project Development leadership in the National market and moving Global.

TTG is fostering renewable energy and environmentally friendly businesses as part of its new growth engine, TTG is expanding its business in the wind and solar sector by taking initiatives towards local engineering and equipment fabrication for its power generation businesses in the IPP sector.

TTG is committed to professional excellence and is playing its due role in the national progress and development of Pakistan.

In accordance with the development strategy of the Adamjee House in line with the vision of its honorable founder Sir Adamjee Haji Dawood of bringing robust growth and economic progress in Pakistan through projects of ground breaking potential and the ideals of the Trans Tech Group under the visionary leadership of its honorable Chairman Mr. Fiaz Ahmad of fulfilling the national agenda of economic self-reliance in infrastructure development with a particular emphasis on Energy Security, both Groups joined hands for the development of the subject 50MW Wind Power Project in the wind corridor of Jhimpir, District Thatta, Sindh, through the Project Company Tricom Wind Power (Pvt) Ltd, (TWP) duly incorporated under the Companies

Ordinance of 1984 (XLVII of 1984) and registered with the Securities Exchange Commission of Pakistan (SECP). Whereas Welt Konnect (Pvt) Ltd has been appointed as the Project Consultants (Annexure 5: Project Company Corporate Documents).

Whereas Welt Konnect Pvt. Ltd ("WKPL" or the "consultant") is a duly established company under the laws of Pakistan specializing in Power Project Development. Its niche in the Alternative Energy sector lies in the provision of Renewable Energy Engineering particularly Wind & Solar Projects as Independent Power Producers (IPP's), various commercial applications & CDM projects. These integrated systems are designed, simulated and tested by its team of experts and engineers' using the most advanced software's and tools the industry has to offer at this time. WK believes in doing top quality engineering works and takes immense pride in being one of the few companies in Pakistan to have achieved this level of competence in this ever growing field of Renewable Energy.

WKPL incorporates technical, ecological and economical optimization in its solutions and ensures an efficient and effective implementation of its projects. The man power resource pool of WKPL consists of managers, engineers, planners, computer professionals, economists, support staff and skilled technicians.

After following due process and conducting due diligence TWP awarded WKPL the task to provide technical and financial consultancy Services for conducting the Feasibility Study Report (FSR) in accordance with the requirements of the Letter of Intent (LOI) issued by Directorate of Alternative Energy, Energy Department, Government of Sindh (DAE GoS) under the prevailing Energy Policy coupled with an energy yield assessment for the Wind Farm of 50MW, located in the region of Jhimpir in the province of Sindh Pakistan.

This report describes the results of the Initial Environment Examination (IEE) performed for the 50MW Wind Power Project on the site 25° 8'35.76"N (Latitude), 68° 0'52.73"E (Longitude).

The wind power plant consists of 25 Wind Turbine Generators (WTGs) each with a generating capacity of 2.0MW with rotor diameter of 121m and hub height of 90m, with a total installed capacity of 50000 kW (50MW).

IV. IEE Study Overview

The IEE covers the assessment of the Wind power plant's significant environmental impacts and identification of the most appropriate mitigation measures based on the review of the environmental aspect in the plants' feasibility study report by WK and their recent site visits in 2015 and 2016. The scope of the IEE also includes a review of the Sponsors corporate policies and operational framework for environmental and social management. The IEE concludes that the proposed project will have insignificant environmental and negligible social impacts. Tricom Wind Power (Pvt) Ltd is fully committed to its environmental and social responsibility and discharges this responsibility in adherence to principles of good corporate governance.

a. **Need of the Study**

The Pakistan Environmental Protection Act, 1997 (PEPA 1997) requires the proponents of every development project in the country to submit either an Initial Environmental Examination (IEE) or "where the project is likely to cause an adverse environmental effect," an Environmental Impact Assessment (EIA) to the concerned environmental protection agency (EPA).

Whereas the IEE/EIA Regulations 2000 issued under the PEPA 1997 provide separate lists for the projects requiring IEE and EIA based on the sector/technology of operations.

ADB Policies and Guidelines also call for environmental and social assessment of projects such as the proposed power plant. Since the proponents may be seeking finances from ADB or other similar international finance institutions for the proposed project, the ADB"s policies and guidelines will also be applicable to the project, in addition to the national legal requirements mentioned above.

b. **Study Objectives**

The objectives of the present IEE are to:

- assess the existing environmental and socioeconomic conditions of the project area,
- identify likely impacts of the proposed project on the natural and human environment of the area, to predict and evaluate these impacts, and determine significance of these impacts, in light of the technical and regulatory concerns,
- propose appropriate mitigation measures that should be incorporated in the design of the project to minimize, if not eliminate, the adverse impacts,
- assess the compliance status of the proposed activities with respect to the environmental legislation and ADB"s environmental and social standards,
- formulate an environmental management plan (EMP) to provide an implementation mechanism for the mitigation measures identified during the study.

c. **Study Scope**

The present IEE study has been conducted for the Tricom Wind power project near Jhimpir, Sindh Province. The study covers the potential environmental and social impacts that may be encountered during the construction and operation phases of the proposed project.

d. **Study Methodology**

The key steps that were followed while conducting the IEE are briefly described below.

Scoping

During this phase, key information on the project was collected and reviewed. A "long list" of the potential environmental as well as social issues likely to arise as a result of the project was developed. The stakeholder analysis was also carried out for the consultation carried out subsequently.

Stakeholder Consultation

Stakeholder consultations were carried out during the IEE study. Meetings were held in the vicinity of the site and in Karachi with the institutional stakeholders and key environmental and social issues discussed. Extensive consultations with the grass root stakeholders were carried out at the project site. Efforts were made to solicit the concerns and views of rural women as well. The main objective of the consultations was to apprise the key stakeholders about the project details, and to obtain their concerns, apprehensions and recommendations regarding the proposed activities.

Data Collection/Compilation

During this phase, data was collected and compiled, in order to develop a baseline of the project area's physical, biological and human environment. For this purpose, both review of secondary sources and field data collection were carried out. Field visits to the site were also carried out.

The secondary resources that were consulted included reports of the studies carried out earlier, published books and data, and relevant websites. With the help of these resources a generic profile of the project area was developed. The extensive field visits were then carried out in order to collect the primary data specific to the project sites.

During these field visits, key information on environmental and social parameters was collected. The environmental and social "hot spots" falling at or near the project sites were identified, and most importantly, the project affectees were determined.

Impact Assessment

During the impact assessment, the environmental, socioeconomic, and project information collected in previous steps was used to determine the potential impacts of the proposed project. Subsequently the potential impacts were characterized in order to determine their significance. Mitigation measures were identified to minimize the significant environmental impacts. A management framework was also developed in the form of an EMP for the implementation of the mitigation measures identified during the study.

1.5 Document Structure

Section VI discusses the ADB"s policies and guidelines as well as the regulatory, legislative and institutional setup in the country, relevant to the environmental and social assessment and the UNDP/GEF guidelines for the impact assessment for Wind farms. **Section VII** provides a simplified description of the proposed project and its components. The project alternatives are discussed in **Section VIII**. The environmental and social baseline conditions of the project area are presented. The stakeholder consultation has been covered in **Section XI**. The environmental and socioeconomic impacts of the project are assessed and their respective mitigations recommended in **Section IX**. **Section X** outlines the implementation mechanism for the mitigation measures, in the form of an environmental management plan. Finally, **Section XII** presents the findings and conclusion of the study.

2 INITIAL ENVIRONMENT EXAMINATION (IEE)

V. Application Form (As per Schedule IV in PEPRA 2000)

1	Name and Address of Proponent	Tricom Wind Power (Pvt) Ltd (TWP) 3rd Floor, Adamjee House, I.I. Chundrigar Road, Karachi, Sindh.	Phones: Fax: Telex:	0092-21-32416391 0092-21-32416392
2	Description of Project	Tricom Wind Farm is a 50 MW electricity generation plant designed to produce electricity by wind energy in Jhimpir, Thatta in the province of Sindh, Pakistan. It employs Wind Turbine technology that converts Wind energy directly into electricity, while emitting zero greenhouse gases (GHG) into the atmosphere. The project is planned to be implemented in phases of 10 MW each and would become operational and start generating CERs right after the completion of the first phase of the project with work on the other phases continuing. The generated electricity will be supplied to the national grid. The project conforms to the government policy that promotes development of renewable energy technology and contributes to lowering dependence on electricity generation by fossil fuels which is over 66% of total generation in Pakistan. It is expected to help alleviate the huge energy deficit in Pakistan. It is the first WIND project of its size in Pakistan and will be a good source of clean energy. The area of this project will be about 347 Acres and annual amount of electricity going to the grid will be about 190,124.5 MWh/yr. As a result over 77,000 tons of CO_2 emissions will be abated per year.		
3	Location of Project	Latitude 25° 8'35.76"N Longitude 68° 0'52.73"E in Jhimpir, Sindh (Copy of Map is attached)		
4	Objectives of Project	To set up a clean energy Independent Power Producer in the Wind sector harnessing the power of the sun.		
5	IEE	IEE	YES/No	
6	Have alternatives been considered and reported in IEE or EIA		YES/No	
7	Existing Land Use	Immediate surroundings are lying completely vacant, with no habitation, cultivation or grazing activity	Land Requirement	347 Acres
8	Is the basic Site data available or has it been measured?	Meteorology (including rainfall) Ambient Air Quality Ambient Water Quality	**Available** Yes/No Yes/No Yes/No Yes/No	**Measured** Yes/No Yes/No Yes/No Yes/No

		Ground Water Quality		
9	Have estimates of the following been reported?	Water Balance Solid Waste Liquid Waste treatment	**Estimated** **Yes**/No **Yes**/No **Yes**/No	**Reported** Yes/**Not Applicable** Yes/**Not Applicable** Yes/**Not Applicable**
10	Source of Power	Natural Wind Energy	Power Requirement	None
11	Labor Force (number): As Per EPC Contract	Construction: As Per EPC Contract Operation.	All local labor force. Only management and consultant officials from other locations.	

Verification

I do solemnly affirm and declare that the information given above and contained in the attached IEE/EIA is true and correct to the best of my knowledge and belief.

Habib

Date 18th February 2016

Signature, name and designation of proponent (with official stamp/seal)

VI. Policy Legal and Administrative Framework

a. National Environmental Laws and Regulations

Pakistan's statute books contain a number of laws concerned with the regulation and control of the environmental and social aspects. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is a relatively new phenomenon. Most of the existing laws on environmental and social issues have been enforced over an extended period of time, and are context-specific. The laws relevant to the developmental projects are briefly reviewed below.

b. Pakistan Environmental Protection Act- 1997

The project is in compliance with the PEPA 1997, and as mentioned in Para 12 of the said act, no project involving construction activities or any change in the physical environment can be undertaken unless an initial environmental examination (IEE) or an environmental impact assessment (EIA) is conducted, and approval is obtained from the federal or relevant provincial EPA. Section 12 (6) of the Act, states that the provision is applicable only to the categories of projects as may be prescribed by the agency. Whereas the categories are defined in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 and are discussed below. The requirement of conducting an environmental assessment of the proposed Wind power project emanates from this Act.

- **National and International Environmental Standards**

National Standards

The National Environmental Quality Standards (NEQS), promulgated under the PEPA 1997, specify the following standards:

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

- **National Energy Conservation Strategy**

The project complies with the three explicit objectives of the NECS: conservation of natural resources, promotion of sustainable development, and improvement of efficiency in the use and management of resources; and would also abide by policies outlined for pollution control as in S. No 4, 8, 10, 12 and 13 of the 14 core program areas.

- **National Environment Policy 2006**

The National Environmental Policy (NEP) was approved by the PEPA in its 10th meeting on 27th December 2004 under the chairmanship of the Prime Minister of Pakistan and thereafter approved by the Cabinet on 29th June 2005. NEP is the primary policy of Government of Pakistan that addresses the environmental issues of the country. The broad Goal of NEP is, "To protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development". The NEP identifies the following set of sectoral and cross-sectoral guidelines to achieve its Goal of sustainable development.

a. Sectoral Guidelines:

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

b. Cross Sectoral Guidelines:

Poverty, population, gender, health, trade and environment, environment and local governance, and natural disaster management The NEP suggests the following policy instruments to overcome the environmental problems throughout the country: Integration of environment into development planning;

- ✓ Legislation and regulatory framework;
- ✓ Capacity development;
- ✓ Economic and market based instrument;
- ✓ Public awareness and education; and
- ✓ Public private civil society partnership.

NEP is a policy document and does not apply directly at the project level. However, the development projects like power generation from Wind energy should not add to the aggravation of the environmental issues identified in NEP and mitigation measures should be adopted to minimize or avoid any contribution of the projects and of course, Wind being a renewable source of energy, Wind energy production can be considered as a means to integrate the environment into development planning.

- **Land Acquisition Act, 1894**

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

For the proposed project, the proponents have leased the land from the Government of Sindh. Since the proposed site was a government-owned land, and no settlement or any structure existed at the site, the LAA is not applicable to the land acquisition for the proposed project.

- **National Forestry Policy**

The project is in harmony with the National Forestry Policy and although being situated in a desert area namely Jhimpir it will contribute to the national grid and hence meet the objectives of Para 1.2 by generating power from Wind energy which will indirectly hinder cutting of mountain trees for firewood. It also supports Para 7, 10.2, and 10.3.

- **Telegraph Act, 1885**

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

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

The Act seems unlikely to be applicable to the Tricom Wind Power project site.

- **Sindh Wildlife Protection Act, 1972 and Amendments 2001**

This law was enacted to protect the province's wildlife resources directly and other natural resources indirectly. It classifies wildlife by degree of protection, i.e. animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. The Act specifies restrictions on hunting and trade in animals, trophies, or meat. The Act also defines various categories of wildlife protected areas, i.e. National Parks, Wildlife Sanctuaries and Game Reserve.

This Act will be applicable to the construction as well as operation and maintenance (O&M) activities of the proposed project. Two amendments to the Ordinance were issued in January and June 2001 respectively pertaining to oil and gas activities within national parks and wildlife sanctuaries. The first amendment allowed the Government to authorize the laying of an underground pipeline through protected areas. The second amendment allowed exploration and production activities within national parks and wildlife sanctuaries. However this amendment is not applicable for other development projects including power generation with the use of Wind energy.

- **Forest Act, 1927**

The Act authorizes Provincial Forest Departments to establish forest reserves and protected forests. The Act prohibits any person to set fires in the forest, quarry stone, remove any forest-produce or cause any damage to the forest by cutting trees or clearing up area for cultivation or any other purpose.

This Act will be applicable to the construction as well as O&M activities of the proposed project.

- **The Ports Act, 1908 (the "Ports Act")**

Sub-section (1) of section 21 of the Ports Act states that no ballast or rubbish/oil / water mixed with oil shall be discharged into any port to which the Ports Act applies. Rule 6 of the Ports Act empowers the Government of Pakistan to make any rules for the prevention of danger arising to the public health, by the introduction and spread of any infectious or contagious disease. This is applicable to all vessels arriving at or sailing from any port to which the Ports Act applies (this includes the Karachi port).

This may include hoisting of signals from vessels having any suspected case of any infectious or contagious disease; medical inspection of such vessels; questions and information required from the masters of the vessels; detention of such vessels; removal to the hospital of the crew members, and the cleansing and disinfection of such vessel. The Act seems unlikely to be applicable to the Tricom Wind Power project site.

- **Canal and Drainage Act, 1873**

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

- **Sindh Fisheries Ordinance, 1980**

The Ordinance provides for the issuing of a fishing license or permit that is mandatory for fishing in public water, for the sale or trade or processing of fish in markets and factories, for the declaration of sanctuary of any public water at any time and the related restrictions, for the disposal of wastes and sewerage that must be treated to prevent water pollution, for banning the use of explosives and toxic or poisonous agents in the fishing activities and, for restricting to sport fishing the use of fishing craft. Fishery Officers shall be appointed under this Ordinance and their powers extended to inspecting persons, vessels, premises and licenses in order to verify compliance with the ordinance. Offences are dealt with and penalties may be confiscation, fines or imprisonment depending on the nature of the offence. The Act seems unlikely to be applicable to the Tricom Wind Power project site.

- **The Sindh Irrigation Act, 1879**

This Act has relevance to the study due to the presence of the extensive irrigation network in the project area. This Act covers the construction, maintenance and regulation of canals for the supply of water and for the levy of rates of water supplied in the Sindh. In this Act "canal" includes channels, pipes and reservoirs constructed and maintained by the Government for the supply for storage of water. Under section 27 of the Act a person desiring to have a supply of water from a canal for purposes other than irrigation shall submit a written application to a Canal Officer who may, with the sanction of the Provincial Government give permission under special conditions. The Act also prohibits the damaging, altering, enlarging or obstructing the canals without proper authority.

This Act will be applicable to the construction as well as O&M activities of the proposed project.

- **Provincial Local Government Ordinances, 2001**

These ordinances were issued under the devolution process and define the roles of the local governments. Under this Ordinance, three tiers of the local governments have been introduced – at the district, tehsil and union levels. The top most tier is the district government, followed by the Tehsil (subdivision of a district) government, known as the Tehsil Municipal Administration (TMA). The lowest tier of the local government is the Union Administration.

In addition to the local governance and municipal administration functions, the local government ordinances also address the land use, conservation of natural vegetation, air, water and land pollution, disposal of solid waste and wastewater effluents, as well as matters relating to public health.

- **Antiquity Act, 1975**

The Antiquities Act of 1975 ensures the protection of cultural resources in 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 archeological significance. Under this Act, the project proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, and if during the course of the project an archeological discovery is made, it should be protected and reported to the Department of Archeology, Government of Pakistan, for further action. This Act will be applicable to the construction as well as O&M activities of the proposed project.

- **Mines, Oil Fields and Mineral Development Act, 1948**

This legislation provides procedures for quarrying and mining of construction material from state-owned as well as private land. These procedures will have to be followed during the proposed project.

- **Factories Act, 1934**

The clauses relevant to the proposed project are those that address the health, safety and welfare of the workers, disposal of solid waste and effluents, and damage to private and public property. The Act also provides regulations for handling and disposing toxic and hazardous substances. The Pakistan Environmental Protection Act of 1997 (discussed above), supersedes parts of this Act pertaining to environment and environmental degradation.

- **Pakistan Explosive Act, 1884**

This Act provides regulations for the handling, transportation and use of explosives during quarrying, blasting and other purposes. The transmission line tower installation sometimes needs blasting at rocky/mountainous areas, however for the proposed project, no such blasting is envisaged.

- **Employment of Child Act, 1991**

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows the child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any of the occupation set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, bidi (kind of a cigarette) making, cement manufacturing, textile, construction and others).

Tricom and its contractors will be bound by the ECA to disallow any child labor at the project sites or campsites.

- **Civil Aviation Rules (1994)**

These rules apply to flight operations within Pakistan by aircrafts other than military aircrafts and, except where otherwise prescribed, to flight operations by aircrafts registered, acquired or operating under these rules, wherever they may be. The rules with relevant significance to the activities taking place in Jhimper Wind Corridor are the following:

- ✓ No person shall erect any temporary or permanent structure, nor position a vehicle or other mobile object on or in the vicinity of an aerodrome (airport), that will be within the clearance area, or will protrude through an obstacle limitation surface, at that aerodrome.

- ✓ No person shall operate a light in the vicinity of an aerodrome which because of its glare is liable to dazzle pilots of aircraft taking off from or landing at that aerodrome; or which can be mistaken for an aeronautical ground light. If such a light is operated it shall be extinguished or satisfactorily screened immediately upon notice being given to the person or persons operating the light, by the Director-General or by the Manager or by a person authorized by him.

- ✓ No person or persons shall operate a radio station or electrical equipment in the vicinity of an aerodrome or of a radio aid to navigation serving an airway or an air route in Pakistan which is liable to cause interference with radio communications between aircraft and an Air Traffic Services Unit, or which is liable to disturb the signal from a navigational radio aid.

- ✓ A captive balloon or a kite shall not be flown at a height above 200ft within 6km of an aerodrome, and a free balloon shall not be flown at any place, except with the express permission of the Director-General and in compliance with the conditions attached to such permission

- ✓ An aircraft shall not be flown over congested areas of cities, towns, or settlements or over an open air assembly of persons, except by permission of the Director-General, unless it is at such height as will permit, in the event of an emergency, a landing to be made without undue hazard to persons on the ground, and except when it is taking off or landing, shall not be flown closer than 500ft to any person, vessel, vehicle or structure.

- **Pakistan Penal Code, 1860**

The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions and disposal of effluents. Most of the environmental aspects of the Code have been superseded by the Pakistan Environmental Protection Act, 1997.

- **National Renewable Energy Policy**

The project complies with NREP, articles 4 (4.4), 8.1, and 8.3 (8.3.3)

- **Medium-term Development Framework**

The project supports Medium term Development Framework objectives such as poverty reduction, upgrading of physical infrastructure, energy security, accelerated development of lesser developed areas, and environment.

- **Pakistan Environmental Protection Agency Regulations 2000**

The Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 20006 (the "Regulations") developed by the Pak-EPA under the powers conferred upon it by the Act, provide the necessary details on preparation, submission and review of the IEE and the EIA. Categorization of projects for IEE and EIA is one of the main components of the Regulations. Projects have been classified on the basis of expected degree of adverse environmental impacts. Project types listed in Schedule I are designated as potentially less damaging to the environment, and those listed in Schedule II as having potentially serious adverse effects. Schedule I projects require an IEE to be conducted, provided they are not located in environmentally sensitive areas. For the Schedule II projects, conducting an EIA is necessary.

The proposed project falls under Schedule I of the Regulations; hence an IEE has to be conducted for it.

- **Other Relevant Policies and Plans of the Government**

The project complies and is in harmony with all relevant concerned policies of the government of Pakistan. The project will not result in any obligation towards the investor country other than CER authorization.

c. **Institutional Setup for Environmental Management**

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided by the Chief Executive of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and environmental tribunals. The EPAs were first established under the 1983 Environmental Protection Ordinance; the PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports (IEEs and EIAs) of the proposed projects, and provide their approval (or otherwise).

The proposed projects would be located in the Sindh Province. Hence this ESA report will be sent to the Sindh EPA for review.

d. **Environmental and Social Guidelines**

Two sets of guidelines, the Pak-EPA's guidelines and the AEDB Guidelines for the Environmental Assessment of Wind Farms in the Thatta Wind Corridor are reviewed here. These guidelines address the environmental as well as social aspects relevant to the proposed project.

- **Environmental Protection Agency's Environmental and Social Guidelines**

The Federal EPA has prepared a set of guidelines for conducting environmental assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below.

- ✓ Guidelines for the Preparation and Review of Environmental Reports,
- ✓ Guidelines for Public Consultation,
- ✓ Guidelines for Sensitive and Critical Areas,
- ✓ Sectoral Guidelines.

It is stated in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 that the EIA or IEE must be prepared, to the extent practicable, in accordance with the Pakistan Environmental Protection Agency Environmental Guidelines.

e. **Obligations under International Treaties**

Pakistan is signatory of several Multilateral Environmental Agreements (MEAs), including:

- ✓ Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal,

- ✓ Convention on Biological Diversity (CBD),
- ✓ Convention on Wetlands (Ramsar),
- ✓ Convention on International Trade in Endangered Species (CITES),
- ✓ UN Framework Convention on Climate Change (UNFCCC),
- ✓ Kyoto Protocol,
- ✓ Montreal Protocol on substances that deplete the ozone layer,
- ✓ UN Convention to Combat Desertification,
- ✓ Convention for the Prevention of Pollution from Ships (MARPOL),
- ✓ UN Convention on the Law of Seas (LOS),
- ✓ Stockholm Convention on Persistent Organic Pollutants (POPs),
- ✓ Cartina Protocol.

These MEAs impose requirements and restrictions of varying degrees upon the member countries, in order to meet the objectives of these agreements. However, the implementation mechanism for most of these MEAs is weak in Pakistan and institutional setup non-existent.

Although almost all of the above MEAs would apply to the projects such as Tricom in one way or the other, the ones which have direct relevance for the proposed project include the Basel Convention, Montreal Protocol, Stockholm Convention, UNFCCC and Kyoto Protocol.

VII. Description of the Project

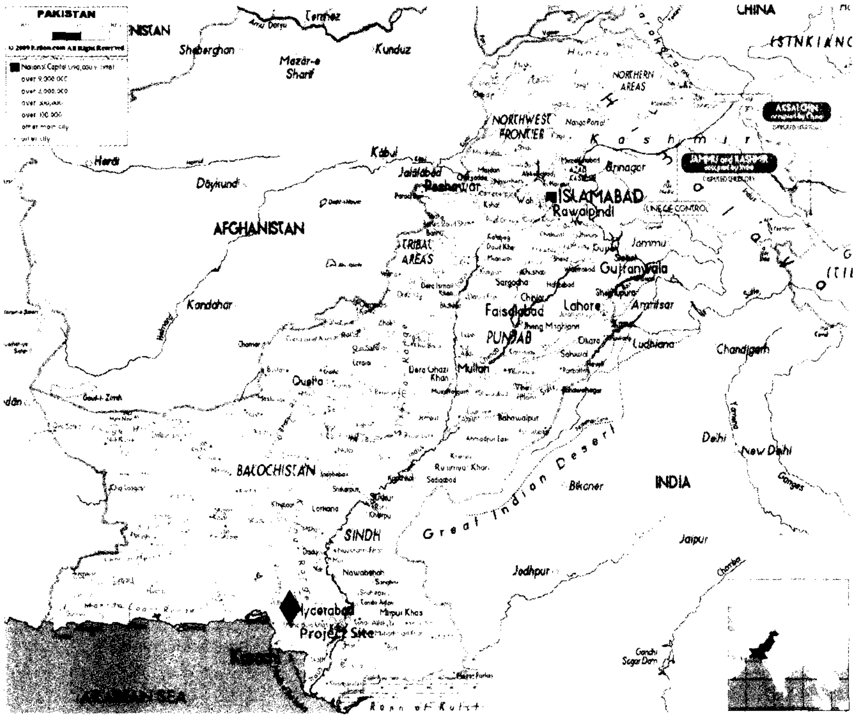
a. Project Location

Comprehensive due diligence was carried out by experts and representatives from all stakeholders of the project, which was followed by a review and selection procedure. The site allocated encompasses an area of 347 Acres (Latitude 25° 8'35.76"N and Longitude 68° 0'52.73"E in Jhimpir, Sindh). **Extract 1** shows the Coordinates of the project, while **Extract 2** shows the geographical location of the project.

50 MW Tricom Wind Power Project Coordinates

Node	Longitude (East)	Latitude (North)
1	68° 0'52.73"E	25° 8'35.76"N
2	68° 0'50.19"E	25° 8'32.16"N
3	68° 5'41.07"E	25° 5'33.57"N
4	68° 5'44.10"E	25° 5'37.59"N

Extract 1: Coordinates of the project



Extract 2: Geographical location of the project

b. **Scope and Layout**

The project area is generally very flat, and the most prominent natural feature is the creeks that surround the area. The project components are:

- 25 Wind turbines, each with a generating capacity of 2.0 MW and a rotor diameter of 121 m. Each turbine will be mounted on a tower such that the hub height is 90 m. The tower will be a prefabricated steel structure.
- 25 unit step up transformers mounted at the foot of each turbine tower
- 22 KV underground electrical collection system that leads to the project substation.
- Project operations and control building, which will also house the substation and grid connection to NTDC 132 KV system.
- Approximately 9.81 km long project road network linked to all the wind turbines.
- Meteorological mast, 120m height, for collection of wind data.

- Plant O&M facility.

1	Location of the Wind Farm		
1.1	Elevation	m	51.8
1.2	Longitude (East)		25° 8'35.76"N
	Latitude (North)		68° 0'52.73"E
	Wind Resource		
	Annual Average Wind Speed	m/s	6.7
	Major Equipment		
	Wind Turbine Generators		
3.1.1	Overall		
	Type		SL2000/121
	Rated Power	kW	2000
	Rotor Diameter	M	121
	Cut-In Wind Speed	m/s	3
	Rated Wind Speed	m/s	8.7
	Cut-Out Wind Speed (10min Average)	m/s	25
	Survival Wind Speed (3s Max)	m/s	52.5
	Survival Temperature	°C	-20 to +50
	Operating Temperature	°C	-15 to +40
3.1.3	Design Life	years	20
	Rotor		
	Blade Material		GRP
	Blade Quantity		3
	Blade Length	m	59
	Rotational Direction		Clockwise (front view)
	Orientation		Upwind
	Swept Area	m^2	11518
3.1.3	Gearbox		
3.1.3	Transmission stage		3
	Ratio		91.67
	Lubricating method		Pressure lubricating
3.1.3	Generator		
	Type		Double-fed asynchronous generator
	Rated Power		2150
	Rated Voltage	V	690
3.1.3	Rated Speed	rpm	1200
	Speed Range	rpm	680 to 1320
	Power Factor		Capacitive 0.95 to Inductive 0.95
3.1.3	Insulation Level		H

	Protection Level		IP54
	Grid Compliance		
	Range of input/output frequency	Hz	50±2 (adjustable)
	Voltage	V	690 ±10%
	Voltage asymmetry		5%
	Brake		
	Brake System		Aerodynamic + Mechanical
	Aerodynamic Brakes		Full feathering
	Mechanical Brakes		Active hydraulic
3.1.6	Yaw System		
	Type		Active
	Drive Units		Electrical Motor + Planetary gearbox + Exposed gear
3.1.7	Control System		
	Control Mode		PLC and Remote Control
	Lightning Protection		
	Design Standard		IEC61400-24
	Resistance of Earthing	Ω	≤4
3.1.9	Nacelle Cover		
	Material		GRP
3.2	Tower		
	Type		Conical Steel Tower

Extract 3 shows the technical specifications of the turbines.

The turbines selected for the project have in built features for extreme weather conditions to be suitable for the project site. The turbines would be subject to conditions such as temperatures exceeding 50 °C, wind speeds exceeding 10 m/s, and precipitation on panels in case of rare occasional occurrence of a sand-storm. Therefore, turbines should consist of materials that have high tolerance to these conditions and more, meaning a high factor of safety and resilience. Additionally, the turbines should allow for easy and fast maintenance along with cleaning operations.

SL2000 Series Wind Turbine

Adopting advanced load optimization and smart control technologies, SL2000 series wind turbine has reliable performance, easy maintenance and high availability. Smart wind farm management system brings maximum life cycle to the customer. Rotor diameter 100m/110m/116m/121m and hub height 80/90/100m are applicable to TC II and lower wind speed zones. This series can be installed in coast, mountain and highland as well as the other areas. SL2000/116 and SL2000/121 wind turbines have obvious energy production superiority in low wind speed zones.

Technical advantages

- Nature air cooling system for gearbox and generator has the advantage of less power consumption, fault rate and noise.

- Leading load optimization control technology significantly reduces the load of turbine and key components and improves turbine reliability;

- Smart technologies including pitch control, fine yaw control, soft cut-out control, adaptive energy acquisition and grid connection optimization control maximize power generation and environment suitability and bring maximum profitability.

- Advanced technologies like customized online monitoring system, smart fault self-diagnosis and operational optimization, sharing information with the neighboring turbines, turbine commissioning and fault eliminating bring to customer better reliability and availability;

- Big data and cloud platform for turbine operation and maintenance data analysis makes automatic and smart operation and maintenance of the wind farm.

- Leading technologies including wind farm power prediction system, smart security system, fine data management system, sector management and noise control successfully meet the needs of customers.

- Human-machine engineering theory optimizes maintenance access and operational space.

Technical features

- Blade

High-strength glass fibre blade with anti-wear on blade leading edge; reliable lightning protection;

- Pitch System

Super-capacitor as backup power has the advantage of low temperature and fast response; pitch control system inside the hub makes well lightning protection and sealing.

- Automatic Lubrication System

Automatic lubrication for pitch system, yaw system and main bearing saves time and reduces cost for maintenance

- Gearbox

Oil-to-water heat exchanger has the advantage of high efficiency and smooth start in cold climate environment;

Offline fine filteration system ensures oil quality and extends life time;

- Noise Decoupling

Rubber element as gearbox noise decoupling has the advantage of simple structure, reliable operation and easy maintenance.

- Generator

Air-to-water cooling generator has the advantage of small size and light weight;Technologies including insulation cover and multi-point earthing eliminates the influence of axial current.

- Nature Air Cooling System

Nature air cooling system has the advantage of less power consumption, noise, fault rate and maintenance.

Maintenance Crane
600kg lifting capacity; operational range covers the complete nacelle.

Maintenance Access
Generator lifting can be done without removing nacelle top cover. Easy for operation.

Converter
Air-cooled converter at tower base has the advantage of reliable operation and easy maintenance.

c. **Logistics**

All equipment, supplies and personnel will be moved to and from the site using road transport. Description of existing roads, additional roads required, and the vehicles to be used are given below.

- **Roads and Tracks**

The site is connected to Karachi via three routes.

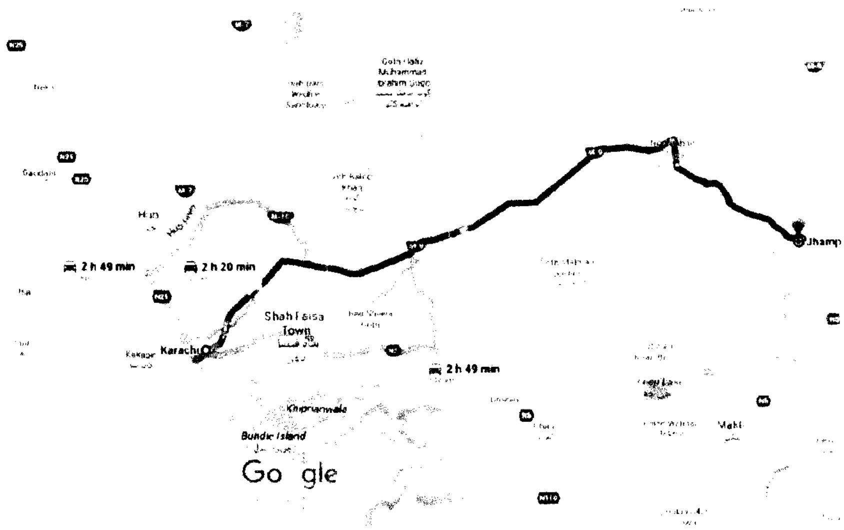
The first route comprising taking the M.A. Jinnah Road and Shahrah-e-Pakistan to the M-9 Karachi-Hyderabad Motorway for 13.5km, continuing on the M-9 for 80.7km before turning right on to the Thatta-Thano Bula Khan Road towards Jhimpir for 31.6km and reaching the site through access roads in approximately another 12km.

The second route comprising taking the M.A. Jinnah Road and Mauripur Road to the Karachi Northern Bypass/M-10 for 8.2km, following the M-10 onto the M-9 Karachi-Hyderabad Motorway and continuing till Nooriabad for 122km, before turning right on to the Thatta-Thano Bula Khan Road towards Jhimpir for 31.6km and reaching the site through access roads in approximately another 12km.

The third route comprising taking the Mission Road, Strachan Road and Abdullah Haroon Road to Merewether Road for 3.1km, whereon driving from Shahrah-e-Faisal N-5/AH2, Eastern Bypass onto the M-9 Karachi-Hyderabad Motorway onward to Nooriabad for 109km, before turning right on to the Thatta-Thano Bula Khan Road towards Jhimpir for 31.6km and reaching the site through access roads in approximately another 12km.

The Second and Third alternate routes to the site are not suitable for long trailer trucks required for transportation of the turbine blades due to sharp turns and narrow widths at several locations.

The multi lane Motorway's and Highway's new tarmac road will be used by project vehicles as it is and no modifications for the haulage of project equipment will be required up to the project site access roads. From the nearest point on the Thatta-Thano Bula Khan Road approximately 3 km long and 30 m wide access road to the site (TRICOM) will be constructed under TRICOM right of way (ROW). An approximately 100 km internal road to service the towers will be constructed on the site premises



Extract 4 shows the routes to the Project Site from Karachi

- **Vehicles and Traffic**

The movement of heavy vehicular traffic will primarily be during the turbine, tower, blade and other equipment's delivery stage and during the movement of the batching plant and ancillaries. A maximum of 6 vehicles (4 axles and above) per hour will be used during the construction period. Excluding the buses and coasters required for movement of the site staff.

- **Work Schedule**

It is expected that work on the project will commence during the second quarter of 2017. Work will commence with the construction of the access road and site preparation (civil works). The construction phase is expected to take 18 months. The schedule of activities is expected to be finalized during a kick of meeting between the contractors and project companies expected to be in second quarter of 2017.

- **Construction Activities**

The land acquired by the Joint Venture consists primarily of flat ground and slight uneven terrain. Construction of the Wind farm will be uniformly spread throughout the project site.

Prior to any construction activity, the site must be cleared of all debris and surface vegetation if any. The leveling and grading can be carried out by normal earth moving machine. It is recommended that immediately after excavation for construction of foundation or other substructures, the excavation bottoms and slopes are cleared of all debris, proof rolled and covered by a 5 cm thick blinding concrete layer. The onsite material is generally classified as SANDY SILTY CLAY (CL-ML) group of Unified Soil Classification System. Select fill material should consist only of inorganic material and shall have 5-20% passing the No. 200 sieve. Fill material should pass 100% the 50 mm sieve. Besides, that portion of material passing sieve No. 40 should not have liquid limit more than 35 and plasticity index of not more than 12. Atterberg limits are not required for select fill material with less than 15% passing sieve No. 200. Select fill material shall have a carbonate content of less than 25% by weight.

The main construction activities of the project are the foundations of the 132 kV substation, wind turbine generators (WTGS), Medium Voltage Substations and High Voltage Substations. The earthquake basic intensity of this Project is 7 on the Richter scale. Total 25 wind turbine generators with the single-machine capacity will be installed on this project. This phase initially drafted the wind turbine generators' basic force-bearing layer is strongly weathered limestone, strongly weathered mudstone layer and characteristic value of the sub-grade force-bearing 350 kpa-500 kpa. The basic buried depth of the wind turbine generators shall be roughly 4.5 m, and initially drafted on the basis of the natural and chunks of body independent foundation with reinforced.

The foundation of the 22 kV Compact Prefabricated Substations initially drafted to design by the shallow foundation on the natural foundation. Following to the collected Compact Prefabricated Substations overall dimension and its foundation adopt C25 brick and concrete box-foundation. There are 100mm thick of C10 base adopts C25 brick and concrete box foundation under the foundation whose burial depth is 2.50m, and the excavation slope initially employs the rate 1:0.5.

The civil works or construction of buildings will be divided in to the following segments:

a) Segment A comprising a:

1) a life management area which consists of the multiple-use building accessory occupancy and so on. It shall have buildings with living quarters, highly and lowly strew at random, weekly and strongly alternative.

2) a multiple office building for operations and monitoring of the wind power generation's characteristics.

3) there shall be a building which provides the perfect leisure fitness place for living human resource.

4) there shall be an affiliated housing colony including garage, overhaul room, with sewage treatment equipment and so on fixed up jointly merged.

b) Segment B comprising of:

1) production areas, with mainly arranged 22 kV indoor power distribution unit, reactive-load compensation equipment, main transformer and 132 kV outdoor architecture.

Every permanent constructions parting from the multiple-use building in the Substation is independent foundation by reinforced concrete. The others employ rubber concrete with the strip foundation, natural foundation bearing-force 11 layer is viscous powder soil or silty sand 1 2 layer which bearing capacity of foundation soil's value is 220 280 kPa, and the enclosing wall of the Substation is made of rubber stone as the foundation.

- **Staff**

It is planned that, on an average, around 180 direct manpower will be required during the construction phase. This will increase to 800 for 6 months of the construction period. Additionally, around 80 support staff will also be present. No expatriate workers are expected to be on site. Local people will be hired for unskilled jobs, especially during the construction phase.

- **Supplies**

All supplies, both for construction and for the camp, will be transported by trucks from either Karachi or the adjoining areas, as required. This will include all fuels and oils, drilling requirements, spare parts for the construction machinery and food and supplies for the construction camp. Fuels and oils will be unloaded in designated areas. Aggregate / sand will be procured from Hub. A catering company will be contracted to supply the camps.

The onsite storage capacity for fuel will be 12,000 gallons, consisting of 2 steel tanks of 6000 gallons each. The total fuel requirement is estimated to be 2.198 ML.

- **Water**

During the construction phase an estimated 186,300 m3 of water will be required for civil works. The daily maximum will be around 40,000 liters of water for civil works. The onsite storage capacity of water will be approximately 8,000 liters. This water will be obtained from the Kalri Lake..

The camp will require 8000 liters of potable water each day, and this will be obtained from Jhimpir City/Town. This water will be stored in plastic tanks.

- **Electricity**

The expected maximum requirement of electricity for construction and the camp is 1300 KVA. Diesel generators will be used for power generation to operate the construction equipment and for the camp. It is expected that 3 generating sets of 50 KVA each, 3 generating sets of 80 KVA each and 3 generating sets of 200 KVA each will be sufficient for the requirements. The welding generators will be in addition to the above generating capacity. The daily fuel requirement will be around 6000 liters. Emissions from the generators will be reduced by ensuring that the engines are always properly tuned and maintained, and generators will be located so that emissions are blown away from the camp and work areas.

- **Waste Management**

All efforts will be made to minimize waste generated during the construction period. The main types of waste that will be generated are:

- ✓ Fuels and oils
- ✓ Garage waste
- ✓ Sewage
- ✓ Camp waste

The piling operation is not likely to generate any waste as only water based bentonite clay may be used during piling. As bulk concreting will be done using concrete pump wastage of concrete will be minimal.

Fuels and oils will be stored in containers in areas with impervious floors and surrounded by dyke walls. Recyclable materials will periodically be transported out of the site and sold / given to contractors. Non-recyclable material will be collected and disposed of 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 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 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 it being blown away. Any non-combustible and non-biodegradable waste, such as glass, metal and plastic, will be separated and transported out of the site area, where it will be sold / given to a contractor for recycling or disposal at designated sites.

- **Noise**

The generators and other heavy construction machinery will not produce excessive noise which will exceed the limits at the boundary of the plant. Workers near these machines will use appropriate PPE.

d. **Operational Activities**

After the completion of its construction, the Project shall be jointly managed with the 132 kV Substation. A joint management organization will be established with the principle of requiring "few on-duty staff". After the electrical equipment and machinery have entered their stable operation mode; the wind farm and substation shall be managed with "no on-call staff and few on-guard staff'.

OEMs for WTG's are responsible for providing the generic maintenance plans for WTG's which include cleaning. The maintenance manuals would be prepared for the utility plant. The joint management between TWP and EPC Contractor will be required to further determine the suitable maintenance requirements for the Turbines/Equipments. This would be done by sharing complete site information (dust, dirt, pollen and/or pollution in the site environment; the frequency of rain) with the OEMs, and ask them for site specific cleaning plans and details such operations.

- **Staff**

Operation and maintenance team members and their qualification requirements will be dependent on the requirements presented by OEMs for equipment and components, requirements identified by EPC Contractors and TWP. Team structure would be dependent on the nature of approach taken towards the responsibility of O&M.

TWP & the EPC Contractor will jointly draft procedure and decision protocols regarding the presence of skilled engineers and technicians on site to operate the plan or control through utility from remote location. The systems of Patrol Inspection, operation guardianship, maintenance and overhaul will be established for the daily maintenance of production equipment, instruments and apparatus. These SOPs would be in-line with all requirements of International Standards of Safety, Management, Quality and Human resource management

- **Supplies**

All supplies, both for operations and for the site staff, will be transported by trucks from either Karachi or the adjoining areas, as required. This will include all fuels and oils, spare parts required for maintenance and food and supplies for the site staff. Fuels and oils will be unloaded in designated areas, which will have above ground storage for 400 gallons of fuel. LPG will be used for cooking purposes.

- **Water**

850 liters per day of potable water will be required. This will be obtained from Kalri Lake, and the site will have storage for 8,000 liters

- **Waste Management**

Fuels and oils will be stored in containers in areas with impervious floors and surrounded by dyke walls. Recyclable materials, including garage waste, will periodically be transported out of the site and sold / given to contractors. Non-recyclable material will be collected and disposed of at designated landfill sites. The drainage and sewerage system constructed during the construction phase will be used during the operations phase of the project i.e. soak pits for the collection of waste water from kitchen and washing / ablution areas and septic tanks for sewage from the toilets. Sewage and solid waste disposal trucks will be used to remove the sludge, sewage and solid waste from the site.

Storm water drainage will be managed by controlled flow into the natural rain canals.

- **Noise**

The generators and other heavy construction machinery will not produce excessive noise which will exceed the limits at the boundary of the plant. Workers near these machines will use appropriate PPE.

I. Decommissioning

TWP will ensure that the entire Project Location is restored back to its pre-construction condition (successional vegetation land use or as may be appropriate at that time) and that the decommissioning is conducted in accordance with the applicable local (Jhimpir bodies), provincial (Sindh Government) and federal requirements. In addition, potential effects and mitigation pertaining to significant natural features on and/or in proximity to the Project Location will documented. Overall, no significant adverse impacts to the environment are expected as a result of decommissioning the Project. **The Flow Chart below (Extract 4: From Feasibility Report)** shows the flow chart of the decommissioning procedure.

Extract 5: Decommissioning Plan

Decommissioning Notification
The Notice will provide information regarding the expected start date and duration of decommissioning activities and the Proponent's contact information, including a telephone number, e-mail, and website and mailing address for those seeking more information about the planned decommissioning activities and/or reporting emergencies and complaints.

↓

Equipment Dismantling and Removal
Any electrical decommissioning will include obtaining the required permits and following lockout/tag out procedures before de-energizing, isolating, and disconnecting electrical devices, equipment and wiring/cabling.

→

Management of Wastes and Excess Materials
Waste that requires disposal will be disposed of in a provincially licensed facility by a provincially licensed hauler. It is not anticipated that hazardous waste that requires special disposal will be generated, with the exception of the transformer oil, which is to be disposed of in accordance with federal, provincial and municipal requirements.

↑

Site Restoration
The Project doesn't include any permanent changes to the original use of the land. Therefore, it will be possible to restore the site to its pre-construction, successional vegetation condition.

VIII. Description of Environment & Socioeconomic Conditions

a. Physical Environment

On the basis of the physical environment and geology, the project area falls in the Indus Basin, which is briefly described below.

The Indus Basin essentially forms the western extension of Indo-Gangetic Plain, and has been made up of the silt brought by the Indus and its numerous tributaries, such as Jhelum, Chenab, Ravi and Sutlej on the east bank, and Kabul, Kurram, Tochi, and others on the west bank. The Indus Plain is known for its agricultural fertility and cultural development throughout history.

On the basis of hydrology and land form, the Indus Plain can be divided into the Upper and Lower Indus Plains. The Upper Indus Plain differs from the Lower Indus Plain (where the project area is located) primarily because of the major tributaries (Jhelum, Chenab, Ravi and Sutlej) divide the land surface into several interfluves or *"doabs"*. The two plains are separated by a narrow corridor near Mithankot where the Sulaiman range approaches the Indus River. The Lower Indus Plain is very flat, generally sloping to the south with an average gradient of 95 mm per km (6 inches per mile).

The Lower Indus Plain can be divided in five distinct micro-relief land forms: active flood plain; meander flood plain; cover flood plain; scalloped interfluves; and the Indus delta. The proposed project site is located in the last of the micro-relief forms listed above. Topographically, Sindh can be divided into four distinct parts with the dry and barren Kirthar Range in the west, a central alluvial plain bisected by the Indus River, a desert belt in the east, and the Indus delta in the south. On the basis of this classification, the project area is located in the Indus delta.

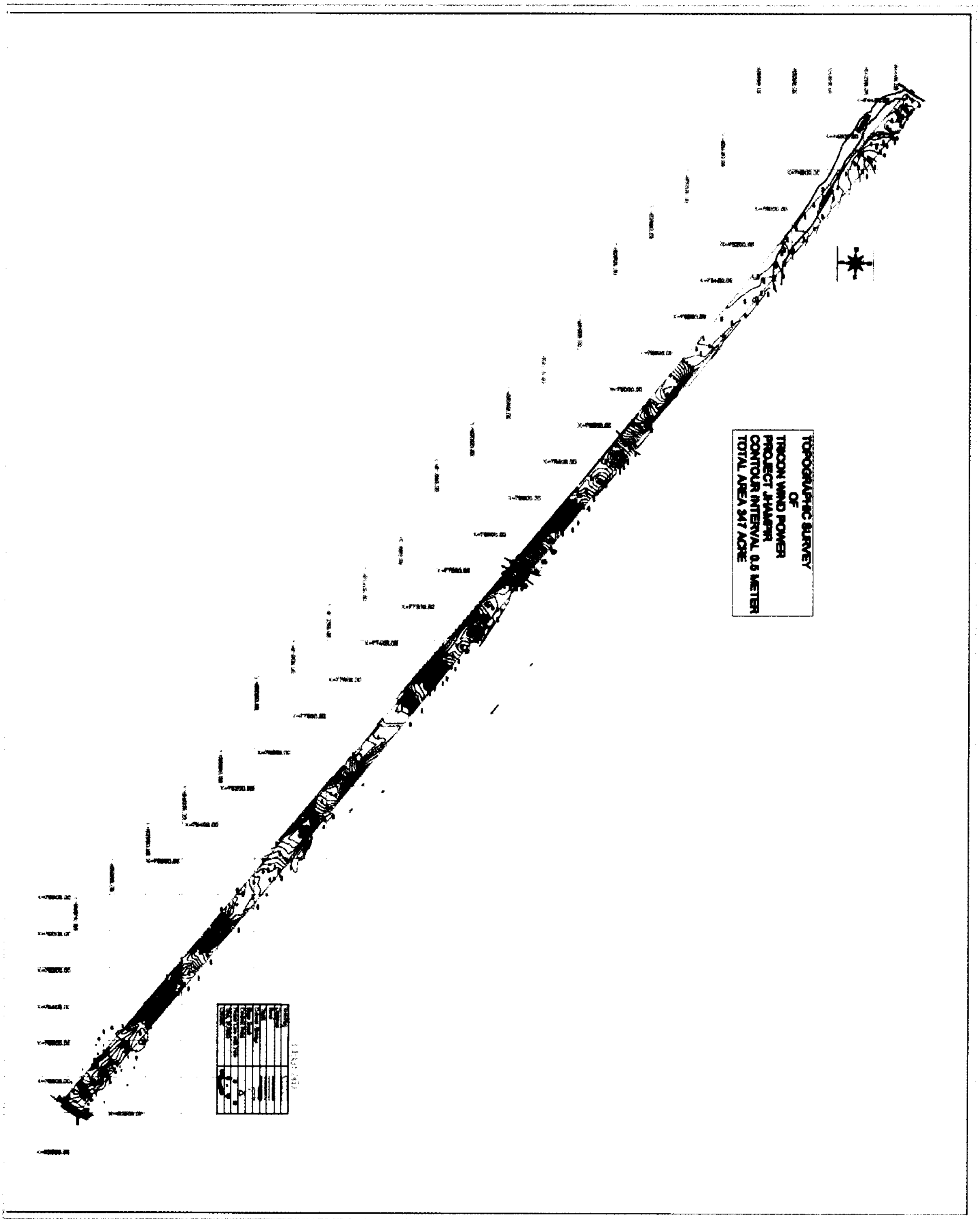
Geological Setting: The prevailing geologic conditions in the region are the results of extensive inundation, depositions, coastal movements, and erosions over a long period of time in the geological ages. The geology of the region is closely related to the formation process of Himalayan ranges resulting in intense deformation with complex folding, high angle strike-slip faults and crust thickening expressed in a series of thrust faults. The important tectonic changes which have had so much influence in the region are feebly visible particularly in the Indus Plain, and it is only by considering the geology on a broader regional scale, as well as in site specific detail, that the effects can be appreciated. Most parts of Sindh are covered either by recent alluvium or wind-borne sand. The principal features of geological significance are to be found in the hilly portions of the province, towards the west of the Indus. Outlying extensions of this hilly tract occur east of the Indus as well, near Sukkur, Hyderabad and Jerruck. The isolated hills of Nagarparkar on the northern border of the Rann of Kutch belong to quite a different system both geographically and geologically.

The geological studies of the proposed site have not been conducted in detail. However, the studies carried out in the vicinity of Port Qasim area which is not far away from the proposed site reveal that Port Qasim and its adjoining areas have been formed in the middle and upper Tertiary and the soil formation found in the area are fresh and slightly weathered with recent and sub-recent shoreline deposits. These formations are derived from Gaj / Manchar formation of lower Miocene to middle Miocene to Pliocene age.

Similar deposits are found all along the coastal belt of Karachi and adjoining areas. The earthquake hazard in the Indus Delta and the estuaries on the passive continental margin is mainly from intra-plate active faults particularly Rann of Katch Fault also known as the Karachi-Jati-Allah Bund Fault. It has three other segments namely Jhimpir Fault, Pab Fault and Surjani Fault. The main faults between Karachi and Rann of Kutch are generally oriented easterly and slightly concave to the north. Two severe earthquakes occurred in the vicinity of Karachi, one in the year 1050 at Bhambore in which 0.15 million casualties were reported and the other in the year 1668 at Pipri near Steel Mill which is only 60 km away from Karachi, however the details of this are not available.

Land Use: Agriculture, followed by forestry, is the main land use in most parts of Sindh. Although more than 50 percent of the total geographical area is cultivable, only 26 percent of it is actually located in the central plain. The land inside the Indus embankments is almost equally employed by agriculture and forestry, while that outside the embankments is more extensively utilized for agriculture in the form of sparsely distributed irrigated plantations. The proposed site and its immediate surroundings are lying completely vacant, with no habitation, cultivation or grazing activity.

Extract 6: Topographic Survey of the Site



b. **Micro Climate Effects**

Meteorology: The climate in the Sindh coastal area can be characterized by dry, hot and humid conditions, typical of sub-tropical coastal zones lying in monsoon region. There is a minor seasonal intervention of a mild winter from mid-December to mid-February and then a long hot and humid summer extending from April to October. The nearest meteorological station is located at the Karachi Airport. The data from this meteorological station is discussed in the following sections.

Temperatures: The air temperature in the coastal zones in the vicinity of the proposed site is generally moderate. Annual air temperature range is 6 to 42 °C. The mean maximum temperature during summer is 35 °C whereas the mean minimum temperature during winter is 10 °C. However, there are occasions when the coastal belt including Karachi is in the grip of heat wave and the maximum temperature exceeds 40 °C. This extremely hot weather condition persists for 2-3 days and happens only three to four times during the year. The average temperature data showing maximum and minimum temperatures recorded by Pakistan Meteorological Department (PMD) at Karachi Air Port is provided in Extract 6

Wind: In Karachi and adjoining deltaic areas, the winds blow throughout the year with highest velocities during southwest monsoon (May to August). The dominant wind direction during the winter is east-northeast, while during summer the direction is west-southwest.

Rainfall: The rainfall in the coastal belt of Karachi and Indus Deltaic area in the vicinity of the proposed site is extremely low. The rainfall data shows that 156.8 mm rainfall was recorded during first six months.

Climate: Pakistan's latitudinal and longitudinal extents and its northern rim of lofty mountains are the two factors, which have a great bearing not only on the temperature and rainfall patterns, but also on the general circulation of the atmosphere on the southern Asia. Climate of Pakistan according to Koppen"s classification7 falls under the following five types:

a. **Tropical Semi-arid with Dry Winter:** This climate type prevails in Karachi, Hyderabad, and southern Khairpur Division. The mean annual temperature is above 18 C.

b. **Tropical Arid:** This is characterized by average annual temperature of about 18 C with dry winters. This includes southern Kalat and whole of the Indus Plain.

c. **Cold Semi-arid With Dry Summer:** This climate type covers central Kashmir, Peshawar, D. I. Khan, Quetta and northern half of Kalat Division.

d. **Snow Forest Climate:** This climate type is characterized by average temperature of coldest month below 0 C. Mean temperature of the warmest month is between 10 and 22 C. It includes northern mountainous areas and parts of Kashmir.

e. **Extreme Cold:** This climate type is characterized by average temperature of the warmest months between 10 and 0 C. It comprises eastern and northern parts of Kashmir, Chitral, Gilgit and Laddakh.

Based upon the above classification, the project area falls in the tropical semi-arid with dry winter climate zone.

Ambient Air Quality: No sources of anthropogenic sources of air pollution exist in the immediate vicinity of the site; therefore the ambient air of the area is likely to be free from the key pollutants such as carbon monoxide (CO), oxides of nitrogen (NOx), sulfur dioxide (SO2) and particulate matter (PM).

Freshwater Resources

Indus River: The Indus River is the main source of surface water in the project area (and in the country). The Indus rises in Tibet, at an altitude of about 18,000 feet (5,486 m) amsl, and has a total catchment area of 654,329 km2. Length of the Indus River in the country is about 2,750 km. Five main rivers that join the Indus from the eastern side are Jhelum, Chenab, Ravi, Beas and Sutlej. Besides these, two minor rivers - Soan and Harrow also drain into the Indus. On the western side, a number of small rivers join Indus, the biggest of which is River Kabul with its main tributaries i.e. Swat, Panjkora and Kunar. Several small streams such as Kurram, Gomal, Kohat, Tai and Tank, also join the Indus on the right side. The Indus River exhibits great seasonal variations, with more than 80% of the total annual flow occurring during the summer months, peaking in June, July and August.

The Indus River and its tributaries on an average bring about 154 million acre feet (MAF) of water annually. This includes 144.9 MAF from the three western rivers and 9.14 MAF from the eastern rivers. Most of this, about 104.7 MAF is diverted for irrigation, 39.4 MAF flows to the sea and about 9.9 MAF is consumed by the system losses which include evaporation, seepage and spills during floods. The flows of the Indus and its tributaries vary widely from year to year and within the year. As is the case with the water availability there is significant variation in annual flows into sea.

Several irrigation canals originating from the Indus River exist in the area, including the Baghar, Ladhya and Jam Sakro canals. The canal nearest to the proposed site is Jam Sakro canal.

Lakes: Several fresh and brackish water lakes exist in the Thatta district. These include the Kalri and Haleji lakes and Jhuddo lagoon. Kalri Lake (also called Keenjhar) is a large freshwater lake providing drinking water to Karachi. It was declared a Ramsar site in 1976 and later became a wildlife sanctuary under the Sindh Wildlife Protection Ordinance. Haleji Lake is an artificial freshwater lake with marshes and a brackish seepage lagoon. Considered a game reserve in 1971, this lake was declared a wildlife sanctuary and in 1976, the lake proceeded to become a Ramsar site. Haleji serves as an important source of water for Karachi besides being a popular recreational destination. Jubho Lagoon is a shallow, small brackish water lagoon with mudflats and marshes that support a large concentration of migratory birds including flamingos and endangered Dalmation pelicans, a rare species in the world. This was declared a Ramsar site in 2001 because of the efforts made by IUCN Pakistan.

None of the above water bodies are in the immediate vicinity of the proposed project site.

River Water Quality: The water quality of Indus River is generally considered excellent for irrigation purposes. The total dissolved solids (TDS) range from 60 mg/l in the upper reaches to 375 mg/l in the lower reaches of the Indus, which are reasonable levels for irrigated agriculture and also as raw water for domestic use. The disposal of saline drainage from various irrigation projects has been a major factor in the increased TDS in the lower reaches of the rivers in the Indus Plain. There is progressive deterioration downstream and the salinity is at its maximum at the confluence of the Chenab and Ravi rivers, where the TDS ranges from 207 to 907 mg/l. A slight improvement in water quality is noted further downstream at Panjnad due to dilution from the inflow from Sutlej River. The quality of the Indus water at Guddu, however, is within acceptable limits for agriculture; TDS being in the range of 164-270 mg/l.

In the upper reaches of the Indus River, the Dissolved Oxygen (DO) content remains above 8.5 mg/l which is well above the acceptable levels of 4 mg/l. The Biochemical Oxygen Demand (BOD) downstream of Attock has been recorded as 2.9 mg/l. At Kotri, it has a suspended solid (SS) content of 10 to 200 mg/l. Indus River water quality has been studied at the Dadu - Moro Bridge and Kotri Barrage, with nitrate levels at 1.1 and 7.5 mg/l, phosphate at 0.02 and 0.3 mg/l, BOD at 2.4 and 4.1 mg/l, faecal coliforms at 50 and 400 per ml, and aluminum at 1.8 and 0.2 mg/l respectively. Due to industrial waste discharges from Punjab and Sindh, a high content of heavy metals such as nickel, lead, zinc and cadmium have also been found in Indus water.

Biological Environment

In this section, biological information of the area in general is provided, followed by the site-specific description. While the information of the general area is based upon the secondary literature, the site-specific description has been updated on the basis of the recent field work carried out.

Biological Resources of the adjacent Area: Five types of habitats have been found in the area adjacent to the study area viz.

a. *creek area,*
b. *marshes,*
c. *saim nullah,*
d. *barren/ waste land*
e. *open plain area.*

Kalri Lake is situated close to the Project Area. Slight East to the Kalri Lake lies the path of the Indus River flowing downwards towards the creek area before entering the Arabian Sea. The Creek area forms a part of the Indus Delta which is also a Ramsar Site (Wetland of International Importance). The main migratory route of the migratory water birds in the area falls along the Korangi/Phitti Creek System, Waddi Khuddi Creek, Patiani Creek, Gharo Creek, Dabbo Creek and the Keti Bunder Area. Patiani Creek is located in the west of the project area while the other creeks of Thatta district are quite away from the proposed site. The creeks support large concentrations of migratory water birds particularly the *Waders* which feed on the shallow margins or at marshes along the water line. The main concentrations of birds are found along Korangi/Phitti Creek System in Karachi District and Keti Bunder area in Thatta District.

The project area does not fall along the main migratory bird path.

The feeding area of the water birds lies along the marshes of the creek area which is far south of the project area and will not be affected due to the project.

Marine Ecosystem

Mangroves: In the Thatta Region Mangroves of the Indus Deltaic creek system are of great ecological and economic significance. Mangroves play a very important role in the local economy being a source of timber, fuel wood, fodder, honey and fisheries. The Indus Delta mangrove ecosystem is highly rich in biodiversity, and provides, natural breeding and nursery ground for offshore and coastal fishery resources of shrimps and fish. The mangroves also provide sanctuary for a wide variety of migratory birds and other wild life. In addition to this, the mangrove ecosystem also plays an important role in protection from erosion as well as cyclones and tidal bores.

Mangroves are one of the most outstanding ecosystems of coastal zone of Sindh. The mangroves along Sindh coast are unusual in that they occur in an arid climate. The mangrove ecosystem stretches along the entire Sindh coast from east of Karachi to Sir Creek covering the whole of Indus River Delta past and present.

The present Indus Delta is spread over an area of 600,000 hectares (ha), of which as much as 260,000 ha are covered with mangrove vegetation which has been estimated through satellite imageries. The mangroves of the Sindh Coastal areas at present do not receive fresh water continuously which is required for their healthy growth. Mangroves in the vicinity of Karachi receive their fresh water supply from domestic and industrial effluents through Lyari and Malir Rivers, while the mangroves in the delta depend on the fresh water supply from River Indus.

Earlier eight species of mangroves were reported to occur in Indus Delta along Sindh Coast. However, now only four species are found along Sindh Coast, which include *Aegiceras corniculatum Avicennia marina, Ceriops tagal and Rhizophora mucronata*. *Avicennia marina* is the most dominant species of the mangrove ecosystem along Sindh coast covering 95-98% of the mangrove forest. *Rhizhophora mucronata* has been reintroduced / planted in Port Qasim Area with the efforts of Sindh Forest Department and IUCN and only the other three species grow naturally in Indus Deltaic area. *Aegiceras corniculatum* and *ceriops tagal* have been reported at specific places like Hajamro Creek, Keti Bunder and Shah Bunder area.

The project area is barren and far north of this area. It is far away from and not under the influence of normal high tide. No mangrove plants have been observed in the project area during the recent field visit.

Avicenna marina previously recorded in the coastal creek area has already disappeared. It is presumed that previously recorded mangroves in the region would have been the result of mangrove seeds reaching this area from nearby mangrove forest through seawater movement in the creeks adjoining Port Qasim, but due to scarcity of fresh water and the resultant increase in salinity in the intervening years the growth of the mangrove is affected. The area is now mostly covered with halophytic plants.

Biological Resources of the Proposed Site: This section provides an overview of the ecozones, wild flora and fauna, and the habitat conditions prevailing in the project area. The description in this section has been prepared on the basis of secondary literature review, and field visits carried out in the area during this study and earlier assignments.

Original Ecozones of Project Area include the Tropical Thorn Forest Ecozone. This habitat was the most extensive ecozone of the Indus plain, and currently exists only in places where the land has not been converted for habitation or cultivation. This habitat comprises low forests of thorny and hard-wooded tree species, dominated by *Acacia* spp. The trees of such forests have short boles and low branching crowns. These are usually not close-growth trees hence their canopies touch each other in exceptionally favorable spots. The usual height of the trees is 20-30 feet (6-9 m). Other plants that grow mixed with *Acacia* include *Salvadora, Prosopis, Capparis,* and *Tamarix.* The shrubs of the ecozone included *Calotropis, Zizyphus, Suaed*, while herbs of the area included *Chenopodium, Calligonum, Haloxylon* and various species of grasses.

The major wildlife mammal species of this ecozone was Long-eared Hedgehog, Desert Hare, Porcupine, Desert Wolf, Jackal, Bengal Fox, Desert Fox, Honey Badger, Small Indian Civet, Grey Mongoose, Small Indian Mongoose, Striped Hyena, Indian Desert Cat, Caracal, Jungle Cat, Wild Boar, Nilgai, Blackbuck and Chinkara Gazelle. Birds of the ecozone included Grey Partridge, Peafowl, Common Quail, Ring Dove, Red Turtle Dove, Little Brown Dove, Green Pigeon, Hoopoe, Spotted Owlet, Barn Owl, Dusky Horned Owl, Indian Nightjar, Wryneck, Golden-backed woodpecker, Pied Woodpecker, Wood Shrike, Great Grey Shrike, Rufous-backed shrike, Fantail Flycatcher, Common babbler, Jungle babbler, Houbara Bustard, Great Indian Bustard and many other species of passerine birds.

Whereas originally the riverine tract habitats used to have heavy, seasonal floods. Since forecasting and prior warning were not available to the rural people, these habitats were not occupied for agriculture and habitation. Natural resource exploitation was also not extensive. As a result, this natural flora along the rivers flourished. These included: *Tamarix, Saccharum, populous* and *Acacia. Typha* growth was common wherever the water was stagnant or slow moving.

Now with the passage of time, reduced water flow in the Indus, better flood warning systems and other such developments in the area, the nature of Habitat has been modified. Major parts of the original habitats described above have been modified into new habitats, primarily as a result of extensive cultivation and expanding urban centers as well as rural settlements. These new habitat types are briefly discussed below.

- **Agricultural Habitats** Most parts of Sindh are under very intensive irrigated cultivation. In addition, livestock rearing is also practiced extensively, and milk animals are common. The use of the chemical fertilizers and pesticides is very common. Several species of wildlife have adapted to the changed habitat. These include: Jackal; Jungle Cat, Bengal Fox, Small Indian Mongoose, Shrew, Rodent pests including Porcupine, Fruit Bats and Wild Boar. The avifauna which survived the modified habitat include Doves, Black Partridge, Cuckoos, Koel, Woodpeckers, Parakeets, Bulbuls, Babblers, Black Drongo, Bee-eaters, Finches and House Sparrow. The reptilian species of this modified habitat include Krait, Cobra, Saw-scaled Viper, Rat Snake and Monitor Lizard.
  In these modified habitats, the winter bird species from Himalayas have reduced due to the extensive use of pesticides in these areas, since these species feed on the insects. These birds play an important role in controlling

insects particularly in the forests. Almost all of the project components are located in this type of habitat.

- **Rural and Urban Habitats** These include human habitations within agriculture areas, as well as the urban centers. Scavengers like Jackals are attracted to the garbage dumps and human feces for food. House Sparrows breed in the houses. Bank Mynas and Cattle Egrets feed on grasshoppers in the rangelands with cattle and buffalos. Banyan and Peepal trees still grow in villages. Green Pigeons and barbets feed in these trees.

As for the **Migratory Birds** it is pertinent to point out that there are total 660 birds species found in Pakistan. Out of the total checklist of birds, 30 % of the birds are species which visit the country for a significant period of the year's long distance migrants, while 43 % of the total checklist are either Palearctic or Oriental Species which come to Pakistan only for breeding. 28 % of the total numbers of species are regular winter visitors which breed extortionate and mainly in trans-Himalayan northern regions, If Himalaya is taken as a separate and distinct zoogeographic region and only those species which do not breed widely north of Himalaya, are excluded then 19.5 per cent of all species are endemic.

In addition **Wetlands** are among the most productive ecosystems in the world. Since Pakistan is situated on the flyway to Central Asia and South Asia, the birds breeding in Central and Northern Asia, migrate through Afghanistan to the Indus Valley, particularly to the wetlands across Sindh which are major wintering grounds of migratory water birds.

Some of the important wetlands are briefly described below:

- **The Indus Dolphin Reserve** is spread over 135 km from the Sukkur upstream to the Guddu Barrage. In 1974, the entire area was declared the home of the endangered Blind Dolphin. The major threats it faces include split populations of the dolphins due to dams and barrages on the River Indus, reduction in habitat size during dry season, high turbidity, pollution, and hunting. The number of dolphins at the site has increased from 150 in 1974 to 620 in 2001.

- **Manchar Lake**, a threatened wetland dying from pollution and mismanagement, was once considered the largest freshwater lake in Asia. It is located about 12 miles west of the town of Sehwan Sharif and spread over an area of 100 square miles that was once renowned for its beauty and the large population of migratory birds and wild fowl. The water supply for Manchar Lake depends on water flows from River Indus via Aral Wah and Danistar Wah, storm water and hill torrents from Kirthar Hills and effluents from drainage units via Main Nara Valley Drain. Over the last two decades, the fresh water intake of the lake has declined significantly relative to the saline and toxic effluents discharged into it.

- **Keenjhar (Kalri) Lake** Keenjhar also known as Kalri Lake is one of the largest freshwater lakes in Pakistan. It is located on 24° 56 N, 068°03'E coordinates. It has length of about 24 km, width 6 km and capacity of 0.53 million acre feet. It is located at a distance of about 122 km east from Karachi and 19 km north-east of Thatta town. The lake was created in 1930s from the two smaller lakes Keenjhar and Kalri by the construction of a dam at Chilya and a 12 km embankment on the eastern side. Indus provides Keenjhar, the required water through Kalri Baghar (KB) Feeder. KB Feeder starts from Kotri Barrage. Since the area is arid and receives less than 200 mm annual rainfall, hence Indus is the only source of water for this lake.

  The lake has extensive reed-beds, particularly in the shallow western and northern parts and rich submerged and floating vegetation. The natural vegetation of the surrounding area istropical thorn forest. The climate is dry subtropical monsoonal.

  The lake is internationally important for a wide variety of breeding, staging, passage and wintering water birds. The wintering birds include ducks and geese, shorebirds, flamingos, cormorants, herons and egrets, ibises, coots, gulls, terns etc. The breeding birds reported from this wetland are Cotton Teal, Night Heron; Pheasant tailed Jacana and Purple Moorehen21. This lake has rich submerged and floating aquatic vegetation. The natural vegetation of the surrounding area is tropical thorn forest. The Lake is rich in fish fauna and supports the livelihood of about 50,000 local people. Main activities at the site are commercial fishing, nature conservation and public recreation. The site serves as a major source of drinking water for Karachi. Keenjhar Lake was declared a Game Sanctuary in 1971 and designated as a Wildlife Sanctuary in 1977.

- **Drigh Lake:** It lies 18 km west of Larkana. It is located on 27° 34 N, 068°06'E coordinates. Drigh is a small, slightly brackish lake, with extensive marshes, situated in the Indusfloodplain. The lake is fed by water from the nearby canal system and by local run-off from monsoon rains. The lake is situated in an area of cultivated plains, generally divided into small fields for rice cultivation. It is a semi-natural wetland, supporting rich and diverse aquatic vegetation. The climate is arid and sub tropical, with hot summers and cool winters. The site regularly hosts over 20,000 water birds, mostly ducks, geese and coot in winter. It is a breeding and wintering area for a wide variety of water birds and an important roosting site for night-heron. The wintering birds also include shorebirds, cormorants, pelicans, flamingos, jacanas, gulls and terns. This lake was designated as a Wildlife Sanctuary in 1972.

- **Haleji Lake** is a perennial freshwater lake with marshes and a brackish seepage lagoon. Considered a game reserve in 1971, this lake was declared a wildlife sanctuary and in 1976, the lake proceeded to become a Ramsar site. Haleji serves as an important source of water for Karachi besides being a popular recreational destination. The Lake is located in Thatta district on 24° 47 N, 067°46'E coordinates.

- **Jubho Lagoon** is a shallow, small brackish water lagoon with mudflats and marshes that support a large concentration of migratory birds including flamingos and endangered Dalmation pelicans, a rare species in the world. This was declared a Ramsar site in 2001 because of the efforts made by IUCN Pakistan. The lagoon is located in Thatta district on 24° 20 N, 068°40'E coordinates.

- **Nurri Lagoon** is also a brackish, privately owned lagoon with barren mudflats that is visited by large concentrations of migratory water birds. It was also declared a Ramsar site in 2001. Increased salinity, sea intrusion, population pressures, agricultural and industrial pollution are major threats to this site. The lagoon is located in Badin district 24° 30 N, 068°47'E on coordinates.

- **Deh Akro** is a wildlife sanctuary consisting of four major habitats; desert, wetland, marsh, and agricultural. Located in Nawabshah district, it is a natural inland wetland ecosystem, which supports a variety of rare and endangered wildlife species. This area hosts a considerable number of rare fauna. Many indigenous fish species are also found here. Water scarcity during a persistent dry spell is adversely affecting this area. Other lakes of the province include Badin and Kadhan Lagoons, Charwo Lake, Ghauspur Jheel, Hadiero Lake, Hamal Katchri Lake, Khango Lake, Khipro Lakes, Langh Lake, Mahboob Lake, Phoosna Lakes, Pugri Lake, Sadhori Lake, Sanghriaro Lake, Shahbuder and Jaffri Lake, Soonhari Lake and Tando Bago Lake.

The project site is located in the area which does not affect any of the above biological resources.

Protected Areas: Several protected areas exist in the Jhimpir Wind Corridor generally and Thatta district specially. Among these, Haleji Lake, Hadero Lake, Keti Bunder North, Keti Bunder South, Bijoro Chach, Cut Munarki Chach, Gullel Kohri, Hilaya, Kahdi Lake and Kalri Lake have been notified as the wildlife sanctuaries, while game reserves are located at Mirpur Sakro, Deh Jangisar and Deh Khalifa.

None of these protected areas are located in the immediate vicinity of the proposed site.

Socioeconomic Description

This section provides socioeconomic description of the project area and its surroundings.

Administrative Setup: Administratively, the proposed site is located in Thatta, which is one of the districts of the Sindh Province. The Thatta District is further divided in ten talukas (sub-division of a district, also called tehsil): Thatta, Sujawal, Mirpur Bathoro, Jati, Jhimpir, Mirpur Sakro, Ghorabari, Keti Bunder, Kharo Chann and Shah Bunder. These talukas include 55 union councils, 7,200 villages and 185,477 households with the average size of 6 individuals per household. The proposed Wind power plant site is situated within the boundaries of Deh Kohistan, which is one of the union councils of the Tapo Jhimpir Taluka. However the site is outside the boundaries of the revenue village.

Much like rest of the country, the local government system has been established in Sindh Province as well, which consists of the elected representatives as well as government functionaries. Under the system, each district is governed by the district government, which is headed by the District Nazim - an elected representative, and the District Coordination Officer (DCO) - a government official. Each district comprises several talukas (or tehsils), which are governed by their respective Taluka/Tehsil Municipal Administration (TMA). In turn, each tehsil or taluka comprises several unions, which is governed by the Union Administration (UA). The nearest village located in the site vicinity is Ali Muhammad Jatt, having a population of approximately 4000 people

Demographic Features of the Area: The Thatta District covers an area of 17,355 square kilometers (about 4.3 million acres), and according to the 1998 census, had a population of 1,113,194 individuals living in 185,477 households. This population constituted 589,343 males and 523,853 females, with a growth rate of 2.26 percent, and having a density of 67 individuals per square kilometer.

Whereas Jhimpir being in the administrative control of Thatta district is unique in terms of population sensibility and characteristics. The total area of Thatta district is 17,355 square km. The total population consists of 1,113,194. Gender wise distribution shows a figure as 589,341 are male and 523,853 are of female. The population density of Thatta is 64.1 per sq/km. The percentage of total population residing in urban settings is 11.2%. The average house hold size is of 5.1 persons. The average growth rate of population has remained from 1981-98 as 2.26.

Culture, Ethnicity and Castes: Much like rest of the province, the project area has rich culture, customs and traditions. There is a significant influence of the Arabian culture on the local population, though the traces of ancient Sindhi culture as well as Hindu, Buddhism and other religious thoughts are also present in the attitudes and approaches of the local communities. The *Pirs* and *Murshids* (religious leaders, saints) are held in high esteem and confidence amongst the Muslims particularly in the uneducated and poor class of the rural areas. Annual festivals at the shrines of saints are regularly held in which people very enthusiastically take part. Similarly, the Hindus also hold great confidence and reverence in *Thakurs* and *Brahmans* (the higher castes). The *Brahmans* usually perform spiritual rites of Hindus on special occasions.

The social setup in the rural areas exhibits a strong *beraderi* (communal) system, which defines the inter- and intra-community hierarchy and allegiance, and also plays an important role in conflict resolution at the local level. Every social group has its own *Sardar (*Chief*)*, who represents the entire community. Most of the disputes among the community members are resolved at village level by the *Sardar.* Sindhi is the common language in the project area whereas Urdu is also spoken in some urban parts of the district.

Majority of the population in the project area is Muslim and Sindhis. Most of the population in Thatta district belongs to Sayed, Samma, Jokhio, Palejo, Baloch, Rind, Khaskheli, Khawaja, Memon, Mallah, Mirbahar, Jatt and Lashari castes. The Mirpur Sakro Taluka, particularly the area near the project site, is inhabited by Khaskhelis, Rinds, Mallahs, Jatts, Katiars, Hadyas, Sammas, Sathyas and Lasharis.

Physical Infrastructure: The area is connected to the rest of the country through the Thatta-Thano Bula Khan Road which passes through Jhimpir connecting it to the M-9 Karachi-Hyderabad Motorway and through it to other parts of the Province. The main Karachi-Lahore-Peshawar railway line also passes through eastern parts of the Project Site in Thatta district. A road network connects various parts of the Taluka – to other adjacent regions.

Generally, electricity is available in the area, though in the rural areas, its consumption is quite low, where the electricity is primarily used for a few light bulbs and fans in a typical household. In rural areas, houses without the electricity connections are not uncommon. The water supply systems exist in most of the communities, however networked systems are limited to the urban areas and larger villages/towns. Recently, the Government of Pakistan has initiated the Clean Drinking Water Program, under which each UC will be provided with water filtration system.

The telecommunication link is also available in the area. Moreover, the recent development of mobile phones has expanded the service coverage to areas which were not previously connected to the land lines. Several industrial organizations exist in the Thatta District. These include sugar mills, textile mills, a cement factory and rice and flour mills. However no major industry is located near the project site.

Education and Literacy: A large number of educational institutes exist in the Thatta District, however many of these institutes, particularly the schools in the rural areas, are either partially functional, or altogether non-functional for a variety of reasons, most common being the absence of teachers. The Haji Girano Union Council is one of such rural areas, and here several of the primary schools are non/semi functional.

Furthermore, the girls' enrollment is very low in the few schools which are functional. There is only one middle school in the Union Council, which makes it difficult for the students to come to the school from far off locations. For higher education, the students have to rely upon institutes in the urban areas such as Jhimpir and adjacent Taluka towns. In line with the state of the educational institutes in the area described above, the literacy in the area is also quite poor.

The literacy in the Thatta district at 22.14% is far below the overall literacy in the Sindh Province which is 45.29%. There are marked urban and rural and male-female differentials in Thatta as 46% urban and 19% rural. Further analysis the literacy data reveals that generally, the urban areas enjoy a better literacy ratios compared to the rural areas. Similarly, male literacy is generally higher than the female literacy.

Health and Diseases: Several health care facilities exist in the Thatta district, including one district hospital, four Taluka hospitals, 46 Basic Health Units (BHUs) and eight Rural Health Centers (RHCs). Out of these, one Taluka hospital, nine BHUs and one RHC are located within the Mirpur Sakro Taluka. In the Haji Girano Union Council, only one BHU is located. However these facilities are not only quite inadequate to provide medical care facility to the population of the area, but most of these are poorly equipped and staffed as well. As a result, the local population is forced to go to the larger towns and cities in case of serious diseases. The common diseases in the area include malaria, tuberculosis, skin infections, eye infections, diarrhea, and hepatitis. The majority of rural population in the area does not have access to safe drinking water; hence the prevalence of the water borne diseases is quite high in the area.

Agriculture

Agro-ecological Zones: The use of land is governed by several interacting factors, which are physical, biological, social and economic in nature. A clear vision of these factors is essential for increased agricultural production in any given region. The Pakistan Agricultural Research Council in 1980 divided Pakistan in ten agro-ecological zones, based on a survey carried out by the Food and Agriculture Organization (FAO) and review of the available literature on physiography, climate, soils, land use and other factors affecting agriculture production.

According to this zonation, the project area falls under the Zone I, which is characterized by moderate temperatures, low rainfall, saline soils and poor drainage. However as described earlier, the proposed site does not support any agricultural activities such as cultivation or grazing.

Cultivation: Cultivation is one of the main livelihood activities of the people of the Thatta District in general and Jhimpir in particular. Almost all the households possess some piece of land which is used for cultivation. Rice, wheat, sugarcane and tomato are main crops of the area. During *rabi* (winter) season, mostly wheat and vegetables are grown, whereas during *kharif* (summer) season, most of the farmers grow rice, sugarcane, vegetables and by the end of this season tomato is also cultivated. The cultivation methods are traditional in most of the area hence the crop yields are also quite poor. The agricultural produce is usually sold out to the local wholesale dealers at the rate which is typically lower than the market rate. This is primarily because the villagers do not have much exposure of and access to the open markets in larger towns and cities, and they find it convenient to sell their produce to the whole sale dealers at lower-than-market rates.

Irrigation: The Indus River is the main source of irrigation water for much of the Sindh Province. In the Jhimpir area canals originating from Kalri Lake provide the irrigation water. During the consultations in the Union Councils, the villagers informed that most of the areas in the Union Council do not receive enough irrigation water, because of being located at the tail of the canals. The availability of sweet groundwater in the area is quite limited, and usually only a thin layer of sweet water exists over the brackish aquifer.

Hence the usage of groundwater for the irrigation purposes is quite limited.

Livestock: Much like rest of the province, livestock is also one of the key livelihood means for the rural population of the area. The farmers in these areas traditionally keep a few heads of livestock, ranging from bullocks for draught to cows and buffalos for milk, and poultry for eggs and meat. There have been many traditional communities in the area exclusively dependent on livestock for their livelihood, however, the importance of livestock as a source of income has declined over the years.

Several commercial livestock and dairy farms also exist near Jhimpir, some of them along the road leading to the site. Produce from these farms is usually transported to cities like Karachi, Hyderabad and Thatta.

Fishing: Fishing is also one of the important livelihood means of the local population in the Thatta District, particularly along the coastal belt. In these areas, almost every household possesses one to two fishing boats. In the Mirpur Sakro Taluka, the union councils Bhuhara and Haji Girano are located in the coastal belt hence fishing is the key occupation in these areas. In the west of project site, the Paitiani creek is an important fishing area for the people living in Bhuhara, Haji Girano and the surrounding villages.

The fishermen of the area generally remain within the creeks, and only occasionally do they go beyond the creeks along the sea shore. The fishermen in the area generally go for fishing on the seven-day trips, although some of them also go for the one-day fishing trips. The fish catch from the area is mostly sold in Karachi, though a limited quantity is also bought locally.

The project does not affect fishing communities nor does it affect the access of the fishing community to the coastline.

Developmental Activities in the Area: No major development projects are under implementation in the area. The TMAs and UAs routinely undertake small development works, such as street pavements and water supply schemes. Under such development works in the Union Councils, new primary schools are being constructed. In addition, an NGO is providing smoke-free stoves to the villagers in the area.

Sites of Archeological, Historical, Cultural or Religious Significance: There exist a large number of sites of archeological, cultural, historical and religious significance in Sindh. The major ones include the archeological remains at Moen-Jo-Daro, which is one of the most important Indus Civilization sites, and the Makli Hills graveyard in the Thatta District. However, none of these places are at or near the proposed power plant site.

Extract 6 The meteorological details of the site

	Wind Speed (m/s)	Temperature (°C)	Precipitation (mm/day)
Months	**Avg.**	**Max**	**Mean**
Jan	2.0	26.0	0.30
Feb	3.0	31.3	0.00
Mar	3.0	31.8	0.33
Apr	6.2	34.0	0.00
May	8.0	34.6	0.00
Jun	7.7	35.3	0.00
Jul	8.3	33.8	66.0
Aug	6.2	31.0	148.0
Sep	4.7	34.2	21.9
Oct	4.2	35.0	0.00
Nov	2.2	33.4	3.1
Dec	3.0	26.3	61.3

IX. Anticipated Impacts and Mitigation Measures

a. Impacts during Construction

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact significance
Physical Environment							
Soil Erosion, degradation	Direct	Long Term	Local	Irreversible	Likely	Major	High
Air Quality Deterioration	Direct	Short Term	Local	Reversible	Likely	Minor	Medium
Surface water Contamination	Direct	Short Term	Local	Reversible	Likely	Major	High
Biological Resources							
Loss/Damage to Natural Vegetations	Direct	Medium to Long Term	Local	Irreversible	Unlikely to Possibly	Mid to Moderate	Low to Medium
Loss/Damage to Wildlife	Direct and Indirect	Medium Term	Local	Reversible	Low to Medium	Moderate to Severe	Medium to High
Social Aspects							
Damage to Infrastructure	Direct	Medium Term	Local	Reversible	Low	Moderate	Low

Blocked Access	Direct	Short Term	Local	Reversible	Possibly	Moderate	Low to Medium
Noise and Vibration	Direct	Short Term	Local	Reversible	Low	Moderate	Low
Safety Hazard	Direct	Short Term	Local	Reversible	Likely	Severe	High
Public Health	Direct	Short Term	Local	Reversible	Likely	Severe	Medium to High
Gender Issues	Direct	Short Term	Local	Reversible	Possibly	Moderate to Severe	Low to Medium
Impact on Sites of Archeological, Cultural, historical or religious significance	Direct	Short Term	Local	Irreversible	Unlikely	Severe	Medium

b. Impacts during Operation

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact significance
Soil and water contamination	Indirect	Long Term	Local	Reversible	Likely	Severe	High
Safety Hazards	Direct and Indirect	Long Term	Local	Reversible	Likely	Severe	High
Noise	Direct	Long Term	Local	Reversible	Unlikely	Moderate	Low
Air Quality Deterioration	Direct	Short Term	Local	Reversible	Likely	Moderate	Medium
Shadow Flicker and Glint	Direct	Long Term	Local	Reversible	Unlikely	Low to Moderate	Low
Species Mortality	Direct	Long Term	Local	Reversible	Low	Moderate	Medium
Threat to Marine Fauna	Direct	Long Term	Local	Reversible	Likely	Severe	High
Habitat Modification	Direct	Long Term	Local	Reversible	Low	Moderate	Low to Medium

c. Mitigation Plan

Impact	Action	Execution Responsibility	Monitoring Responsibility	Timing
Soil Erosion, degradation	▪ The site roads will be designed appropriately to avoid any shoulder erosion.	Tricom	EHSD	BC
	▪ The International recognized EHS Guidelines will be strictly followed. ▪ Operation of vehicles and machinery close to the creek channels will be minimized. ▪ Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.	Contractors	EHS Monitor	BC / AC
Air Quality Deterioration	▪ Appropriate waste disposal systems (warehouse/workshop wastes, domestic sewage, and domestic solid waste) will be included in the design of the power plant and associated facilities. ▪ The transformer procured for the proposed project will be PCB-free. ▪ Leaked oil collection arrangement (such as a channel and a drain pit below the transformers) will be incorporated in the design of the transformer foundations.	Tricom	EHSD	BC
	▪ The International recognized EHS Guidelines will be strictly followed. ▪ Construction machinery and vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions. The vehicle exhaust will comply with the NEQS ▪ Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. ▪ Generators and vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions.	Contractors	EHS Monitor	BC / AC
Surface water Contamination	▪ No waste effluents will be released to the environment without appropriate treatment. ▪ The solid waste will not be thrown in the open or in the creek water. ▪ The power plant and associated facilities will have appropriate solid waste collection and disposal arrangements. ▪ The power plant and associated facilities will have appropriate sewage handling, treatment and safe disposal system. ▪ Waste oils and chemicals will be disposed in accordance with their respective Material Safety Data Sheet (MSDS). MSDS will be made available at the power plant.	Power Plant Staff	EHS Supervisor	During O&M

	▪ Non-toxic recyclable waste (such as cardboard) will be given away for recycling. ▪ Toxic waste will be stored separately, and incinerated at an appropriate double chamber incinerator. ▪ The power plant will have channels and drainage pits to collect any leaked oil from the transformers. This oil will be sent back to the workshop for recycling. ▪ Any soil contaminated by the oil/chemical spillage will be removed and disposed off appropriately in accordance with the MSDS of the spilled oil/chemical.			
Loss/Damage to Natural Vegetations	▪ Any plantation carried out at the site will be carried out after obtaining expert advice; generally, only indigenous species will be planted. ▪ Plantation of mangroves along the creek channels is recommended.	Contractors	EHS Monitor	BC / AC
Loss/Damage to Wildlife	▪ The waste disposal systems mentioned above will ensure that no contaminated effluents/solid wastes end up in the creek channels	Contractors	EHS Monitor	BC / AC
Damage to Infrastructure	▪ Lettering, company insignia, advertising, or graphics on the turbines will be avoided. ▪ The plantation mentioned above will also enhance the aesthetic value of the area.	Contractors	EHS Monitor	BC / AC
Blocked Access	▪ Movement of extra heavy loads will be carefully planned, in consultation with the affected communities and relevant authorities.	Contractors	EHS Monitor	BC / AC
Noise and Vibration	▪ The International recognized EHS Guidelines will be strictly followed. ▪ Vehicles will have exhaust mufflers (silencers) to minimize noise generation. Vehicle noise will comply with NEQS ▪ Nighttime traffic will be avoided near the communities. Local population will be taken in confidence if such work is unavoidable. ▪ Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities.	Contractors	EHS Monitor	BC / AC
Safety Hazard	▪ The International recognized EHS Guidelines will be strictly followed ▪ Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. ▪ Project drivers will be trained on defensive driving. ▪ Vehicle speeds near / within the communities will be kept low, to avoid safety hazard and dust emissions.	Contractors	EHS Monitor	BC / AC / DC
Public Health	▪ The International recognized EHS Guidelines will be strictly followed ▪ The construction camps and site offices will have first-aid kits. ▪ The construction crew will be provided awareness for the transmissible diseases (such as HIV/AIDS, hepatitis B and C).	Contractors	EHS Monitor	BC / AC / DC

Gender Issues	• The International recognized EHS Guidelines will be strictly followed • Construction crew will avoid entering the villages and settlements. • No child labor will be employed.	EHS Monitor	EHS Supervisor	BC / DC
Impact on Sites of Archeological, Cultural, historical or religious significance	• The International recognized EHS Guidelines will be strictly followed. • In case of discovery of any sites or artifacts of historical, cultural, archeological or religious significance, the work will be stopped at that site. The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites.	EHS Monitor	EHS Supervisor	BC / DC

a. **Environmental Management Plan**

This EMP provides the delivery mechanism to address the adverse environmental as well as social impacts of the proposed project during its execution, to enhance project benefits, and to introduce standards of good practice to be adopted for all project works. The specific objectives of the EMP are to:

- Define the responsibilities of the project proponents, contractors, and environmental monitors, and provide a means of effectively communicating environmental and social issues among them,
- Define the implementation mechanism for the mitigation measures identified during the present study.
- Define the monitoring mechanism and identify monitoring parameters in order to:
    - Ensure the complete implementation of all mitigation measures, and
    - Ensure the effectiveness of the mitigation measures.
- Provide the mechanism for taking timely action in the face of unanticipated environmental or social situations,
- Identify environmental as well as social training requirements at various levels.

The EMP consists of the following:
- Institutional Arrangements
- Mitigation plan
- Monitoring plan
- Change management plan
- Communication and documentation
- Environmental and social trainings,
- Public disclosure requirements
- Budgetary estimates for EMP implementation.

These have been discussed previously **and** below.

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.

Management Approach: TRICOM 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 proposed for the project are:

- The incumbent will be responsible for overseeing and monitoring the entire implementation of the EMP and IEE.
- The EMP as well as environmental management requirements and specifications will be included in all contracts TRICOM executes.
- The contractor(s) will be required to appoint a dedicated field EHS Monitor (EHSM) at the project site.
- TRICOM, through the EHS officer, will cooperate with regulatory agencies (such as the Sindh EPA) and other stakeholders who may want to send their own teams to monitor the project activities.
- During the O&M phase of the project, the EHS officer will be responsible for the environmental, social, safety and occupational health aspects of the site activities.

Organizational Structure and Responsibilities

Construction Phase

The organizational structure's, for the construction phase EMP, salient features described below.

1. Primary responsibilities:

The TRICOM through its Chief Executive Officer will be responsible for the project"s compliance with the IEE and EMP throughout the project. The EHSD will assist the Chief Executive and will provide policy support in all environment and socioeconomic, occupational health and safety matters.

- The Supervision Consultant (if TRICOM chooses to employ one) through its Resident Engineer (RE) will be responsible for ensuring that the contractor(s) adhere to the quality requirements and other commitments including implementation of the EMP and IEE.
- The contractors" Chief Executive Officers or Country Managers will assume the main responsibility for all EHS and social matters pertaining to their works.
- TRICOM will coordinate with relevant government departments (Sindh EPA) and other stakeholders through the EHSD.

2. Field management and quality control:

- Carrying out construction activities in an environmentally and socially sound manner during the construction phase will be the responsibility of the site managers of the contractor(s).
- The TRICOM"s site in-charge (or RE, if the Supervision Consultant is employed) will be responsible for the EHS and social soundness of all construction activities.

3. On-the-job supervision and monitoring:

- The EHSM of the contractor(s) will be responsible for the implementation of the EMP during construction works. He will also be responsible for communication with and the training of their respective construction and camp crews in all aspects of the EMP.

- The TRICOM's EHSS will ensure implementation of the EMP in the field. S/He will also coordinate with the TRICOM"s site in-charge, the contractor's project management and EHSM of each contractor. The EHSS will be part of TRICOM's site organization if no Supervision Consultant is employed. Otherwise, S/he will be part of the Supervision Consultant's site staff.

- If any monitoring teams from government departments or from NGOs visit the field during the field activities, the EHSS will be responsible for coordinating their visits.

Operation Phase: During the operation phase of the proposed project, EHS and socioeconomic management will become a routine function, as an integral part of the O&M activities.

The EHSD will be the focal point for all matters relating to EHS and socioeconomic aspects during the routine operations of the power plant. The EHSD will advise various departments within TRICOM on the EHS and socioeconomic matters. In addition, the EHSD will develop and implement the EHS and socioeconomic management system for the Company, defining roles and responsibilities of various departments and their respective staff.

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 following monitoring program will be implemented.

Compliance Monitoring: The compliance monitoring of the 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 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 project.
- Verify that the activities are undertaken in compliance with the IEE and EMP.

- Document and communicate the observations to the concerned person(s) of the contractors and TRICOM"s EHSD, so that any corrective measures, if required, can be taken in a timely fashion.
- 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.
- Prepare periodic reports of the environmental and social performance of project.

Effects 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. However, there is always an element of uncertainty in such predictions due to an insufficient grasp of the processes, limitations in prediction techniques, or inadequate data on the environment/social aspects. Consequently, it is possible that even if the mitigation measures are implemented fully, the negative impacts of the project will exceed acceptable limits.
In order to address the above concerns, effects monitoring will be undertaken during the project activities, with the overall objective of proper management of environmental and social risks and uncertainties. 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 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 detailed methodologies will be developed during the detailed design phase of the project, when the specific information on field activities will be known. The effects monitoring will be carried out for the following parameters:

- Soil erosion
- Water quality
- Species mortality and loss of habitat
- Noise

- Damage to infrastructure
- Socioeconomic aspects
- Grievance redress system.

In addition, contact will be maintained with the communities, their views and concerns solicited. The outcome of these consultations will be discussed during the fortnightly meetings at the site.

External Monitoring: In addition to the compliance and effects monitoring discussed above, TRICOM will engage an independent consultants to carry out external monitoring on periodical basis. 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.

The external monitoring consultants will periodically visit the project site, examine the compliance monitoring activities, review the documentation maintained at the site, interview key site staff, make spot checks, take photographs where necessary, and meet with the communities. After each external monitoring visit, the consultant will prepare a monitoring report and submit to TRICOM. The report will include the observations made during the visits, highlight non-compliances observed, if any, salient information obtained from communities, and make recommendations.

Communication and Documentation: An effective mechanism for recording, storing and communicating environmental and social information during the 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.
- Processing the information to produce periodic reports.
- Annual environmental monitoring reports will be submitted to ADB for review and posting on ADB website.
- Compliance with ADB Core Labor Standards (CLS) will also be monitored and reported as part of the environmental monitoring and reporting.
- Implementation Report of all mitigation measures mentioned in the IEE report will be submitted to the SEPA on quarterly basis.

Data Recording and Maintenance: The forms to be used for recording information during the environmental and social monitoring will be developed by the EHSD. These forms will follow a standard format, which will correspond to the database into which all the information gathered will be placed. All common fields will have identical formats in the database and on the forms.

Check boxes will be used as much as possible for ease in filling out the forms and to facilitate data entry. All forms will be numbered and a tracking system will be developed for each. Whenever a form is released for use in the field, its number will be recorded. The field staff will be required to account for each form after completion. In this manner, it will be ensured that all forms are returned to the office.

Meetings: The following environmental meetings will take place during the project:

- Project initiation meetings (once for each of the contractors).
- Fortnightly meetings.

The purpose of the project initiation meetings will be to discuss the EMP, and ensure full understanding and commitment from concerned parties for its implementation. The periodic meetings will be held at site during the construction phase. The purpose of the meetings will be to discuss the conduct of the operation, non-compliances noted by the EHSS or Contractors' EHSMs, and any EHS / social issues identified in the field. The remedial measures will also be discussed and agreed during these meetings. The meeting will be recorded in the form of an EHS report prepared by the EHSS.

Grievance Redress Mechanism: An attempt has been made during the present IEE to identify all potential impacts of the proposed project, to provide mitigation measures to address the potential impacts, and to chart out a mechanism to implement these mitigation measures. However during the project implementation, the stakeholders (mostly the communities in the vicinity of the project site) may still have some grievances with respect to the project activities, their impacts, compensation and other mitigation measures.

In order to address the above eventualities, the Grievance Redress Mechanism (GRM) has been devised. The main objective of the GRM will be to provide a mechanism to mediate conflict and cut down on lengthy litigation, which often delays the projects such as the TRICOM wind power plant. It will also facilitate people who might have objections or concerns regarding the project activities, provide a public forum to raise their objections and through conflict resolution, address these issues adequately. The main functions of the GRM will be as follows:

- Provide a mechanism to the communities/other stakeholders to address the problems arising as a result of project activities,
- Record the grievance of the communities/other stakeholders, categorize and prioritize the grievances that need to be resolved,
- Determine and implement the mitigation actions to address the grievances,

- Report to the aggrieved parties about the developments regarding their grievances and the decision of the project authorities.

Under the GRM, the EHSS will maintain the Social Complaint Register (SCR) at the sites to document all complaints received from the local communities or any other stakeholder. The information recorded in the Register will include date of the complaint, particulars of the complainant, description of the grievance, actions to be taken, the person responsible to take the action, follow up requirements and the target date for the implementation of the mitigation measure. The register will also record the actual measures taken to mitigate these concerns.

As soon as a complaint is received, the EHSS will discuss it with the EHSM, and determine the remedial action. If required, consultations will also be undertaken with the contractor's site managers and TRICOM"s site in-charge. Once the remedial action is decided, implementation responsibility as well as schedule will be determined.

The proposed remedial action will be documented in the SCR, with complete details (by whom and by when). The proposed remedial action will be shared with the complainant. Similarly, the actual action taken will also be documented in the Register and shared with the complainant. The complainant's views on the remedial action taken will also be documented in the Register.

The SCR will be reviewed during the fortnightly meetings at the site during the project, and the action items discussed. The progress on the remedial actions will also be reviewed during the meetings. The Register will also be shared with the EHSD, on regular basis, for information and further action, if any.

Reports: The EHSS will produce periodic reports based on the information collected. These will include reports for:

- Project initiation meetings with each contractor,
- Fortnightly meetings,
- Non-compliances,
- Effects monitoring.

These reports will be shared with the contractors, TRICOM"s site in-charge and TRICOM"s EHSD. The reports will also be made available for review, to the external monitoring teams, and to any other stakeholders who visit the site. In addition, the external monitoring consultant will prepare report for each monitoring visit.

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 EHSS. 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 TRICOM staff, the construction contractors, and other staff engaged for the project. Training will cover all staff levels, ranging from the management and supervisory to the skilled and unskilled personnel. The scope of the trainings will cover general environmental awareness and the requirements of the IEE and the EMP, with special emphasis on sensitizing the project staff to the environmental and social aspects of the area.

During the O&M phase of the project, these trainings will continue to be conducted by EHSD for all relevant staff of the Company.

Public Disclosure: TRICOM will disclose this IEE and EMP to all the stakeholders before the commencement of the proposed project. The IEE report will be made available to the stakeholders at the sites designated by the EPA, in accordance with the national legislation (PEPA 1997). In addition, the executive summary of the IEE will be translated into Urdu language (and Sindhi language if necessary), and made available to the affected communities (and also kept at the project sites). This will ensure that the local communities are aware of the project, its key impacts, the mitigation measures and the implementation mechanism. In addition, the Executive Summary will be disclosed through the TRICOM"s official website.

Cost of Environmental and Social Management: The primary component of the environmental and social management cost pertains to the personnel dedicated for EMP implementation. The mitigation measures should be made part of the project design and hence included in the overall project cost.

X. Analysis of Alternatives

a. Management Alternatives

No Project Alternative: As described above, the electricity demand has been increasing during the past several years, and this trend is expected to continue as a result of the on-going economic uplift in the country. The key factors fueling the increasing power demand include increasing population, rapid urbanization, industrialization, improvement in per capita income and village electrification.

In order to match the increasing trend in the power demand, regular investments in various segments of the power network – generation being of foremost importance – is vitally important. Otherwise, the gap between the supply and demand will keep on increasing.

The proposed project seeks to increase the power generation capacity of the country, by harnessing the so far unutilized wind power potential in the southern areas of Sindh. In case the proposed project is not undertaken, the country will miss out on an invaluable opportunity to utilize vast potential of wind energy, and as a result, the power generation will be necessitated by other means – such as by using fossil fuel – which will not only be more expensive in the long term, but will also be more polluting than the clean energy produced by the wind power plants.

In view of the above, the "no project" option is not a preferred alternative.

Siting Alternatives: The wind farms are by their very nature located where the wind potential is significant – where high velocity winds are prevalent for most parts of the day, and most parts of the year. In Pakistan, such conditions are found along the coastal areas of Sindh and Balochistan. Between these two broad areas, the coastal belt and adjoining wind corridor in Sindh, particularly the areas close to the major load center, i.e. Karachi, is a preferred location, compared to the remote coastal areas of Balochistan, such as Pasni and Gwadar. These coastal areas in Balochistan are far away from the major load centers in the country, necessitating the need for installing long transmission lines, which would have their own environmental and social impacts. Therefore, the selected location for the proposed TRICOM wind power plant is a preferred location with respect to the wind potential on one hand, and vicinity of the electricity load center, on the other.

b. Technology Alternatives

Renewable Vs. Non-renewable Power Plants: The non-renewable power generation technologies, such as burning fossil fuels for thermal power generation have been the most common options throughout the world for almost the entire 20th century.

However, depleting fossil fuel resources and associated increasing prices, often dependent upon imported fuels are some of the problems associated with the fossil fuel driven power plants. In addition, these power generation technologies are a major contributor in the pollution load locally as well as regionally and globally, particularly with respect to the greenhouse gases, which is causing global warming.

In order to address the above problems, extensive research and development has been going on for some time in the renewable energy technology, which include Solar thermal, Solar photo-voltaic, Wind energy, bio-mass, geothermal, tidal and many more. Of these, the Wind energy technology offers great potential, particularly in areas which experience consistently high velocity winds. This technology offers clean energy without any air pollution load, at a reasonable cost, which is likely to further reduce once the technology matures and the scale of production increases, thus bringing the cost of power plant production lower.

In light of the above, the establishment of the TRICOM plant is a step in right direction, providing electricity to an energy-deficit country through technology which does not produce air pollution.

Transformer Oil: Traditionally, transformer oil – meant for providing insulation and cooling of the transformer windings – used to contain poly-chlorinated biphenyls (PCB), a man-made chemical known for its excellent dielectric properties. However, this chemical was then found to be highly toxic, and more importantly, chemically very stable. Hence this chemical would not decompose or disintegrate naturally. Due to this property of PCB, it was included in a group of chemicals collectively known as persistent organic pollutants (POPs). Although, production and use of the PCB containing transformer oil is not allowed anymore in the West, it is still being used locally. In view of their extremely harmful effects however, use of this oil is not a preferred option for all applications, including the proposed project.

TRICOM through inclusion of the appropriate clauses in the transformer specifications will have to ensure that the PCB-containing transformer oil is not used in the transformers procured for the power plant.

XI. Stakeholder Consultation

Objectives: The stakeholder consultation is an integral part of the environmental and social assessment for a project such as the proposed power plant, and aims to provide a two way communication channel between the stakeholders and the project proponents. In line with this aim, the objectives of the stakeholder consultations conducted as part of the present IEE were to:-

- develop and maintain communication links between the project proponents and stakeholders,
- provide key project information to the stakeholders, and to solicit their views on the project and its potential or perceived impacts, and
- ensure that views and concerns of the stakeholders are incorporated into the project design and implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits of the proposed project.

Participation Framework: The stakeholder consultation is a continued process, and should be maintained throughout the project. The consultations carried out during the present IEE and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders needs to be ensured.

Stakeholder Identification and Analysis: The stakeholder analysis reveals the nature and magnitude of the stakeholders" interests in and influence on a project. The first step for the analysis is to identify the stakeholders, who are essentially not limited to those affected by the project. They also include those who can affect or influence the project. They can be winners, losers or indifferent. The stakeholder analysis aims to distinguish between the actual effects of the project on different stakeholders, and those stake stakeholders" perceptions about the project and its effects.

The second step in the stakeholder analysis is to analyze the interests and influence of the stakeholders, examining their assets and capabilities. The small landowners may have high stakes in a development project, but very little influence. As a contrast, the regulatory agencies may have very high influence but low interest in a project.

The third step is to differentiate stakeholders by their attachment to the status quo, or conversely, their desire/willingness to change. The stakeholders can be best analyzed by comparing their commitment to the status quo against the influence they wield.

The stakeholders that have considerable influence and are determined to prevent changes, are the greatest challenges for many projects. The groups that want change, whether or not they have much influence, are the possible counterbalances. The project needs to find ways to increase the influence of groups that favor change but lack influence and to mediate between the influential groups that favor change and groups that oppose it.

During the present IEE, the stakeholder analysis was carried out to identify relevant stakeholders on the basis of their ability to influence the project or their vulnerability to be negatively impacted from it. This approach ensured that no relevant groups were excluded from the consultations, and appropriate engagement strategies were developed for each stakeholder.

Consultation Process: Consultations with the project stakeholders were carried out while conducting the IEE.

During the stakeholder consultations carried out in the communities near the proposed site, the participants were first provided the salient information about the proposed project. Some of the villagers already knew about the project, but did not know the specific details. The participants generally welcomed the plans to establish the proposed power plant in the area. Since the project would not directly affect them, the villagers generally did not have any apprehension or reservation about the project. On the contrary, they expected that the project would bring employment and small business/trade opportunities for the local population.

Consultation in the Project Area at the grass root level were carried out in the following project adjoining areas and villages:

- Village Bachal Jakhro
- Village Dad Muhammad Chang
- Village Faqeer Muhammad Palari
- Village Godar Chang
- Village Ladho Ganjo
- Village Marak Jakhro
- Village Muhammad Arab Chang
- Village Muhammad Yousuf Panhwar
- Village Nawaz Ali Brohi
- Village Raheemdad Chang
- Village Shafoo Palari
- Village Sulaiman Brohi
- Village Umer Chang
- Village Hassan Jamari
- Village Wallo Palari
- Village Yar Muhammad Chang

It was ensured that the maximum number of residents attend the consultation activities. Door to door and village assembly methods were also used. The number of the participants may seem to be low; as a matter of fact it is very high in the project area where there are thinly populated and the male members usually busy in jobs at nearby city and at working places; these figures may be treated as the representation of the community living in and around the villages mentioned in

In the public consultation process it was observed that, though these villages are not far beyond the national grid still most of the villages are without electricity. As a matter of fact the villages where consultation was conducted there is no electricity, facility of safe drinking water etc. In other words most of the basic amenities are not available to the inhabitants of these villages. Accordingly they are facing a lot of civic issues. Therefore they are expecting improvement in the civic facilities like availability of water, electricity etc.

The consultant is of the view and recommends that the company should get developed a social development plan and set aside some amount for investment in human capital. Detailed consultation was conducted separately with men and women folks. Their observation, expectation and available civic amenities are detailed in Appendix of this report.

Village Bachal Jakhro Different consultations were made on different spots of the village including the houses and gathering places of the villages. Few consultations were also held on the way of the village females when they were fetching water from nearby storage facility of rainy waters. Generally the villagers supported the project in the area. But there was some reservation about dealing of government officials that could be due to lack of communication between the villagers and the government agencies.

The community member welcomed the project in the area and expected that this project is going to improve the general economic conditions of the people of area by creating many more new employment opportunities during the different phases of the project construction and commissioning. Community member were also requesting the project implementer to provide to them the free electricity supply, help them in building basic infrastructure facilities like road access, sewerage and sanitation facilities in the village. Support in health sector related infrastructure development was their main demand. Their attitude towards the proposed WF was supportive.

Village Dad Muhammad Chang The community of the village exclaimed that they were very lucky to have a project like this that can really change their living standards as a whole. Their area was waiting for the project like this to be initiated since long; they stated. The community members have associated extra expectations from the proposed project in the area. At

Village Faqeer Muhammad Palari The people living in this village were of the view that being away from main market they expected that this project will facilitate them with hospitals and schools for their next generations. Our whole community was looking for the project like this one to facilitate us in clean water for drinking, school for our children, hospitals for our family members and many more facilities like these was observation of residents. Many of the community members were very anxious to know the time frame of the project to be started in the area.

Community members did not show any of their reservation on the environmental aspect during the consultation. Few were of the opinion that as this is clean system of producing the electricity so we are not expecting any of the adverse effects form this. Moreover this project is in the area which is already isolated from the normal trail that community members use to use; so they are least concerned with it.

Village Godar Chang The consultations were held at the village meeting place and inside their houses (as they don't have any boundary wall; instead they use the little raised brick barrier for the purpose to serve). The community members were mostly very poor and their major source of living was the work in nearby industrial estate Noori Abad. The community members were of the view if the project company is really serious to establish the wind power plants here then it should help us improve our living standard and reduce our suffering. Few of the female members expressed that all this is not going to happen; the project implementers will not be doing anything here, they will simply install the power plants and vanish away. And in the end we will have nothing left for our betterment.

Village Ladho Ganjo The majority of the community members were talking in favor of the proposed project. They all were unanimous regarding the betterment that proposed project can bring with the due course of time. Few of them were also talking about the workers of the other areas to come over here in the project area and create a social stress among the residents of the area. They also were afraid of being neglected in the jobs by the project implementer in the later stages of the project. They were also mentioning few other interested project implementers in the area that are also willing to go ahead with the project.

Village Marak Jakhro Inhabitants of this community showed mix reaction for the project. Some of the community members were hesitant to talk with the team whereas some of the community members were apprehensive in talking.

When they were asked through intrusive and extended rapport building using participatory methodology; they started sharing their concerns and their reservations about the project. Some of the members were of the view that no one from the area was against the possible development resulting from the proposed project; but they were demanding some facilities in return of their moral support of the project in the area.

Some of the community members raised the mobility issue regarding the proposed fencing around the WTG. They were also talking about the limited access to the project area after the construction and commissioning of the project site. Community members were demanding the establishment of girl's high school for the girls, maternity home for women and transportation facilities for better access to other areas of the district.

Village Muhammad Arab Chang We don't expect anything big from the proposed project at this stage; stated a participant during the consultation in the village. Consultations were held at open fields and at village meeting places. Community members were supporting the idea of the WF in the area. They were hopeful that this project is going to help them in creating new jobs for the youth of the area. During the consultations it was noted that they has reservation on the employment opportunity which they should get on the implementation of the project. The women participation was encouraged during the consultations so as their views can be incorporated in the development of the area.

Womenfolk from these tribes do not undertake employment or engage in activities outside their homes and their respective land areas. Opportunities for women employment in project activities are therefore considered to be negligible. However, they hope that project would bring employment/business opportunities for the men which they could support. There is an expectation that the villages where electricity is not available, will get connected and this will enable them the savings in time from daily chores of fetching water, chopping fodder etc. and thus engage in handicrafts which can be sold to augment their income.

XII. Conclusions And Recommendations

This IEE has been revised and updated in line with the relevant guidelines of the GoP and ADB. The objective of the IEE is to identify and assess the potential environmental and social impacts of the TRICOM's proposed Wind power plant near Jhimpir. The IEE also includes public consultation with the institutional as well as grass root stakeholders, in order to apprise them of the project activities and to obtain their views and concerns.

This Chapter presents the conclusions of the key findings and recommendations for further actions.

Conclusions: The major conclusions of the IEE are:

▪ For the Wind power plant such as the proposed project, environmental and social impacts are experienced primarily during the construction phase. The operation phase will have mostly insignificant impacts on the social, physical and biological environment of the area. This has been confirmed during the environmental and social assessment as part of this IEE. Furthermore, some of the impacts can be forestalled at the design stage as well.

▪ The key potential impacts during the construction phase of the proposed project include soil erosion and contamination, water contamination, deterioration of ambient air quality caused by exhaust emissions and kicked-up dust, noise pollution, damaged infrastructure, safety hazards and public health concerns for the nearby communities, loss of natural vegetation, habitat modification and threat to wildlife.

▪ The key potential environmental and social management issues during the operation phase of the proposed project include soil and water contamination, air quality deterioration, noise generation, species mortality, loss of habitat, threat to marine fauna, safety hazards, and shadow flicker and blade glint.

▪ The IEE includes appropriate mitigation measures to address the environmental and social impacts identified and assessed during the study. These mitigation measures are provided in the EMP, which will need to be made part of the construction contract(s). The EMP also provides the organization structure for the environmental and social management system during the project implementation, and defines roles and responsibilities of various role players.

The EMP includes a mitigation plan, which precisely defines the mitigation actions, executing persons, monitoring persons and timing of these actions. An environmental and social monitoring plan is also included in the EMP, in addition to communication and documentation requirements, and training needs, in the context of environmental and social management.

On the basis of the overall impact assessment, more specifically, nature and magnitude of the residual environmental and socioeconomic impacts identified during the present IEE, it is concluded that the proposed project is unlikely to cause any significant, lasting impact on the social, physical and biological environment of the area, provided that the proposed activities are carried out as mentioned in this report, and the mitigation measures included in this report are completely and effectively implemented.

Recommendations: On the basis of the environmental and social impact assessment discussed in, and the conclusions provided above, it is recommended that:

- The EMP should be made a part of the contracts awarded by TRICOM for the proposed project.

- In-house environmental and social management capacity should be developed in TRICOM. For this purpose, an EHS Department should be established within the company.

- TRICOM should develop its Environmental and Social Policy, which should demonstrate the company's commitment towards sound environmental and social management practices throughout its operations.

- TRICOM and its contractors should employ local labor as much as possible.

REFERENCES

ADB, 2003: *Gender and Development*

ADB, 2003: *Social Protection*

ADB, 2006: *Core Labor Standards Handbook*

ADB, 2009: *Safeguard Policy Statement,*

Ahmed, M. F. 1999: *The Wildlife of the Indus River and Allied Areas*. Oxford University Press, Pakistan.

Ahmad, M. F., Ghalib, S.A., Iffat, F. and Hasnain, S.A. 1999: *Vertebrate Biodiversity of Mangroves of Pakistan*. Sindh Forest and Wildlife Department & The World Bank.

EPA, 1997: *Guidelines for the Preparation and Review of Environmental Reports*. Pakistan Environmental Protection Agency, Government of Pakistan.

EPA, 1997: *Guidelines for Public Consultation*. Pakistan Environmental Protection Agency, Government of Pakistan, May.

EPA, 1997: *Guidelines for Sensitive and Critical Areas*. Pakistan Environmental Protection Agency, Government of Pakistan, October.

Ghalib, S.A. and Bhagat, H.B. 2004: *The Wetlands of Indus Delta Ecoregion*. WWF – Pakistan.

GoP 1997: *Act No. XXXIV of 1997.* The Gazette of Pakistan, Government of Pakistan. Islamabad, December 6, 1997.

GoP 1999: *District Census Report of Thatta (1998)*. Population Census Organization, Statistical Division, Government of Pakistan. December 1999.

GoP 2000: *Provincial Census Report of Sindh (1998)*. Population Census Organization, Statistical Division, Government of Pakistan. May 2000.

GoP 2001: *Socio-economic Indicators at District Level, Sindh*. Federal Bureau of Statistics, Government of Pakistan, 2001.

GoP 2003: *Pakistan National Human Development Report*. 2003.

GoP 2004: *Development Statistics of Sindh*. Bureau of Statistics, Government of Pakistan, Karachi 2004.

Hasan, A. Khan, S.A., Ahmed, S.I. 2005: *Fish and Birds in Keti Bunder, Shah Bunder and other parts of Indus delta*. Rec. Zoological Survey of Pakistan, Vol.16:33-39.

IUCN – Pakistan Water Gateway: *Key Water Information.*

IUCN 2004: *Sindh State of Environment and Development.* IUCN, 2004.

Kazi, S. A., 1952: *Climatic Regions of West* Pakistan, Pakistan Geographical Review. .

Mirza, Z. B. 2007: *Field Guide to the Birds of Pakistan*. Bookland, Lahore.

Pak-EPA 2000: *S.R.O. 339 (1)/2001*. Pakistan Environmental Protection Agency, Islamabad, 2000.

Roberts, T. J. 1982: *The Indus Delta*. World Wildlife Fund Newsletter. Vol. 1 (2):1-6.

Roberts T. J., Passburg, R, and Van Zalinge, N. V. 1986: *A Checklist: Birds of Karachi and Lower Sind (Pakistan)*. WWF-P. 38 pp.

Roberts, T. J. 1991-1992: *The Birds of Pakistan*, vols. 1 and 2. Oxford University Press, Karachi.

Scott, D. A. (ed.) 1989: *A Directory of Asian Wetlands*. IUCN, Gland, Switzerland and Cambridge, U.K. xiv+1181 pp, 33 maps.

Sikander Brohi 2002: *Degradation of Indus Delta and its Impact on the Local Communities*. SZABIST, Karachi, 2002.

Survey of Pakistan, 1997: *Atlas of Pakistan*. Director Map Publication, Survey of Pakistan, Rawalpindi.

World Bank. 1991: *Environmental Assessment Sourcebook, Volume III: Guidelines for Environmental Assessment of Energy and Industry Projects.* World Bank Technical Paper No. 154. Environment Department, The World Bank.

World Bank, UNIDO, and UNEP. 1999: *Pollution Prevention and Abatement Handbook*: Towards Cleaner Production. Environment Department, The World Bank, UNIDO, UNEP.

WHO 1993: *Guidelines for Drinking-water Quality.* World Health Organization, Geneva, 1993.

Ahmed, M. 1999: *Animal and plant communities of the present and former Indus Delta.* The Indus River (Biodiversity, Resources, Humankind). Azra Meadows and Peter Meadows (Eds.) Oxford University Press.

Anonymous 2006: *Tidal analysis and establishment of reference datum at Kuti Kun, New Island, Gharo, Sindh.* Final report by TCI, Karachi.

Chaghtai, F. and Saifullah, S.M. 1992: *First recorded bloom of Navicula Bory in mangrove habitat of Karachi*. Pak.J.Mar. Sci 1: 139-140.

Chaghtai, D. and Saifullah, S.M. 1997: *Occurrence of Phaeocystis in mangroves creeks near Karachi.* Pak.J.Mar.Sci., 6:105-106.

Chaghtai, F. and Saifullah, S.M. 2001: *Harmful Algal Bloom (HAB) organism of the North Arabian Sea bordering Pakistan.* I. Gonyaulax Diesing. Pak.J.Bot. 33(1): 69-75.

Farah, A. and Meynell, PJ. 1992: *Sea Level Rise possible impacts on the Indus Delta Korangi Ecosystem Project* Paper No. 2, Coastal Ecosystem Unit, IUCN, Karachi.

Haq, B.U. and Milliman, J.D. 1984: *Marine Geology and Oceanography of the Arabian Sea and Coastal Pakistan* Published by Van Nostrand Reinhold Company Inc. USA.

Haq, B. U., Haq, S. M., Kullenberg, G and Stel, J. H. 1997: *Coastal Zone Management Imperative for Maritime Developing Nations* Kluwer Academy Publishers. The Netherlands.

Quraishee, G.S. 1986: *Variation in the Indian River Discharges and their Hazards.* Presented in an International Symposium on National and Man-Made Hazards from 3-9 August 1986 held in Rimousk and Quebec City, Canada.

Quraishee, G.S. 1988: *Arabian Sea cooling and productivity. pp.59-66.* Marine Science of the Arabian Sea. M.F. Thompson and N.M. Tirmizi (Eds.). American Institute of Biological Sciences, Washington, D.G., USA.

Quraishee, G.S.1989: *Global Warming and Rise in Sea level in the South Asian Sea Region.*

Qureshi, M.T 1999: *Neglected Coastal Ecosystem of Indus Delta p 9-18* Proceedings of National Seminar on Mangrove Ecosystem Dynamics of the Indus Delta organized by Sindh Forest and Wildlife Department and The World Bank

Rabbani, M.M and Khan, S.H. 1988: *The Chlorophyll fluctuation spectrum in relation to physical process in the Indus estuary. pp 101-111.* Marine Science of the Arabian Sea, M.F. Thompson and N.M. Tirmizi (Eds.). American Institute of Biological Sciences, Washington, D.C., USA.

Rizvi, S. H. N 1988: *Steel Mill Effluents: Influence on the Bakran Creek environment p 549-569* Marine Science of the Arabian Sea. M. F. Thomson and N. M. Tirmizi (eds) American Institute of Biological Sciences Washington USA.

Rizvi, S. H. N 1999: *Primary productivity at the Gizri to Gharo Creek System, Indus Delta p 33-62.* Proceedings of National Seminar on Mangrove Ecosystem Dynamics of the Indus Delta organized by Sindh Forest and Wildlife Department and The World Bank

Saifullah, S. M. 1982: *Managrove Ecosystem of Pakistan p 69-80* The Third Research in Mangroves in Middle East, Japan Cooperative Centre for the Middle East Publ. No. 137, Tokyo, Japan

Saifullah, S.M. and Chaghtai, F. 1990: *Incidence of Noctiluca scintillance (Macartney) Ehrenb. Blooms along Pakistan's Shelf.* Pak. J. Bot., 22:94-99.

Saifullah, S. M. 1997: *Management of Indus Delta Mangroves. p 347-371.* Coastal Zone Management Imperative for Maritime Developing Nations. B. U. Haq, S. M. Haq, G. Kullenberg and J. H. Stel (eds) Kluwer Academy Publishers. The Netherlands.

Snedaker, S. C. 1984: *Mangroves: a summary of Knowledge with emphasis in Pakistan. p 255-262* Marine Geology and Oceanography of Arabian Sea and Coastal Pakistan B. U. Haq and JD Milliman (eds) Van Nostrand Reinhold Inc. USA.

Thompson, M. F. and Tirmizi N. M. 1984: *Marine Science of the Arabian Sea.* Proceedings of an International Conference held at Karachi in 1986. Published by American Institute of Biological Sciences, Washington D.C. USA.

Thompson, M. F. and Tirmizi N. M. 1995: *The Arabian Sea, living Marine Resources and the Environment* Proceedings of an International conference held at Karachi in 1993 Published by American Institute of Biological Science Washington D. C. USA and Vanguard Books, (PVT) Ltd. Lahore.

UNEP. 1986: *UNEP regional seas reports and studies No.77. Environmental problems of the marine and coastal areas of Pakistan.* National report – UNEP 1986.

UNESCAP 1996. *Coastal Environmental Management plan for Pakistan. pp.233.*

Wells, J.T and Coleman, M. 1984: *Deltaic morphology and sedimentlogy with special reference to the Indus River Delta. p. 85-100.* Marine Geology and Oceanography of Arabian Sea and coastal Pakistan, Haq, BU. and Milliman J.D (eds) Van Nostrand Reinhold Company, Inc. USA.

Zaqoot H.A. 2000: *Impact of oil pollution on coastal environment of Karachi.* M.E.Thesis. Institute of Environmental Engineering and Management, Mehran University of Engineering and Technology, Jamshoro, Sindh.