SCHEDULE I
(Regulation 3(1))

FORM OF APPLICATION

The Registrar
National Electric Power Regulatory Authority (NEPRA)
NEPRA Tower,
Attaturk Avenue (East),
Opposite Federal Flood Commission,
Sector G-5/1,
Islamabad, Pakistan

Subject: **Application for a Generation License for a 49.6MW Wind Power Project**

I, Arooj Asghar, Chief Financial Officer & Project Director, being the duly authorized representative of Jhimpir Power Private Limited (formerly Dewan Energy Private Limited) (the "**Applicant**"), by virtue of Board Resolution dated 01 April 2014, hereby apply to the National Electric Power Regulatory Authority (NEPRA) (the "Authority") for the grant of a Generation License of 49.6MW Wind Power Project to the Dewan Energy (Private) Limited pursuant to the Section 15 of the Regulation of Generation, Transmission, and Distribution of Electric Power Act, 1997.

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

A Pay Order (PO) No 0422884 dated May 08, 2014 in the sum of Rs 264,960/- (Rupees Two Hundred, Sixty Four Thousand, Nine Hundred And Sixty Only), being the non-refundable license Application Fee; calculated in accordance with Schedule II to the National Electric Power Regulatory Authority (Application and Modification Procedures) Regulations 1999, is also attached herewith.

Date: May 08, 2014

JHIMPIR POWER PRIVATE LIMITED

AROOJ ASGHAR
Chief Financial Officer & Project Director

APPLICATION FOR THE GRANT OF A GENERATION LICENSE

Jhimpir Power Private Limited

(Formerly Dewan Energy Private Limited)
(A project of Burj Capital)

a 49.6MW Wind Power Project at Jhimpir, District Thatta, Sindh Pakistan

Lead Project Developer:
Burj Power
1909 Gold Crest Executive Tower, JLT,
P O Box 309037,
Dubai, UAE
Tel: +971 4 454 2799
Fax: +971 4 454 2797

May 2014

APPLICATION FOR THE GRANT OF A GENERATION LICENSE

This application is for the Grant of Generation License duly filed by Jhimpir Power Private Limited (*formerly Dewan Energy Private Limited*), a project of Burj Capital (the "**Applicant**" and/or the "**Project Company**") for its 49.6MW Wind Power Project (the "**Project**") in Jhimpir, Sindh, Pakistan.

1 The Authority's participation in the process

This Application for the grant of a generation license is made pursuant to Section 15 of the Regulation of Generation, Transmission, and Distribution of Electric Power Act, 1997 (the "**Act**") and Regulation 3 of the National Electric Power Regulatory Authority (Application and Modification Procedure) Regulations, 1999 (the "**AMP Regulations**").

Where;

Section 15 of the Act provides, inter alia, that:

"(1) No person except under the authority of a license issued by the Authority under this Act and subject to the conditions specified in this Act and as may be imposed by the Authority, construct own or operate a generation facility.

(2) An application for the grant of a license for a generation facility shall specify.

- (i) The type of facility for which the license is applied;
- (ii) The location of the generation facility; and
- (iii) The expected life of the generation facility.

Regulation 3 of the AMP Regulations provides that an application for license shall be made in the form specified in the AMP Regulations and also provides a list of documents required to be submitted to the Authority along with the requisite application.

2 Introduction of the Applicant

Jhimpir Power Private Limited *(formerly Dewan Energy Private Limited)* is a Pakistan based company with the sole objective of developing, financing, building and operating up to a 50 MW wind power project in Pakistan. Project Company was issued a Letter of Intent ("**LOI**") in 2013 by the Alternative Energy Development Board ("**AEDB**") after submission of a bank guarantee of US$ 25,000 for setting up a 50MW wind Power Generation Project (the "**Project**") at Gharo-Keti Bandar Wind Corridor, Pakistan.

3 Introduction of the Sponsors

Burj Capital, a Dubai based investment firm took over Jhimpir Power Private Limited (formerly Dewan Energy Private Limited) in 2012 on an as-is-basis.

The Board of Directors decided to change the name of the Project Company in March 2014. Securities and Exchange Commission of Pakistan ("**SECP**") formally issued the "Certificate of Incorporation on Change of Name" to the Project Company on March 27, 2014. Project Company intimated the same to NEPRA on April 03, 2014 vide its letter No. DEPL/18/14.

Burj Capital is a Dubai based investment firm focused on activities in investment banking, power generation, oil and gas, retail and agriculture sectors. With presence in Dubai, Karachi, and Islamabad, along with representative offices in Zambia and Ghana.

JHIMPIR POWER PRIVATE LIMITED Karachi

Burj Capital targets opportunities in the developing markets across Middle East, South Asia and Africa. The firm comprises world class, multi-disciplined professionals with experience and track record in identifying quality assets in the core sectors and geographies and advance them from development to operations.

4 Introduction of Lead Project Developer

Burj Power is a power project advisory and management company headquartered in Dubai with an objective to acquire, develop, build, own and operate power projects in the Africa and Asia regions. It comprises of a strong team of industry veterans with a successful track record of developing, operating and managing large power assets globally, including Pakistan, both as a part of the global power company, AES Corporation, as well as on their own.

5 Progress of the Project

Applicant has successfully secured financing for the Project from Overseas Private Investment Corporation ("**OPIC**"), USA. The Board of Directors of OPIC has approved the financing up to US$ 101.5 million for the Project on September 19, 2013. Sponsors have also lined up the required equity for the Project.

Project Company has accepted the Wind Upfront tariff duly issued by NEPRA on April 24, 2013

Applicant is confident that the Project can achieve financial close by 31st August 2014; and construction can be started in September 2014. Under the terms of the EPC Contract, construction will be completed in 16 months and Commercial Operations Date ("COD") is December 31, 2015.

6 Basis of the application

The Sponsors of the Project Company decided to pursue the project under the upfront tariff regime hence it filed the generation license application under the upfront tariff regime in November 2013. NEPRA solicited additional information through its letter No. NEPRA/R/LAG-30/DEPL/2953 dated November 21, 2013 (a copy of the letter is attached as Annexure i), which were provided on November 25, 2013 vide Project Company's letter No. DEPL/25/13. However, NEPRA vide its letter No. NEPRA/R/LAG-30/DEPL/1356 dated February 06, 2013 returned the generation license application on the grounds that NEPRA had already received applications of 500MWs for wind upfront tariff. Later Project Company re-submitted the generation license application on February 14, 2014, which was again returned by NEPRA on May 02, 2014 (received on May 06, 2014) because of the above mentioned reason.

The Honorable Authority of NEPRA in the matter of review of determination of upfront tariff for the wind power generation vide order No. NEPRA/TRF-WPT/2013/4445-4447 dated May 02, 2014 decided to accept and award wind upfront tariff of April 2013 to all those companies submitted wind upfront tariff application within 365 days from the date of determination by the Authority, i.e. till April 23, 2014.

The excerpt from the above mentioned decision is given below for ready reference;

> *""...v). The choice to opt for this tariff will only be available to those companies who applied for grant of tariff within 365 days from the date of determination by the Authority. All those applicants who have submitted their application conveying unconditional acceptance of this tariff to the Authority, up to 365 days from the*

date of its determination by the Authority, irrespective of the fact whether those applications were not earlier accepted by the Authority or were returned or rejected, will be granted up front tariff, subject to the fulfillment/completion of all the terms and conditions of this determination and the National Electric Power Regulatory Authority Upfront Tariff (Approval & Procedure) Regulations, 2011...."

Project Company submitted complete application for the unconditional acceptance of wind upfront tariff within 365 days from the date of determination by the Honorable Authority.

Following is a brief history of wind upfront tariff application of the Project Company;

Letter of:	**Description**
Project Company	1. Project Company submitted upfront tariff application on November 21, 2013;
NEPRA	2. NEPRA returned the upfront tariff application of the Project Company on December 11, 2013 (received on December 13, 2013) vide its letter No. NEPRA/TRF-100/13610;
Project Company	3. Project Company re-submitted upfront tariff application on December 16, 2013;
NEPRA	4. NEPRA returned the upfront tariff application of the Project Company on January 29, 2014 (received on January 31, 2013) vide its letter No. NEPRA/TRF-100/1073;
Project Company	5. Project Company re-submitted upfront tariff application on February 10, 2014;
Project Company	6. Project Company requested NEPRA to consider its upfront tariff application in line with its order dated May 02, 2014 through its letter No. JPL/24/14 dated May 05, 2014;

Hence, as per the decision of the Honorable Authority of NEPRA in the matter of review of determination of upfront tariff for the wind power generation vide order No. NEPRA/TRF-WPT/2013/4445-4447 dated May 02, 2014; Project Company qualifies for the award of wind upfront tariff of April 2013.

7 Annexure

Kindly find enclosed the following Annexure:

Annexure-1	:	Form of Application – Schedule 1 of Regulation 3(1)
Annexure-2	:	Extracts of minutes of meeting of the Board of Directors
Annexure-3	:	Affidavit
Annexure-4	:	Prospectus
Annexure-5		Summary of Plant details
Annexure-6	:	Details of Lender's Facility available for the Project
Annexure-7	:	Bank Statement of the Project Company
Annexure-8	:	Company Profile of Applicant and Project Sponsors
Annexure-9	:	CV of Senior Management, Technical and Professional Staff
Annexure-10	:	Certificate of Incorporation on Change of Name Certificate of Incorporation & Memorandum and Articles of Association
Annexure-11	:	Last Three Years Financial Statement

Annexure-12	:	Last Filed Annual Return (Form A of Companies Ordinance 1984)
Annexure-13	:	EPC Contract (Signature Pages only)
Annexure-14	:	Profiles of EPC Contractor
Annexure-15	:	Reference list of EPC Contractor
Annexure-16		Approval of Electrical Grid Interconnection Study by NTDC
Annexure-17	:	Electrical Grid Interconnection Study
Annexure-18	:	Health and Safety Policy of Project Sponsors
Annexure-19	:	Decision (NOC) on Initial Environmental Examination (IEE) by Environmental Protection Agency, Government of Sindh
Annexure-20	:	Copy of Letter of Intent (LOI)
Annexure-21	:	Check List for Examination New Generation Facility (Wind) License Application Regulation 3(5)

The Applicant would be pleased to provide any other information/assistance that the learned Authority may require in the matter of grant of Generation License.

This Application and its Annexures are being submitted in triplicate.

It is most humbly prayed to the esteemed Authority as follows:

A That the Applicant may be granted a Generation License for the development of the Facility.

B That the Honorable Authority may be pleased to treat the Applicant's request for the grant of Generation License on a non-discriminatory basis and any concession offered to comparable projects on the date of filing of this Application and at any stage subsequent to the grant of license may kindly be granted to the Applicant as well.

We hope that the information provided above meets your requirements, and we remain available to assist you if you have any further quarries.

Respectfully submitted for and on behalf of the Applicant;

AROOJ ASGHAR
Chief Financial Officer & Project Director
Jhimpir Power Private Limited
(formerly Dewan Energy Private Limited)
Ground Floor, OICCI Building,
Talpur Road, I. I. Chundrigar Road,
Karachi, Pakistan.
Ph. No. 0213 246 8041,
Fax. No. 0213 246 8039

THE BOARD OF DIRECTORS IN A MEETING OF THE BORD OF DIRECTORS OF THE COMPANY HELD ON 01 APRIL 2014 AT 11 A.M. AT GROUND FLOOR, OICCI BUILDING, TALPUR ROAD, OFF I.I. CHUNDRIGAR ROAD KARACHI.

Present:

Saad Zaman	**Director/ Chairman**
Zafar Masud	**Director**
Shahzad Qasim	**CEO/Director**
Saleem uz Zaman	**Company Secretary**

RESOLVED THAT the Board hereby approves and authorizes Mr. Arooj Asghar the Chief Financial Officer and Project Director of the Company to do any and all acts and things as listed hereunder in respect of the Company's Application to National Electric Power Regulatory Authority (NEPRA) for the grant of Generation License in respect of its 49.6 MW wind power generation project to be located at Jhimpir, District Thatta, Province of Sindh, Pakistan (**"Application"**) (the **"Project"**):

I. To review, revise and make changes to the Application, execute, submit and deliver a Revised Application (including any modification to the Application) if required and submit related documentation required by NEPRA, including any consents, contacts, documents, power of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memoranda, amendments, letters, communications, notices, certificates, request, statements and any other instruments of any nature whatsoever;

II. Sign and execute necessary documentation, pay the necessary fees, appear before NEPRA as needed, and do all acts necessary for the issuance of Wind Upfront Tariff for the Project by NEPRA;

III. Do all such acts, matters, and things as may be necessary for carrying out the purposes aforesaid and giving full effect to the above resolution(s).

CERTIFICATION:

I hereby certify that the above resolution was duly passed by the Board of Directors of ***Jhimpir Power (Private) Limited*** *(formerly Dewan Energy (Private) Limited) (the "****Company****") present in the meeting, named above, on the 1st day of April, 2014; have been entered into the Minutes Book of the Board; are in accordance with the Memorandum and Articles of Association of the Company; and that the Company is a Private Limited Company, incorporated in Pakistan under the Companies Ordinance, 1984.*

Saleem Zaman
Company Secretary

JHIMPIR POWER (PRIVATE) LIMITED

(Formerly Dewan Energy Private Limited)

Jhimpir Power Private Limited *(formerly Dewan Energy Private Limited)* is a Pakistan based company with the sole objective of developing, financing , building and operating a 50 MW wind power project in Pakistan (the "**Project**"). The Project is being pursued under the terms of a Letter of Intent ("**LOI**") issued by AEDB in 2013 and is being developed under the build-own-operate ("**BOO**") scheme, with non- recourse financing.

Burj Capital, a Dubai based investment firm acquired Jhimpir Power Private Limited *(formerly Dewan Energy Private Limited)* (the "**Project Company**") in 2012 on an as-is-basis.

The Board of Directors decided to change the name of the Project Company in March 2014. Securities and Exchange Commission of Pakistan ("**SECP**") formally issued the "Certificate of Incorporation on Change of Name" to the Project Company on March 27, 2014. Project Company intimated the same to NEPRA on April 03, 2014 vide its letter No. DEPL/18/14.

A. SPONSORS

Burj Capital is a Dubai based investment firm focused on activities in investment banking, power generation, oil and gas, retail and agriculture sectors. With presence in Dubai, Karachi, and Islamabad, along with representative offices in Zambia and Ghana, Burj Capital targets opportunities in the developing markets across Middle East, South Asia and Africa. The firm comprises world class, multi-disciplined professionals with experience and track record in identifying quality assets in the core sectors and geographies and advance them from development to operations.

B. PROJECT DEVELOPER

The Project is being developed by Burj Power. Burj Power ("**BP**") is a power project advisory and investment company with an objective to acquire, develop, build, own and operate power projects in the Africa and Asia region. It was organized by a strong team of industry veterans with a successful track record of developing, operating and managing large power assets globally, including Pakistan, both as a part of the global power company, The AES Corporation as well as on their own. The team has a proven track record of developing sustainable and profitable projects both in AES and outside.

C. THE SITE:

GoS has allocated approximately 1,250 acres of land in Jhimpir, Sindh, Pakistan. Jhimpir wind corridor falls within the Gharo-Keti Bandar wind corridor. The site was selected after going through various technical studies of terrain and assessment of wind.

The site pictures are given below;

Geo-technical study has been carried out on the Project Site. Soil conditions were found to be favorable for road construction and for installing underground facilities such as wind turbine foundations etc. The bearing capacity is high and stable. A comprehensive geotechnical study will be conducted under the supervision of EPC Contractor.

Below image shows the location of Project;

B. EPC CONTRACTOR, MACHINES AND O&M CONTRACTOR

Project Company circulated a Request for Proposal ("**RfP**") to various equipment suppliers and EPC Contractors for wind power plants soliciting EPC proposals. In response, only the following two companies showed serious interest and submitted their proposals.

1. Consortium of Sinovel Wind Group Co., Ltd. and Hydrochina Huadong Engineering Cooperation, China; and
2. Harbin Electric International Co., Ltd, China with GE Energy as wind turbine supplier.

General Electric offered the latest model of GE 1.x series WTG i.e. 1.6-82.5-50Hz that is more reliable and has an international footprint whereas Sinovel offered SL1500/82/80 model WTGs' of 1.5MW. Project Company also engaged Lahmeyer International for thorough evaluation of EPC proposals besides reviewing proposals internally and selected GE because of better output and performance.

Project Company signed Off-shore Supply Contract with Harbin Electric International Company Limited, China whereas General Electric (GE) will supply 31 WTG of 1.6MW each. Project Company signed Construction Contract with Harbin Electric (HE) Corporation for the construction of wind power plant.

The Project is comprised of installation of up to thirty one (31) wind turbine generators. The Project will be constructed under the terms of a fixed price, turnkey contract and construction will be completed in a continuous period of 16 months.

Please find below the key features of WTG to be supplied by GE;

Model	1.6-82.5-50Hz
Diameter	82.5 meters
Number of blades	03

Harbin Electric International Company Limited, China will procure brand new plant and equipment including WTGs' and entire plant and equipment will be reliable, efficient and of highest international standard with proven technology.

C OUTSOURCED O&M

The O&M will be carried out by the WTG supplier for the first ten (10) years after COD after which, the Project Company will take it over. The outsourced part of O&M has been locked through an agreement with the WTG Supplier for ten (10) years.

HEI will carry out O&M Operations of first two years of operations of the plant with the support of GE whereas GE will carry out O&M Operations from Year 3 to Year 10 during the operations of the plant.

D: WIND ASSESSMENT

Assessment of the wind resource is a complex process involving several stages of data collection, modeling and statistical analysis. Project Company has engaged WindRose Consultancy to carry out wind resource assessment and estimation of Annual Energy Production ("**AEP**") for the Project.

Wind is abundant in the summer months with peak winds during May to July and lower winds in the winter months from November to January. Assessment of wind data clearly indicates that the

Jhimpir site is located within the vicinity of one of the best wind corridors in the country i.e. Gharo ~ Kati Bander Wind Corridor.

E GRID INTERCONNECTION

In order to assess the impact of the Project and the National Grid on each other, a detailed grid interconnection study has been carried out. The power from the Project will be delivered to the grid at an approved interconnection point.

F ENVIRONMENTAL STUDIES

As per the requirements of Section 12 of Pakistan Environmental Protection Act (PEPA), 1997, Project Company has completed the Initial Environmental Examination ("**IEE**") report for the Project. The Project is not likely to have any significant adverse environmental impacts, which could be irreversible or could affect sensitive eco-system, requires involuntary resettlement, or has an unprecedented impact. The Project has no gaseous and other emissions. Sewerage will be treated and reused at the Project Site for sprinkling on the unpaved site to reduce fugitive dust. The Project is also not located in the vicinity of sensitive location of national importance. Therefore, Project falls under Category "B" according to "Pakistan Environmental Protection Agency, Review of IEE & EIA Regulations 1997/2000 (revised)". Sindh Environmental Protection Agency has issued No Objection Certificate ("NOC") to the Project Company on January 07, 2013.

G SOCIAL RESPONSIBILITY

The Sponsors of Project Company always regard corporate social responsibility as an important force in building a harmonious society. They also believe in paying full attention to human factors, exercising environmental protections and conservation, increasing employment, and helping build the community. Every year they support numerous educational, sporting, and charity programs designed to help a wide range of people. Operations of the Plant will provide job opportunities especially to the local people. Poverty alleviation, though at minor scale, will be another benefit besides meeting power shortage in Pakistan.

H PROJECT AGREEMENTS

Project company will sign;

i. Implementation Agreement with the Government of Pakistan through Alternative Energy Development Board
ii. Energy Purchase Agreement with National Transmission And Despatch Company Limited (through its Central Power Purchasing Agency on behalf of ex-WAPDA Distribution Companies)

I FINANCING

Total Project Cost, expressed in United States Dollars, has been calculated after thorough analyses, evaluation, and understanding of the dynamics that affects the development, construction, and operations of a wind farm in Pakistan.

The Project cost will be financed by a combination of debt and equity. Maximum Debt Equity ratio for the Project is assumed as 75%:25%.

Equity: Sponsors have lined up the required equity for the Project. Burj Capital will contribute 96~100% of the required equity whereas Mr. Dewan Muhammad Yousuf has an option to fund up to 4%.

Debt: Project Company has successfully secured financing for the Project from Overseas Private Investment Corporation ("**OPIC**"), USA. The Board of Directors of OPIC has approved the financing up to US$ 101.5 million for the Project.

Approval of the Board of OPIC can be viewed from the below link;
http://www.opic.gov/sites/default/files/files/Dewan%20Energy%20%28Private%29%20Limited.pdf

There is no encumbrance on the Facility.

J TARIFF

Project Company has accepted Wind Upfront tariff duly issued by NEPRA on April 24, 2013.

As explained above, 100% of the project debt is in foreign currency therefore Project will have the following tariff;

Year	O&M Rs/kwh	Insurance Rs/kwh	RoE Rs/kwh	Principal Repayment Rs/kwh	Interest Rs/kwh	Total Tariff Rs/kwh	Total Tariff US Cents/kwh
1	1.6040	0.7833	4.6902	5.2331	3.2496	15.5602	15.9428
2	1.6040	0.7833	4.6902	5.5025	2.9802	15.5602	15.9428
3	1.6040	0.7833	4.6902	5.7857	2.6970	15.5602	15.9428
4	1.6040	0.7833	4.6902	6.0836	2.3991	15.5602	15.9428
5	1.6040	0.7833	4.6902	6.3967	2.0860	15.5602	15.9428
6	1.6040	0.7833	4.6902	6.7260	1.7567	15.5602	15.9428
7	1.6040	0.7833	4.6902	7.0722	1.4105	15.5602	15.9428
8	1.6040	0.7833	4.6902	7.4362	1.0465	15.5602	15.9428
9	1.6040	0.7833	4.6902	7.8190	0.6637	15.5602	15.9428
10	1.6040	0.7833	4.6902	8.2215	0.2612	15.5602	15.9428
11-20	1.6040	0.7833	4.6902	-	-	7.0775	7.2515
Levelized Tariff	**1.6040**	**0.7833**	**4.6902**	**4.7128**	**1.5601**	**13.1998**	**13.5243**

K TIMELINE

Tentative financial close date of the Project is 31st August 2014 and construction will be started in September 2014. Under the terms of the EPC Contract, construction will be completed in 16 months and Commercial Operations Date ("COD") is December 31, 2015.

Following milestones have been achieved by the Project;

Activity	Status	Dates
Bank guarantee by Sponsors for Letter of Interest (LOI)	Submitted	August 2007 and September 04, 2013
Letter of Interest	Issued	May 2007 and November 13, 2013
Allotment of land by the Government of Sindh	Have Possession	June 2012
Installation of wind mast	Installed	June 2012

SHIMSHAL POWER PRIVATE LIMITED Karachi

Collection of wind data from the project site	Ongoing	June 27, 2012
Soil survey	Completed	November 2012
Geo-tech Study	Completed	November 2012
Environment study	Completed	November 2012
Approval from Sindh Environmental Protection Agency	NOC issued	January 07, 2013
Transportation study	Completed	March 2013
Topographic survey/study	Completed	April 2013
EPC Contract with Harbin and GE	Signed	April 04, 2013
Feasibility study	Completed	April 2013
Grid interconnection study	Completed	May 2013 and December 2013
Wind related studies – wind resource assessment	Completed	August 2013
Equity participation from the Sponsors for the Project	Lined Up	August 2013
Debt for the Project	OPIC Board approved	September 19, 2013
O&M Contract with Harbin and GE	Agreed and closed	October 2013
Application of Generation license	Submitted	October 28, 2013 and February 14, 2014 .May 08, 2014
Lead Lease Agreement	Signed	November 21, 2013
Application for the acceptance of wind upfront tariff	Submitted	November 26, 2013, December 16, 2013 and February 10, 2014
Recommendation from AEDB for the upfront tariff	Issued	December 06, 2013
Consent for grid connectivity by NTDC	Issued	December 09, 2013
Consent for the availability of infrastructure by NTDC	Issued	December 11, 2013
Approval of grid study by NTDC	Approved	January 29, 2014
Approval of Power Acquisition Request (PAR) by NTDC	Approved and issued	March 17, 2014
Insurance	Arranged	March 2014
Construction of Access Road to the project site	Construction underway	May 2014

Following are the future milestones;

Activity
Issuance of Generation License
Upfront Tariff from NEPRA and Letter of Support from AEDB
Execution of Energy Purchase Agreement (EPA)
Execution of Implementation Agreement (IA)
Execution of Financing Documents and meeting condition precedents
Achievement of financial close and issuance of notice to commence
Project Construction and Commercial Operations Date

L CONTACT DETAILS

Arooj Asghar
Chief Financial Officer & Project Director
Ground Floor, OICCI Building, I.I. Chundrigar Road, Karachi, Pakistan.
Landline : +92 213-246 8041 | Fax : +92 213-246 8039

SUMMARY OF PLANT DETAILS

Regulations 3(5), 3(6), and Schedule III of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999

Name of Applicant:	Jhimpir Power Private Limited (formerly Dewan Energy Private Limited)
Registered Office	Ground Floor, OICCI Building, Talpur Road, Karachi, Pakistan. Ph. No. 0213-246 8041, Fax. No. 0213-246 8039
Business Office:	Ground Floor, OICCI Building, Talpur Road, Karachi, Pakistan. Ph. No. 0213-246 8041, Fax. No. 0213-246 8039
Plants Location:	Jhimpir, District Thatta, Sindh
Type of Facility	Wind
Proposed Buyer	National Transmission And Despatch Company Limited (through its Central Power Purchasing Agency on behalf of ex-WAPDA Distribution Companies)
Plant Configuration a) Plant Size b) De-rated Capacity c) Auxiliary Consumption d) Total Net Capacity e) Type of Technology f) Number of Unit g) Unit Size h) Unit Make and Model i) Commissioning Date j) Expected life of the Project from COD	 49.60MW EBOP Loss: 1500KW 300KW 47.8MW without wake losses Wind 31 1.6MW each GE 1.x series WTG i.e. 1.6-82.5-50Hz December 31, 2015 20 Years
Plant Characteristics a) Generation Voltage b) Power Factor c) AGC (Automatic Generation Control/ AVR (Automatic Voltage) d) Ramping Rate e) Alternate Fuel f) Auxiliary Consumption g) Time to Synchronize	 690V at generator terminal and 132kV at the point of interconnection with the grid 0.90 lagging/leading at turbine output. 0.95 lagging/ leading at interconnection point. Not applicable Not applicable Not applicable 300KW As per NTDC's approved specifications
Proposed Tariff	NEPRA Upfront Levelized Tariff of 13.1998 Rs./kWh (100% foreign financing)

Annexure 6: *Details of Lender's Facility available for the Project*

Annexure-6 (A) : Signed Commitment Letter signed by OPIC, DEL (Project Company) and Burj Capital (Main Sponsors of DEL)

Annexure-6 (B) : Signed Resolution of the Board of Directors of OPIC, USA (http://www.opic.gov/sites/default/files/files/Dewan%20Energy%20%28Private%29%20Limited.pdf)

Annexe 6(A)

22. If this Commitment Letter correctly sets forth our understanding and agreement, please confirm your acceptance of the terms hereof by signing and returning to OPIC an executed original counterpart of this Commitment Letter (by email with the original to follow by overnight courier) no later than September 25, 2013. The commitments and agreements of OPIC offered herein will expire at such time if OPIC has not received a fully executed counterpart hereof. Upon its acceptance prior to expiration, this Commitment Letter shall constitute an effective and legally binding agreement among us as of the date hereof.

Very truly yours,

OVERSEAS PRIVATE INVESTMENT CORPORATION

By: _____
Elizabeth L. Littlefield
President and Chief Executive Officer

ACKNOWLEDGED AND AGREED TO
as of the date of this Commitment Letter:

DEWAN ENERGY (PVT.) LIMITED

By: _____

Title: CEO

BURJ CAPITAL

By: _____ SAAD UZ ZAMAN

Title: CHAIRMAN & CEO

Annexure 6(B)

BDR(13)21

BY THE BOARD OF DIRECTORS
OF
THE OVERSEAS PRIVATE INVESTMENT CORPORATION

BE IT RESOLVED, that the Board hereby approves financing under Section 234 of the Foreign Assistance Act of 1961, as amended, in the principal amount of up to $101.5 million, plus interest thereon, to Dewan Energy (Private) Limited for the purpose of developing, constructing, owning, and operating a 49.6 MW wind power project located in Pakistan.

Approved by the Board of Directors
on September 19, 2013

Connie M. Downs
Corporate Secretary

Annexure 7

BankIslami Pakistan Limited
Duplicate Statement of Account
SHAHRAH-E-FAISAL

Statement Issue date: 11-11-2013
Currency: Pakistani Rupee

Account Number : 102610304260001
Account Type : Current Account

DEWAN ENERGY PVT LTD.
DEWAN ENERGY PVT LTD.
FTC 7TH FLOOR, BLOCK-A,
SHAHRAH-E-FAISAL, KARACHI.

KARACHI.

From Date : 01-10-2013 To Date : 31-10-2013 **Opening Balance as on 01-10-2013** 281,070.14

Date	Description	Withdrawal	Deposit	Balance
09-10-2013	Cash Deposit. # 1346128,RAO TANVEER 1026-1039253-0201 RAO TANVEER 1026-1039253-0201		200,000.00	481,070.14
21-10-2013	Cash Withdrawal # 1355472,Cheque No:0012095860 Cheque No:0012095860	100,000.00		381,070.14
21-10-2013	Charges- Cash Withdrawal #1355472 , Cheque No:0012095860 Cheque No:0012095860	300.00		380,770.14
22-10-2013	Cash Withdrawal # 1356534,Cheque No:0012095861 Cheque No:0012095861	60,000.00		320,770.14
22-10-2013	Charges- Cash Withdrawal #1356534 , Cheque No:0012095861 Cheque No:0012095861	180.00		320,590.14
30-10-2013	Inward Clearing.. TO 900184301140586 # 1368363,Cheque No:0012095858 Cheque No:0012095858	2,616.00		317,974.14
30-10-2013	Inward Clearing.. TO 900184301140586 # 1368368,Cheque No:0012095852 Cheque No:0012095852	3,503.00		314,471.14

Closing Balance as on 31-10-2013 **314,471.14**
Available Balance as on 31-10-2013 **314,471.14**

Printed by : SRH724-1026

APPLICANT

The legal and commercial name of the Project Company is Jhimpir Power Private Limited (formerly Dewan Energy Private Limited). It was established in 2007 as a private limited liability company organized under the provisions of the Companies Ordinance 1984 in Pakistan. The Project Company's registered office is located in Karachi, Pakistan.

Jhimpir Power Private Limited (formerly Dewan Energy Private Limited) (the "**Project Company**") is a Pakistan based company with the sole objective of developing, financing, building and operating a 50 MW wind power project (the "**Project**") in Pakistan. The Project is being pursued under the terms of a Letter of Intent ("**LOI**") issued by the Alternative Energy Development Board ("**AEDB**") in 2013 to the Project Company.

Burj Capital, a Dubai based investment firm took over the Project Company in 2012 on an as-is-basis.

Burj Power was mandated to develop the Project in June 2012.

BURJ CAPITAL – *Profile*

Burj Capital is an investment firm focused on investment banking, oil & gas, power generation, retail and agriculture sectors. Burj Capital aims to create a lasting value for its investors and partners by identifying opportunities where it can either build or unlock value by utilizing its team of industry experts and investment banking professionals who have a proven track record of investing across a variety of sectors and combining them with access to capital. The firm's world class and multi-disciplined professionals have a successful track record of identifying high quality assets and advancing them from development to operations.

Burj Capital has an international presence. Headquartered in Dubai, United Arab Emirates it has offices, its own and that of its joint venture partners, in Karachi, Islamabad, Zambia, and Ghana covering South Asia, Middle East, Turkey and Africa. These offices give Burj Capital access to growth markets where its founders and team members have extensive business relationships and deep understanding of business dynamics allowing it to source and develop profitable investment opportunities.

* * *

MR. SAAD ZAMAN, CEO Burj Capital

Burj Capital is the initiative of Saad, a leading and accomplished banking professional who has successfully established and managed a number of conventional and Islamic banks in the region. Saad during his time with Dubai Islamic Bank, led it's international expansion and investment banking expansion, and clearly established DIB as a leading financial player in the Islamic Financial Services Sector

Prior to establishment of Burj Capital, Saad had been part of the following leading organisations:

- CEO of DIB Capital Limited, formerly known an Millennium Capital Limited (MCL), a fully owned full service investment bank for DIB, DIBC is a DFSA regulated entity
- Led the establishment of DIB Pakistan, a locally incorporated, wholly owned subsidiary of DIB. Remained CEO from inception until January 2008 and ensured a successful roll out of the bank in Pakistan
- Chairman Millennium Finance Corporation, an investment advisory company regulated by Dubai Financial Services Authority
- Led the management team in establishment and deployment of Emirates & Sudan Bank
- Served on the Executive Committee of the board of the Bank of Khartoum, Sudan

Prior to joining DIB, he was associated with Citibank. He served as the Managing Director/CEO of Citi Islamic Investment Bank and was responsible for Citi's Islamic offerings globally. Earlier Saad held the position of Corporate Finance and Investment Banking Head Citibank for Middle East, Pakistan and Levant based out of Dubai.

MR. SHAHZAD QASIM, CEO Burj Power & Jhimpir Power

Shahzad Qasim has over 25 years of experience in the power sector globally and has previously worked with The AES Corporation, McKinsey and Stone & Webster.

Prior to Burj Power, Shahzad was President of the Europe, CIS, and Africa regions for The AES Corporation and was responsible for the regional business with revenues of USD 1.4 billion and over 12,000 MW of generation and 3 distribution companies with 1.7 million customers.

While at AES, Shahzad was directly responsible for developing, financing, constructing and operating power plants in Oman, Qatar, Pakistan, Bangladesh, Jordan and India with an installed capacity of over 3,000 MW and capital investment of $2 billion.

Shahzad trained as an engineer and has MS in Energy Management and Policy from Wharton.

MR. RAZI UR RAHAN KHAN, Group CFO

Razi has extensive experience in banking, open and close-end mutual funds management, equity brokerage and private equity investment. A chartered accountant by background Razi has served in various important positions in a number of public and private sector organizations, including Securities and Exchange Commission of Pakistan (SECP) as Chairman; JP Morgan Chase as Country Manager for Pakistan; National Investment Trust (NIT) as Chairman and Managing Director; Hub Power Company (HUBCO) as Finance Director; ANZ Merchant Bank, London as Director International & Islamic Finance; ANZ Grindlays Pakistan as Chief Manager

As the Chairman of SECP, Razi was instrumental in development and implementation of Governance and transparency measures in capital market of the country and introduction of various capital market regulations in Pakistan.

Razi was responsible for conceiving, structuring and executing the first major Islamic Unit Trust in Pakistan. He has advised and arranged more than USD 1.5 BN worth of deals in Islamic Finance.

MR. ZAFAR MASUD, Director

Zafar is a Founding Partner and Director of Burj Capital. Prior to Burj Capital Zafar was a member of Barclays Emerging Markets Management Committee and the Regional Managing Director for Southern Africa at Barclays Bank plc and was responsible for managing the total balance sheet size of US$3Bn in assets and over 4000 permanent staff. As the Regional MD, Zafar increased the banks' Consumer, Corporate and Treasury business by introducing new products and customers.

Previously, Zafar was a founding member of Dubai Islamic Bank team in Pakistan and where his work resulted in DIB investing US$100Mn in Pakistan. Zafar was the inaugural Head of Corporate and Investment Banking Business and was responsible for attracting foreign strategic investors to Pakistan. Notable deals included $375Mn port expansion project, $150Mn palm oil refinery project as well as assisting the first ever leading international cosmetic brands entry into the Country.

Zafar has also been a member of the Country Management Committee at Citibank Pakistan and was responsible for handling Government and Public Sector business. He was involved in all the major deals done by Citibank between 1999-2005 including issuance of First-ever US $600Mn Government of Pakistan Islamic Sukuk, US $350Mn PIA-US Exim Bank Deal, First-ever Derivative/ Interest Rate Swap with Pak Arab Refinery Company, set-up US $100Mn OPIC guaranteed financing facility for KESC and implementation of Management solution for Pakistan State Oil.

Zafar has recently been appointed on the Central Board of Directors of the State Bank of Pakistan (the Central Bank of the country) as an Independent Director. He is also a Member of the Board's HR and Investment Committees of the State Bank of Pakistan.

MR. AROOJ ASGHAR, Chief Financial Officer & Project Director - Jhimpir Power

Arooj has 16 years of experience in the power and financial sectors. He was previously with CER Corporation (a company of SwiCorp Joussour, Saudi Private Equity Firm) as CFO; ACWA Power as Associate Director, Acquisition & Project Finance; Crosby Securities as Vice President, Corporate Finance and AES LalPir/PakGen (700MW/Oil) as Director. Arooj has conducted training sessions for corporate entities and universities on "Financial Modelling for Project Finance in IPP" & "Power Polices and Tariff Calculations". He has Masters degree in Business Administration and has worked on projects in Pakistan, Oman, Jordan, Bangladesh, Turkey, Bulgaria, Nigeria, Kenya and Saudi Arabia.

* * *

B001534

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

SECP

Company Registration Office Karachi

Securities and Exchange Commission of Pakistan

CERTIFICATE OF INCORPORATION ON CHANGE OF NAME

[Under section 40 of the Companies Ordinance 1984 (XLVII of 1984)]

Company Registration No: 0060498

I hereby certify that pursuant to the provisions of section 39 of the Companies Ordinance, 1984 (XLVII of 1984), the name of DEWAN ENERGY (PRIVATE) LIMITED *has been changed to* JHIMPIR POWER (PRIVATE) LIMITED *and that the said company has been duly incorporated as a company limited by shares as a private company under the provisions of the said Ordinance.*

This change is subject to the condition that for period of one year from the date of issue of this certificate, the company shall continue to mention its former name along with its new name on the outside of every office or place in which its business is carried on and in every document or notice referred to in clauses (a) and (c) of section 143.

Given under my hand at Karachi this 27th day of March Two Thousand and Fourteen.

(SIDNEY C. PEREIRA)
Joint Registrar/Incharge
Company Registration Office,
Karachi

Certified to be True Copy

84/21

Asstt./Deputy Registrar of Companies

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

CERTIFICATE OF INCORPORATION

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

Company Registration No. 00000013954/20070407

I hereby certify that DEWAN ENERGY (PRIVATE) LIMITED is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is Limited by Shares.

Given under my hand at Karachi this 18th day of April two thousand and seven.

Fee Rs. 139,500/- (One Hundred Thirty nine Thousand Five Hundred Only)

(MUHAMMAD NAEEM KHAN)
JOINT REGISTRAR OF COMPANIES

S.No. 75919 dt 27/8/13

S.# 13890 dt 18/4/07.

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

Memorandum of Association of
JHIMPIR POWER (PRIVATE) LIMITED
(formerly Dewan Energy (Pvt) Limited)

I. The name of the Company shall be "JHIMPIR POWER (PRIVATE) LIMITED (formerly Dewan Energy (Pvt) Limited)".

II. The Registered Office of the Company shall be situated in the Province of Sindh, in the Islamic Republic of Pakistan.

III. The objects for which the Company is established are all or any one or more of the following: -

1. To carry on, primarily, the business of power generation, as independent power producer of thermal, hydel, nuclear, solar, wind, steam, and/or any other alternative / renewable energy sources, and bio-energy.

2. To generate, produce and sell power to utility companies, power distribution networks and organizations in the power sector, within and outside the country.

3. To set up, operate and manage one or more Power Plants in order to generate, sell and supply electricity to industrial and other consumers, through distribution networks established, owned and operated by the company itself or by any other person, corporate body, autonomous or semi-autonomous corporation or authority or local body, and for that purpose to acquire land, whether freehold or leasehold, machinery and equipment, and construct, install, operate and maintain thereon power houses, civil and mechanical works and structures, grid stations, transmission towers, power lines, buildings, workshops and other facilities as may from time to time be necessary for the attainment of the objects of the company.

4. To take over, acquire, renew, unitize and hold any exploration, prospecting, development and production concessions of whatever nature or otherwise acquire any estate or interest, develop resources of work, dispose of or otherwise turn to account land or sea beds in from, and to search for or participate in the exploration for petroleum or any other oil in any from, asphalt, bitumen or similar substances, or natural gas, or any substance, used, or which may be capable of use, and to organize, equip and employ expeditions, experts and other agents and to carry out drilling and other exploratory operations, and to establish, and operate oil and gas wells and other undertakings to estimate the reserves of oil and gas and for the extraction of any of the aforesaid substances.

5. To produce, refine, sell, supply, market, distribute, transport and otherwise dispose of crude oil, condensate LPG, NGL and Natural Gas and refinery gases and by-products pursuant to any of the objects mentioned in this

Memorandum for domestic, commercial or industrial uses or for lighting, heating power generation or any other purpose whatsoever.

6. To carry out construction, installation, erection of hydel, Steam, thermal, nuclear, geothermal power station, solar energy projects and wind farms.

7. To undertake business in the areas relating to hydel, thermal, solar, energy & wind power installations, controls, protection, communication and instrumentation system for power plants, substations, industrial installation and pumping compressor stations, energy conversation system.

8. To offer and to engage in supply, implementation and installation of EHV and HV transmission lines, medium and low voltage overhead and underground distributions network, high voltage underground cables, and low voltage AC and DC installations, rectifier, capacitor installations and consumer services.

9. To carry out complete electrification of industrial units, municipal electrifications, seaport and airport lighting systems, cathode and lightning protection installation.

10. To act as contractor, sub-contractors, advisors, designers, supervisors, purchasers, project managers with regards, to turnkey construction, development, improvement of Hydel, Wind, Steam, thermal and Nuclear Power Stations, Grid-stations, Transmission and Distribution Lines, Civil Works and work of every description connected with power related sector in general, and to act as contractors, agents, estimators, evaluators, appraisers, surveyors for any other electrical and mechanical work of any kind, whatsoever, anywhere in the world, subject to the approval of authority.

11. To act as electrical/mechanical/civil work contractors to local and foreign Governments, agencies, authorities, municipalities, autonomous corporations, private and public companies in power sector.

12. To represent deal and trade in all kind of power and energy related plants, turbines, equipments, products, cables, termination equipment, tools, accessories, technologies and services.

13. To apply for and obtain necessary consents, permissions and licenses from relevant government, state, local and other authorities for enabling the Company to carry on any of its objects into effect as and when required by law.

14. To enter into any arrangements or agreements with any authorities, Central or any Provincial Government, Municipal, Local or otherwise and to obtain from any such authority any rights, privileges, rebates, licenses, Permits and concessions which the Company may consider desirable to obtain and to carry out exercise and comply with such arrangements, agreements, rights, privileges, rebates and concessions.

15. To manufacture construct, equip, maintain, erect, lay, repair, alter remove pressure control, metering stations, gas works and works connected therewith,

with all necessary machinery and apparatus, pipes, mains meters, conduits, services pipes, lamps posts, and other materials and apparatus for supplying gas for heating, motive power, industrial, commercial, domestic, pre-stressed concrete products, structures, beam, pillars, gilders and structural materials to be used in the building of power plants and to carry out civil work for the construction of power plants and any other purpose whatsoever.

16. To construct, erect, equip, maintain, improve and work or aid in, contribute or subscribe to the construction, erection, equipment, maintenance, improvement and working of any railways, tramways, piers, jetties, wharves, docks, roads, canals, waterways, waterworks, reservoir tanks storage installations, pipe-lines, mills, factories, refineries, laboratories, electric works, gasworks, hydraulic and other works, telegraphs, telephones, plant, machinery, appliances, dwelling houses and other buildings.

17. To acquire, work and dispose of, and deal in any mines, metals, minerals, clay and other like substances and to acquire, refine, prepare for market, produce, manufacture, deal in or otherwise turn to account any mineral, animal or vegetable substances or products.

18. To carry on the business of estimation, drawing up of specifications for works relating to mechanical and electrical engineering.

19. To carry on the business of electrical engineers, electricians, engineers, contractors, consultants, agents and manufacturers of electrical plant, machinery, equipment and apparatus, and of generating, producing and supply light, heat, sound and power by electricity, galvanism, magnetism or otherwise, suppliers of electricity whether for the purpose of light, heat, motive power, telephonic, telegraphic, industrial or other purposes and generally to install, execute, provide, work and maintain all necessary plant, machinery, equipment, cables, wires, accumulators, lamps exchanges, telephones and apparatus.

20. To carry on the work of heavy steel fabrication for power plants, transmission lines and other steel structures within the scope of the object of the Company.

21. To undertake engineering, design, erection, installation testing / commissioning and maintenance of electrical power, communication and mechanical works as well as certain civil engineering and environmental projects related to power based industry.

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

privileges, goodwill, registration, trade mark, import and export registration, or any other facilities.

23. To carry on the business of oil and petroleum, fabricate, contract, erect, lay, and manufacturers of plant, machinery and apparatus for oil and petroleum, gas and chemical installations and to purchase or otherwise acquire, produce, manufacture, refine, treat, purify, blend, reduce, distil, store, transport, market, distribute, supply, sell and otherwise dispose off and generally trade in any and all kinds of petroleum and petroleum products.

24. To buy, sell, manufacture, repair, alter, improve, or otherwise treat, exchange, hire, let-out on hire, import, export and deal in all works, plant, machinery, tools, engines, tanks, cylinders, valves, regulators, testing equipment, tools, utensils, appliances, equipment, stoves, heaters, apparatus, utensils, substances, raw materials, chemicals, natural gas, liquefied petroleum gas, fuel oil, coal, lubricants, articles and things and to manufacture, experiment with render marketable and deal in all products, appliances, equipment, apparatus, products, materials, substances, articles and things capable of being used in any such business as aforesaid or required by any customers of, or persons having dealing with the Company, or any such other company or body as herein mentioned, or commonly dealt in by, persons engaged in any such business, or which may seem capable of being profitably dealt with in connection with any of the said business and to manufacture, experiment with, render marketable and otherwise treat and deal in all products and residual and bye-products incidental to, or obtained, or capable of being made use of, in any of the business carried on by the Company or any such other company or body herein mentioned.

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

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

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

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

29. To buy, import, export, indent, stock, contract, tender, distribute, acquire, secure and grant agency, distribution rights, representations and trade in or

deal in any manner in gases of all kinds and gas plant, machinery, instruments, implements, appliances, equipments, tools, dies, presses and apparatus.

30. To carry on the business of contractors, suppliers and manufacturers of gas regulators and component parts of gas appliances and all other buildings and works, meters, pipes fittings, machinery, apparatus, convenient or necessary for the purposes of the Company, and connection with power generating plant for the generation of electric power and or in connection with supply, transmission and distribution of electric power.

31. To manufacture, sell, deal in, let for hire, fix, repair and remove natural gas apparatus, appliances and fittings, engines, meters, indices, apparatus for testing and measurement, stoves, cookers, gassings, ranges, pipes, mains for lighting, heating, motive power, ventilating, cooking, refrigerating or any other purpose.

32. To carry on the business of natural gas engineers, contractors, agents, manufacturers of plant, machinery, gas apparatus and works for the sale, supply, distribution, storage, use, regulation and measurement of gas.

33. To carry on all or any of the business of storing, transporting, transmitting, distributing, supplying and exporting natural gas for lighting, heating, motive power, generation of electricity, or any other purpose whatsoever.

34. To establish, provide, maintain and conduct or otherwise subsidize research laboratories and experimental workshops for scientific and technical research, experiments and tests of all kinds; and to promote studies and research, both scientific and technical investigations and inventions by providing, subsidizing, endowing or assisting laboratories, workshops, libraries, lectures, meetings and conferences and by providing or contributing to the scientific or technical professors or teachers and by providing or contributing to the award of scholarships, prizes, grants to studies or otherwise and generally to encourage, promote and reward studies, researches, investigations, experiments, tests, and inventions of any kind that may be considered likely to assist any business which the Company is authorized to carry on.

35. To carry on in all or any of the branches of the Company all or any of the business of dealers in natural gas and any component, constituent, product or bye-product thereof, wharfingers, merchants, carriers, shipowners and charterers, lightermen, berge owners, factors and brokers and all other kindred business usually carried on by gas companies and to treat and turn to account in any manner whatsoever natural gas or any component, constituent, product or bye-product thereof.

36. To carry on business and obtain licenses for shipping agents, clearing and forwarding agents, purchasing and indenting agents, selling agents, (except managing agent) on such terms and conditions as the Company may think proper, subject to any permission as required under the law.

37. To carry on and undertake trading business of all sorts and to act as indenters, importers, exporters, traders, suppliers, and commission agents of products, commodities and materials in any form or shape manufactured or supplied by any company, firm, association of persons, body, whether incorporated or not, individuals, Government, Semi- Government or any local authority.

38. To apply for, tender, offer, accept, purchase or otherwise acquire any contracts and concessions for or in relation to the projection, execution, carrying out, improvements, management, administration or control of works and conveniences and undertake, execute, carry out, dispose of or otherwise turn to account the same.

39. To carry on the business of general order suppliers including Government, Semi-Government Agencies, Armed Forces, Army, Military or Defence and to act as commission agents, indenters, traders, general merchants, wholesalers, retailers, dealers, distributors, stockists in any goods or products or within the scope of the object of the Company and subject to any permission required under the law.

40. To carry on in or outside Pakistan the business of manufacturers, importers, exporters, indenters, transporters, dealers in all articles and commodities akin to or connected with any of the business of the Company capable of being conveniently carried on or necessary for the promotion of the objects herein contained, as permissible under law.

41. To invest and deal, from time to time, with the surplus moneys of the Company not required for its main business in any manner and in particular to accumulate funds or to acquire or to take by subscription, absolute or conditional, purchase or otherwise howsoever and to hold, and dispose of shares and other securities of any other company, association, undertaking in Pakistan or abroad.

42. To invest and deal with the moneys of the Company in such new projects, companies, works and research as may be directed by the Government of Pakistan.

43. To carry on agency business (except managing agency) and to acquire and hold selling agencies and to act as selling agents, commission agents, manufacturers' representatives and distributing agents of and for the distribution of all kinds of merchandise, goods, commodities, products, materials, substances, articles and things whether finished, semi-finished, raw, under process, refined, treated or otherwise pertaining to trade and commerce and for that purpose to remunerate them and to open and maintain depots and branches.

44. To purchase, take on lease or in exchange, hire, apply for or otherwise acquire and hold for any interest, any rights, privileges, lands, building, easements, trade marks, patents, patent rights, copyrights, licenses, machinery, plants, stock-in-trade and any movable and immovable property of any kind necessary or convenient for the purposes of or in connection with the Company's business or any branch or department thereof and to use,

exercise, develop, grant licenses in respect of or otherwise turn to account any property, rights and information so acquired, subject to any permission required under the law.

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

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

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

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

49. To purchase, build, charter, affreight, hire and let out for hire or for chartering and affreightment, and otherwise to obtain the possession of, and use, operate and dispose of, and employ or turn to an account ships, lighters, barges, tugs, launches, boats and vessels of all kinds (including tankers and tank vessels), marine equipment, automobiles, lorries, motor trucks and tractors, airplanes, locomotives, wagons, tanks, cars and other rolling stock and otherwise to provide for and employ the same in the conveyance of petroleum and other minerals, movable properties and merchandise of all kinds, and the transportation of personnel, employees, customers and visitors and to purchase or otherwise acquire any shares or interests in any ships or vessels, airplanes, railways, motor transportation, or in any companies, possessed of or interested in any ships, vessels, airplanes, railways and motor transportation.

50. To enter into partnership, to amalgamate or merge movable with immovable and / or to buy on all interests, assets, liabilities, stocks or to make any arrangement for sharing profits, union of interests, co-operation, joint-venture, reciprocal concession or otherwise with any person, firm or company carrying on or proposing to carry on any business which this Company is authorized to

carry on or which is capable of being conducted so as directly or indirectly to benefit this Company and to have foreign collaborations and to pay royalties / technical fees to collaborators, subject to the provisions of the Companies Ordinance, 1984.

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

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

53. To arrange local and foreign currency loans from scheduled banks, industrial banks and financial institutions for the purpose of purchase, manufacture, market, supply, export and import of machinery, construction of factory, building and for the purpose of working capital or for any other purpose.

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

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

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

57. To remunerate any person, firm or company rendering services to this Company, under a contract of employment, management or otherwise, whether by the payment of cash or by the allotment of shares or securities of the Company, during the continuation of such services, the furtherance thereof, or termination of such services howsoever.

58. To give any servant or employee of the Company commission in the profits of the Company's business or any branch thereof and for the purpose to enter into any agreement or scheme of arrangement as the Company may deem

fit and to procure any servants or employees of the Company to be insured against risk of accident in the course of their employment by the Company.

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

60. To carry on any other business, whether manufacturing or otherwise, which may seem to the Company capable of being conveniently carried on in connection with any of the objects specified herein, or calculated directly or indirectly to enhance the value of, or render profitable, any of the Company's property or rights.

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

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

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

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

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

66. To accept, design, display, publish, transmit, distribute or reproduce in any form whatsoever, advertisements and publicity and promotional material of the Company; to acquire, dispose of, and use advertising time and space in any media; to develop, produce and undertake advertising, publicity and promotional campaigns and competitions for itself; to undertake, promote and sponsor any product, service event, individual or publications which in the opinion of the Company will promote, advance or publicize any activity of the Company; and generally to carry on the business of advertising, public relations and publicity consultants and agents, but not to indulge into business of radio and television broadcasting/ transmission.

67. To accept securities of any person or any property or interest therein of whosoever nature, in payment or part payment for any services rendered, or for any sale or supply made to, or debt owing from, any such person.

68. To represent persons at meetings of local, national and international organizations, and bodies concerned with business activities connected or associated with any of the business of the company, to provide services of all kinds to such organizations and bodies and to negotiate and enter into national and international agreements, and standards relating to matters of concern or interest of the company or persons represented by, or having dealings with the company.

69. To borrow money or secure or discharge any debt or obligation of the Company in such manner as may be thought fit by the Company and in particular, but without prejudice to securities of any kind or mortgages or charges (fixed or floating), founded or based upon all or any part of the undertaking, property, assets and rights (present and future) of the Company, or without any such security and upon such terms as to priority or otherwise as the Company shall think fit, and to receive money on deposit and advance payments with or without allowance of interest thereon, subject to the conditions/ restrictions imposed under any law.

70. To apply for purchase or otherwise acquire any patents, patent rights, brevets d'invention, licenses, secret marks, commercial names and designs, copyrights, trade marks, service licenses, concessions, and the like, conferring any exclusive or nonexclusive or limited right to 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 licenses in respect of, or otherwise turn to account the property, rights or information so acquired as permissible under law.

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

72. To distribute any of the property of the Company in specie among the members in the event of winding up or otherwise.

73. To open any current, overdraft, cash credit account, fixed account with any banker.

74. To adopt such means of making known the business and / or services of the Company as may seem expedient and in particular by advertising in the press, or in the other media or by of participation in exhibitions.

75. To employ or appoint any persons, experts, consultants, advisers, contractors (including O & M contractors), brokers in connection with the business of the Company.

76. To employ and remunerate officials and servants of the Company, or any person or firm or company rendering services to the Company.

77. To provide engineering, construction, consultancy and design services and radio and other communication systems and services, and any facilities,

equipment and installations whether related to such services and systems or otherwise.

78. To create any reserve fund, sinking fund, insurance fund, or any other special fund, whether for depreciation or for repairing, insuring, improving, extending or maintaining any of the property of the Company, or for any other purpose conducive to the interests of the Company.

79. To capitalize such portion of the profits of the Company as are not distributed among shareholders of the Company in the form of dividends, and as the directors of the Company may think fit and to issue bonus shares, as fully paid up, in favor of the shareholders of the Company.

80. To advance, lease or deposit money to any person with or without taking any security therefore and upon such other terms as may be thought fit by the company, but only in furtherance of objects of the company.

81. To insure any property, asset, matter or interest and against any potential liability or loss of the company or of any other person and the life or health of any person for the benefit of the company.

82. To apply for, secure, acquire by grant, legislative enactment, assignment, transfer, purchase or otherwise, and to exercise, carry out and enjoy any license, and to exercise, carry out and enjoy any license, franchise, concession, right, privilege, authority, grant; and to pay for, aid in, and contribute towards carrying, the same into effect and do all things required of the company there under.

83. To apply for, promote and obtain (alone or with others) under any statute, order, by-law, charter, rule, regulation or other authorization or enactment which may seem calculated, directly or indirectly, or benefit the company and (alone or with others), to oppose any bills, proceedings or applications which may seem calculated or likely, directly or indirectly, to prejudice the interests of the company or persons having dealings with the company.

84. To sell, dispose of or transfer the business, property and undertaking of the company or any asset or part thereof for any consideration which the company may see fit to accept, and in particular (but without prejudice to the generality of the foregoing), to sell or otherwise dispose of any of the debts due or to become due to the company, to factors or others for collection, and to enter into any obligations or recourse or otherwise in connection therewith.

85. To promote, establish, acquire, subscribe to, or take any interest in, alone or with others, any company, body corporate, fund, trust, or other person or body of persons, whether incorporated or not, and whether or not having objects similar to those of the company.

86. To purchase or otherwise acquire all or any of the business, property and liabilities of any person carrying on a business, including all or any part of the purposes within the objects of the company, or a business which in the

opinion of the company, may be conveniently or advantageously carried on by the company, or a business having rights in assets, the acquisition of which is in the opinion of the company likely to be in its interest, and to conduct, carry on and expand or liquidate and wind up any such business.

87. To establish, purchase, maintain and contribute to any pension, provident, gratuity, superannuation, retirement, redundancy, injury, death benefit or insurance funds, trusts, schemes, entities, or policies for the benefit of, and to give or procure the giving of pension, annuities, allowances, gratuities, donation, emoluments, benefits, of any description (whether in kind or otherwise), incentives, bonuses, assistance (whether financial or otherwise) and accommodation in such manner and on such terms as it thinks fit to, and to make payments for or towards the insurance of, any individuals who are or were at any time in the employment of, or directors or officers of (or held comparable or equivalent office in), or acted as consultants or advisers to, or agents for the company or any company which is its holding company, or is a subsidiary of the company or any such holding company, or any person to whose business the company or any subsidiary of the company is, in whole or in part, a successor directly or indirectly, or any person which is otherwise allied to or associated with the company, and to other individuals whose service has been of benefit to the company, or who the company considers have a moral claim on the company, and the spouses, widows, widowers, families and dependents of any such individuals as aforesaid; and to establish, provide, manage and maintain and provide financial assistance to welfare, sports and social facilities, associations, clubs, funds and institutions which the company considers likely to benefit, or further the interests of any of the aforementioned individuals and spouses, widows, widowers, families and dependents of any such aforementioned individuals, and to mange, maintain, support and provide financial assistance to any such facility, association, club, fund or institution which has been established, provided for, managed, maintained, supported or subscribed to, by any person to whose business the company or any subsidiary of the company is, in whole or in part, a successor.

88. From time to time, to subscribe or contribute (in cash or in kind) to, or to promote, any charitable, benevolent or useful object of a public character, or any object which may in the opinion of the company be likely, directly or indirectly, to further the interests of the company, its employees or its employees or its members.

89. To do all or any of the matters hereby authorized in any part of the world, either alone or in conjunction with, or as factors, contractors, principals, and to act as or secretary, registrar or adviser or consultant to, undertake and execute any trust.

90. To apply for, assist in, process, procure and obtain the listing of any of the securities of the company, or of any derivative securities of the company, or of any Global Depository Receipts pertaining to the securities of the company, on any stock exchange in any part of the world; and to engage advisors, consultants or agents, and to do all acts and things necessary or incidental for the same.

91. To enter into any guarantee, contract of indemnity or surety ship, in order to secure the performance of any contracts, obligations or commitments, with or without consideration, calculated to benefit the Company or the holding company of the Company or any subsidiary of the holding company or any subsidiary of the company, whether by personal obligation, or by mortgaging or charging all or any part of the undertaking, property and assets (present and future) of the Company.

92. Generally to do all such other things as in the opinion of the company are or any be incidental or conducive to the attainment of the above objects or any of them, provided same are not contrary to law in force.

93. To do all or any of the above things in any part of the world as principals, agents, contractors, sub-contractors, otherwise and by or through trustees, agents, subsidiary company or otherwise and either alone or in conjunction with others.

94. To do all and everything necessary, suitable or proper or incidental or conducive to the accomplishment of any of the purposes or the attainment of any of the objects or the furtherance of any of the powers hereinbefore set forth, either alone or in association with other corporate bodies, firms or individuals or with any Government authority or public or quasi-public authority or any other authority, and to do every other act or thing incidental or appurtenant to or arising out of or connected with the business or powers of the Company or part thereof, provided the same be lawful.

95. To do all such other things as are incidental or conducive to the attainment of the above objects, this general statement of objects being deemed as enabling and not in any way as restrictive of the foregoing objects.

96. The Company shall not engage in Banking Business, Business of an Investment Company, Non-Banking Finance Company, Leasing Company and Insurance Company, Business of management agency or any unlawful business and nothing in object clauses shall be construed to entitle company to engage in such business, directly or indirectly. The Company shall not launch multilevel marketing, pyramid and ponzi scheme.

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

It is hereby declared that the word "Company" save when used in reference to this Company shall be deemed to include any partnership or other body of persons whether incorporated or not incorporated, whether domiciled in Pakistan or elsewhere and that in the interpretation of this clause, the powers conferred on the Company by any paragraph shall not be restricted by reference to any other paragraph and that in the event of ambiguity, this clause and every paragraph hereof shall be considered independent and

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 as set opposite names.

S. No.	Name and Surname (Present & Former) in full (in block letters)	Father's/Husband's Name in full (in block letters)	Nationality with any former Nationality	Occupation	Residential Address in full	Number of shares taken by each subscriber	Signature
1.	Dewan Muhammad Yousuf Farooqui NIC: 42301-6948978-9	Dewan Muhammad Umer Farooque (Late)	Pakistani	Business	H.No.10, Street # 4, Khyaban-e-Hilal, Phase 6, DHA, Karachi	90,000/- (Fifty Thousand)	
2	Mrs. Hina Yousuf Farooqui NIC: 42301-7944605-4	Dewan Muhammad Yousuf Farooqui	Pakistani	Business	H.No.10, Street # 4, Khyaban-e-Hilal, Phase 6, DHA, Karachi	10,000/- (Ten Thousand)	

Dated the 16th day of April 2007

Total: 100,000
(One Hundred Thousand)

Witness to the above Signatures

SYED MOONIS ABDULLAH ALVI CHARTERED ACCOUNTANT 8TH FLOOR, FTC, SHAHRA-E-FAISAL, KARACHI.

Certified to be True Copy

THE COMPANIES ORDINANCE, 1984

PRIVATE COMPANY LIMITED BY SHARES

ARTICLES OF ASSOCIATION

OF

JHIMPIR POWER (PRIVATE) LIMITED
(formerly Dewan Energy (Pvt) Limited)

1. The regulations contained in Table "A" in the First Schedule to the Companies Ordinance, 1984, ("the ordinance") shall not apply to the Company, except in so far as the same are expressly made applicable by the said Ordinance, or these Articles. The regulation for management of the Company, and for the observance thereof by the members of the Company, and their representatives shall, subject as aforesaid and to any exercise of the statutory power of the Company in reference to the repeal or alteration of or addition to its regulations by Special Resolution as prescribed by the said Ordinance; be such as are contained in these Articles.

INTERPRETATION

2. In the interpretation of these Articles, the following expressions shall have the following meanings, unless repugnant to or inconsistent with the subject Articles.

2.1: 'The Ordinance" means the Companies Ordinance, 1984, or any statutory modification or re-enactment thereof for time being in force in Pakistan;

2.2: "Board" means a Board of the Directors being the first Directors of the Company under the Ordinance and thereafter as elected by the shareholders, to act on their behalf in the management of the Company affairs;

2.3: "The Company" or "This Company" means **JHIMPIR POWER (PRIVATE) LIMITED (formery Dewan Energy (Pvt) Ltd)**;

2.4: 'The Directors" means the Directors and Alternate Directors for the time being of the Company, or as the case may be, the Directors and Alternate Directors assembled at a Board;

2.5: "Dividend" includes bonus shares;

2.6: "Month" means a calendar month;

2.7: "The Office" means the Registered Office for the time being of the Company;

2.8: "Persons" includes corporation as well as individuals firm, association of persons, etc.;

2.9: "The Register" means the Register of members to be maintained kept pursuant to the Ordinance;

2.10: "In Writing" means written or printed, or partly written and partly printed or lithographed or typewritten, or other substitute for writing;

2.11: Words importing singular number include the plural number and vice versa;

2.12: Words importing masculine gender include the feminine gender;

2.13: Subject as aforesaid, any words or expressions defined in the Ordinance; shall, except where the subject or context forbids, bear the same meaning in these Articles.

PRIVATE COMPANY

3. The Company is a "Private Company" within the meaning of sub section 2(1) (28) of the Ordinance and accordingly:

(1) No invitation shall be issued to the public to subscribe for any share of the Company.

(2) The numbers of the members of the Company (exclusive of persons in the employment of the Company), shall be limited to fifty, provided that for the purpose of this provision, where two or more persons hold one or more shares in the Company jointly, they shall be treated as a single member; and

(3) The right to transfer shares of the Company is restricted in manner and to the extent herein appearing.

BUSINESS

4. The Company is entitled to commence business from the date of its incorporation. The business of the Company shall include all or any number of the objects enumerated in the Memorandum of Association. The business of the Company shall be carried out at such place or places anywhere in Pakistan, or elsewhere as the Directors may deem proper or advisable from time to time.

SHARES AND CAPITAL

5. The authorized share capital of the Company is Rs. 50,000,000/- (Rupees Fifty Million only) divided into 5,000,000/- (Five Million) ordinary shares of Rs. 10/- (Rupees Ten) each with powers of the Company to increase or reduce the same and to divide the shares into several classes.

6. The shares shall be under the control of the Board of Directors, who may allot or otherwise dispose off the same to such persons, on such terms and conditions and at such times, as the Board of Directors think fit. Shares may also be allotted for consideration otherwise than the cash.

7. Fully paid shares shall be allotted to all subscribers in the first instance and the Company shall not be bound to recognize any equitable, contingent, future or partial claim to, or interest in a share on the part of any person other than the registered share holder, save as herein provided, or saves as ordered by some Court of competent jurisdiction.

8. The certificate of title to shares shall be issued under the common seal of the Company.

9. Every member shall be entitled to one certificate for the shares registered in his name, or at the discretion of the Directors, to several certificates, each for one or more of such shares.

TRANSFER AND TRANSMISSION OF SHARES

10. Every person whose name is entered as a member in the Register of Members shall without payment, be entitled to a certificate under the common seal of the Company specifying the shares held by the one or several persons. The Company shall not be bound to issue more than one certificate and delivery of a share certificate to any one of several joint holders shall be sufficient delivery to all.

11. The Directors may decline to register any transfer of shares to transferee of whom they do not approve, and shall be bound to show any reasons for exercising their discretion subject to the provisions of Section 77 and 78 of the Ordinance.

12. No share can be mortgaged, pledged, sold, hypothecated, transferred or disposed off by any member, to either member or non-member, without the prior sanction of the Board of Directors.

13. The legal heirs, executors or administrators of a deceased holder shall be the only persons to be recognised by the Directors as having title to the shares. In case of shares registered in the name of two or more holders, the survivors and the executors of the deceased shall be the only persons to be recognised by the Company as having any title to the shares.

BORROWING POWERS

14. Subject to the provision of the Ordinance, the Directors may from time to time at their absolute discretion raise or borrow any sum, or sums of money for the purpose of the Company from banks, firms or companies, particularly a person holding the office of the Director, and may secure the payment of money in such manner and upon such terms, and conditions in all respects as they think fit particularly by the issue of debentures of the Company, or by making, drawing, accepting or endorsing on behalf of the Company any promissory note or bills of exchange, or giving, or issuing any other security of the Company.

15. Debentures and other securities may be made assignable free from any equities between the Company and the persons to whom the same may be issued.

16. Any debentures or other security may be issued at a discount, premium or otherwise, and with any special privilege as to redemption, surrender, drawing, allotment of shares, attending and voting at general meeting of the Company or subject to compliance of the provisions of the Ordinance.

RESERVES

17. The Directors may, from time to time, before recommending any dividend, set aside out of the profit of the Company, such sums as they think fit, as a reserve for redemption of debentures, or to meet contingencies for equalization of, or for special dividends, or for rebuilding, repairing, restoring replacing, improving, maintaining or altering any of the property of the Company, or for such other purpose as the Directors may in their absolute discretion think conducive to the interests of the Company.

GENERAL MEETINGS

18. 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 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.

19. The Directors may, whenever they think fit, call an extra ordinary general meeting of the Company, whereby also be called on such requisition, or in default may be called by such requisitionists, as is provided by section 159 of the Ordinance.

NOTICE AND PROCEEDINGS OF GENERAL MEETING

20. Atleast Twenty-One days' for a general meetings (inclusive of the day on which the notice is served or deemed to be served, but exclusive 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, to such persons as are under the Ordinance, or the regulations of the Company, entitled to receive 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.

21. All businesses shall be deemed special if is transacted at an extraordinary general meeting, and also are transacted at annual general meeting, with the exception of declaring dividend, the consideration of the accounts, balance sheet and the reports of the Directors and auditors, the election of the Directors, the appointment of, and the fixing of the remuneration of the auditors.

QUORUM

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

23. If within half an hour from the time scheduled 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, quorum is not present within half an hour from the time scheduled for the meeting, the members present being not less than two, shall be a quorum.

24. The Chairman of the Board of Directors, if any, shall preside as Chairman at every general meeting of the Company, but if there is no such Chairman, or if at any meeting he is not present within fifteen minutes after the time scheduled 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 the Chairman for a meeting.

25. The Chairman may, with the consent of any meeting at which the 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 the meeting is adjourned for ten days or more, notice of the adjourned meeting shall be given as in the case of an original meeting. Save as aforesaid, it shall not be necessary to give any notice of an adjournment of the business to be transacted at an adjourned meeting.

26. At any general meeting, a resolution put to the vote of the meeting shall be decided on a show of hands unless a poll is (before or on the declaration of the show of hands) demanded. Unless a poll is so demanded, a declaration by the Chairman that a resolution has, on a show of hands, being carried, or carried unanimously, or by particular majority, or lost an entry to that effect in the book of the proceedings of the Company, shall be conclusive evidence of the fact, without proof of the number or proportion of the votes recorded in favour of, or against that resolution.

27. A poll may be demanded only in accordance with the provisions of section 167 of the Ordinance.

28. If a poll is duly demanded, it shall be taken in accordance with the manner laid down in section 168 of the Ordinance, and the result of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded.

29. A poll demanded on the election of Chairman or on a question of adjournment shall be taken at once.

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

VOTES OF MEMBERS

31. 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 of the Ordinance shall apply. On a poll every member shall have voting rights as laid down in section 160 of the Ordinance.

32. A member of unsound mind, or in respect of whom an order has been made by any Court having jurisdiction in lunacy, may vote, whether on show of hands, or on a poll, by his committee or other legal guardian, and any such committee or guardian may, on a poll vote by proxy.

33. On a poll votes may be given either personally or by proxy.

34. (1) 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.

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

DIRECTORS

35. The number of Directors shall not be less than four. The following persons shall be the first directors of the Company and shall hold the office upto the date of the First Annual General Meeting unless earlier removed by the members in a General meeting:

1. Dewan Muhammad Yousuf Farooqui;
2. Mrs. Hina Yousuf Farooqui.

36. The remuneration of the Directors shall from time to time be determined by the Company in Board of Directors meeting subject to the provisions of the Ordinance.

37. Save as provided in Section 187 of the Ordinance, no person shall be appointed as a Director unless he is a member of the Company.

POWERS AND DUTIES OF DIRECTORS

38. 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 provided 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, but no regulations made by the Company in general meeting shall invalidate any prior act of the Directors which would have been valid if that regulation had not been made.

39. The Directors shall appoint a chief executive in accordance with the provisions of sections 198 and 199 of the Ordinance.

DISQUALIFICATION OF DIRECTORS

40 No person shall become the Director of the Company if he suffers from any of the disabilities or disqualifications mentioned in section 187 of the Ordinance and, if already a Director, shall cease to hold such office from the date he so becomes disqualified or disabled.

Provided, however, that no Director shall vacate, his office by reason only of his being a member of any Company which had entered into contracts 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.

PROCEEDINGS OF DIRECTORS

41. 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 an equality of votes, the Chairman shall have and exercise a second or casting vote. The Chief Executive shall, at any time, summon a meeting of Directors. It shall not be necessary to give notice of a meeting of Directors to any Director for the time being absent from Pakistan.

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

43. A resolution in writing signed by seventy five percent majority of Directors for the time being 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.

FILLING OF VACANCIES

44. At the first annual general meeting of the Company, all the Directors shall stand retired from office, and new Directors shall be elected in their place in accordance with section 178 of the Ordinance for a term of three years.

45. A retiring Director shall be eligible for re-election.

46. The Directors shall comply with the provisions of sections 174 to 178 and sections 180 and 184 of the Ordinance relating to the election of Directors and matters ancillary thereto.

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

48. The Company may remove a Director but only in accordance with the provisions of the Ordinance.

DIVIDENDS AND RESERVE

49. The Company in general meeting may declare dividends, but no dividend shall exceed the amount recommended by the Directors. No dividends shall be paid otherwise than out of the profits of the Company.

THE SEAL

50. The Directors shall provide for the safe custody of the Company seal and the seal shall not be affixed to any instrument except by the authority of a resolution of the Board of Directors, or by a committee of Directors authorized in that behalf by the Directors, and in the presence of at least one Director or Company Secretary; and such Director or the Company Secretary shall sign every instrument to which the seal of the Company is so affixed in his/her presence.

ACCOUNTS

51. The Directors shall cause to be kept, proper books of account as required under section 230 of the Ordinance.

52. The books of account shall be kept at the registered office of the Company, or at such other place as the Directors shall think fit.

53. The Directors shall, under sections 233 and 236 of the Ordinance, cause to be prepared, and laid before the Company in general meeting, such profit and loss accounts or income and expenditure accounts and balance sheets duly audited, together reports as are referred to in those sections.

AUDIT

54. Once at least in every year, the accounts of the Company shall be audited and the correctness of profit and loss accounts, or income and expenditure accounts and balance sheet ascertained by an auditor or auditors, and the provisions of the Ordinance in regard to audit, and the appointment and qualification of auditors, shall be observed.

55. Auditors shall be appointed and their duties regulated in accordance with sections 252 to 255 of the Ordinance.

WINDING UP

56. If the Company is wound up, whether voluntarily or otherwise, the liquidator may, with the sanction of a special resolution, divide amongst the contributories, in specie or kind, the whole or any part of the assets and liabilities of the Company, subject to the section 421 and other provisions of the Ordinance, as may be applicable.

INDEMNITY

57. Every Director, and other officer or servant of the Company shall be indemnified by the Company against, and it shall be the duty of the Directors to pay out of the funds of the Company, all costs, losses and expenses, which any such officer or servant may incur or become liable to, by reason of any contract entered into or thing done by such officer or servant as such in any way in the discharge of the duties of such officer or servant, including traveling expenses.

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

NOTICES

59. (1) A notice may be given by the Company to any member either personally, or by sending it by post to him to his registered address or (if he has no registered address in Pakistan) to the address, if any, within Pakistan, supplied by him to the Company for the giving of notices to him.

(2) Where a notice is sent by post, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting a letter containing the notice, and unless the contrary is

proved, to have been effected at the time at which the letters would be delivered in the ordinary course of post.

60. A notice may be given by the Company to the joint-holders of the share by giving the notice to the joint-holder named first in the register in respect of the share.

ARBITRATION

61. Whenever any difference arises between the Company on the one hand, and any of the members, their executors, administrators or assignees on the other hand, touching the intent or construction, or the incidence or consequences of these presents, or of the statute or touching any thing then or thereafter done, executed, omitted, or suffered in pursuance of these presents, or of the statute or touching breach or alleged breach, or otherwise relating to the premises, or to any statute effecting the Company, or to any of the affairs of the Company, including the fixing of the fair value of the shares of the Company; every such difference shall be referred 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 any umpire to be appointed by the two arbitrators.

SECRECY CLAUSE

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

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 as set opposite names.

S. No.	Name and Surname (Present & Former) in full (in block letters)	Father's/Husband's Name in full (in block letters)	Nationality with any former Nationality	Occupation	Residential Address in full	Number of shares taken by each subscriber	Signature
1.	Dewan Muhammad Yousuf Farooqui NIC: 42301-6948978-9	Dewan Muhammad Umer Farooque (Late)	Pakistani	Business of Power Generation	H.No.10, Street # 4, Khyaban-e-Hilal, Phase 6, DHA, Karachi	90,000/- (~~Fifty Thousand~~) (Ninety Thousand)	
2	Mrs. Hina Yousuf ~~Farooqui~~XXXX NIC: 42301-7944605-4	Dewan Muhammad Yousuf Farooqui	Pakistani	Business of Power Generation	H.No.10, Street # 4, Khyaban-e-Hilal, Phase 6, DHA, Karachi	10,000/- (Ten Thousand)	Hina Yousuf

Total: 100.000
(One Hundred Thousand)

Dated the 16th day of April 2007

Witness to the above Signatures

SYED MOONIS ABDULLAH ALVI
S/O. SYED RIAZUDDIN ALVI
CNIC # 42201-6886191-3
OCCUPATION: PRIVATE SERVICE

CHARTERED ACCOUNTANT

8TH FLOOR, FTC, KHAYABAN-E-FAISAL, KARACHI.

Certified to be True Copy
24/4/07
Asstt./Deputy Registrar of Companies

.L RETURN OF COMPANY HAVING SHARE CAPITAL

0060498	
DEWAN ENERGY (PRIVATE) LIMITED	

h/Year)	31	10	2013
ır)	31	10	2013

PART – A

	7th Floor, Block-A, Finance & Trade Centre, Shahrah-e-Faisal, Karachi.
	(021) – 111 364 111
	(021) – 35630860
9. Nature of Business:	Business of Power Generation

10.

Authorized Share Capital			
Type of Shares	No. of Shares	Amount	Face Value
Ordinary Shares	5,000,000	50,000,000/-	Rs. 10/- each

11.

Paid Share Capital			
Type of Shares	No. of Shares	Amount	Face Value
Ordinary Shares	100,000	1,000,000/-	Rs. 10/- each

12.

Amount of indebtedness on the date upto which Form A is made in respect of all Mortgages/Charges	-

13.

Particulars of the holding Company			
Name	N/A		
Registration No.		% Shares Held	

14. Chief Executive

Name	Abdul Saleem Siddiqi	NIC	42201-2250538-1
Address	House No. D-181/1, Block-7, Gulshan-e-Iqbal, Karachi.		

15. Chief Accountant

Name	-	NIC	-
Address	-		

16. Secretary

Name	Muhammad Zaki	NIC	42301-2149344-5
Address	79 C-1, Block-6, P.E.C.H.S. Karachi.		

17. Legal Adviser

Name	Abbas & Atif Law Associates, Advocate & Corporate Law Consultant
Address	411, Mehboob Chamber, Abdullah Haroon Road, Saddar, Karachi.

18. Auditors

Name	Messrs Tahir Jawad Imran Fecto, Chartered Accountants
Address	309, Progressive Centre, 30-A, Block-6, P.E.C.H.S. Shahrah-e-Faisal, Karachi, Pakistan.

19 List of Directors on the date of Form-A				
Name of Director	Address	Nationality	NIC (Passport No. if foreigner)	Date of Appointment
1. Dewan Muhammad Yousuf Farooqui	H.No.10, Street #4, Khyaban-e-Hilal, Phase 6 DHA, Karachi	Pakistani	42301-6948978-9	23-07-2012
2. Abdul Saleem Siddiqi	House No. D-181/1, Block-7, Gulshan-e-Iqbal, Karachi.	Pakistani	42201-2250538-1	31-10-2011

PART-B

20. List of members & debenture holders on the date upto which this Form A is made					
Folio	Name	Address	Nation-ality	No. of shares	NIC (Passport No. if foreigner)
	Members				
1	*Dewan M. Yousuf Farooqui*	*H.No.10, Street #4, Khyaban-e-Hilal, Phase 6 DHA, Karachi*	*Pakistani*	*90,000*	42301-6948978-9
2.	*Mrs. Hina Yousuf*	*53/1, 26th Street, Phase V, DHA, Karachi.*	*-do-*	*9,500*	42301-7944605-4
6.	*Abdul Saleem Siddiqi*	House No. D-181/1, Block-7, Gulshan-e-Iqbal Karachi.	*-do-*	*500*	42201-2250538-1
	Debenture holders				

Company Registration Office Karachi — Securities and Exchange Commission of Pakistan

21. Transfer of shares (debentures) since last Form A was made				
Folio No.	Name of Transferor	Name of Transferee	Number of shares transferred	Date of registration of transfer
-	-	-	-	-
-	-	-	-	-
	Debenture holders			

Use separate sheet, if necessary

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

Date	21	11	2013

Signature

Designation (Please tick) ~~Chief Executive~~/Secretary

Certified to be True Copy

Deputy Registrar of Companies

Date: 11/2/15

Project Company signed Off-shore Supply Contract with Harbin Electric International Co., Ltd, China ("**HEI**") whereas GE Energy will supply wind turbines and Construction Contract with Harbin Electric Corporation, China ("**HE**"). EPC Contracts were signed on April 03, 2013 in China.

O&M will be carried out by the WTG supplier for the first ten (10) years after COD after which, the Project Company will take it over. The cost of O&M during the first two (02) years will be carried out by EPC Contractor along with the WTG supplier.

IN WITNESS WHEREOF, the Parties hereto have caused this Contract to be executed the day and year first above written in accordance with their respective laws.

SIGNED by: _____

For and on behalf of the Employer in the presence of:

Witness: _____

Name: SHAHZAD RASUL

Address: _____

_____

Witness: ANGEL

Name: AHMAD NAGEEB

Address: _____

_____

SIGNED by: _____

For and on behalf of the Contractor in the presence of:

Witness: _____

Name: Sun Yue

Address: No. 39 Sandadongli, road, Xiangfang District, Harbin, China

Witness: _____

Name: _____

Address: _____

_____

21.4 Security over Insurance Proceeds

The Offshore Supplier acknowledges that the Employer may, at the Employer's sole discretion, enter into security arrangements with any Lender in respect of the proceeds payable under policies of insurance required to be obtained and maintained by the Employer and the Offshore Supplier under Clause 18 (*Insurance*) including arranging for proceeds of such policies of insurance to be paid into accounts secured to the Lenders as collateral for the Employer's indebtedness. The Offshore Supplier hereby consents to such arrangements.

IN WITNESS WHEREOF, the Parties hereto have caused this Contract to be executed the day and year first above written in accordance with their respective laws.

SIGNED by: _____

For and on behalf of the Employer in the presence of:

Witness: _____

Name: _____

Address: _____

_____

Witness: _____

Name: _____

Address: _____

_____

SIGNED by: _____ Ge Xin

For and on behalf of the Offshore Supplier in the presence of:

Witness: _____

Name: Wang Jianjun

Address: No 45 Xusheng Street, Xiangfang Dist, Harbin, China

Witness: _____

Name: Liu Zhizhuo

Address: No.39 Sanda Dongli Road, Xiangfang Dist, Harbin, China

HARBIN ELECTRIC INTERNATIONAL COMPANY LIMITED (HEI)

Harnessing and increasing the supply of power has long been a key in the advancement of human society. During the last half century, Harbin Electric Group (HE Group) has been responsible for numerous "firsts" in Chinese Power equipment manufacturing. Harbin Electric International Co., Ltd. (abbreviation HEI) is an important member of HE Group, and is China's leading large-scale enterprise in power project contracting and export of power equipment.

Established in 1983, HEI is primarily engaged in the supply of complete sets of equipment, the undertaking of EPC projects, and the construction of relative substation, transmission lines, and other utilities in the area of thermal power plants, hydropower station projects, combined-cycle power plant and wind power project. HEI also provides comprehensive professional after-sale service for the power plant.

HEI offers a combination of excellence in power plant construction and professional after-sale services.HEI was the first professional power engineering company passing the ISO9001 International Quality Assurance system certification. In 2009, it again took the lead by passing certification on OHSAS 18001-2007 Occupational Health and Safety system and GB/T24001-2004 idt ISO 14001-2004 Environmental Management System. For project management, the PMS (Project Management System) uses advanced and internationally-recognized software.

During the past 30 years, HEI with advanced technology, exemplary management and outstanding service, has provided complete sets of power equipment or built large power stations on turnkey basis in more than 20 countries such as Pakistan, the Philippines, Vietnam, Bangladesh, Cambodia, Iran, Sudan, India, Indonesia, and Turkey, with total installed capacity of nearly 30000MW and has grown into the backbone enterprise for the export of large power generation equipment and power plant general contracting in China and has become one of the most important international contractors in the world. It has been recognized in the list of ENR as one of the world's top 225 international contractors for many years. Its corporate performance continues to set new records both in the HE Group and among China's domestic enterprises.

A few achievements of HEI are mentioned below:

- Gudu power plant project, Pakistan.
- Uch power plant project, Pakistan.
- KESC BQPS-II 560MW power plant project, Pakistan.
- Garri power plant project, Sudan; the first large power plant built in Africa.
- Sudan Merowe power transmission project; the longest power transmission project with largest contract amount undertaken by Chinese EPC contractor internationally.
- Vietnam Cam Pha 2×300MW power plant project.
- Indonesia Paition 1×660MW coal-fired power plant project.
- Batch export of 600MW generating unit to India.
- Hydropower project on turnkey-basis in Ecuador-San Francisco 3×90MW.
- In 2010, the Energy Association of Vietnam awarded HEI the "Outstanding Contribution Award for Vietnam's Power Development", making HEI the first Chinese power plant construction company to receive this award.

GENERAL ELECTRIC (GE)

The world's most complex problems stem from accessibility to clean and sustainable sources of power and water. GE teams are swiftly advancing these technologies, focused on productivity and efficiency. With a full array of advanced power generation and water optimization technologies, GE works to drive growth and progress, anticipate future energy needs, and power a cleaner, more productive world.

GE supplies reliable and cost-efficient products and systems helping ensure reliability, availability, grid compliance and network quality for productivity. GE provides a complete range of electrical equipment and systems to wind OEMs, wind farm developers and operators for both onshore and offshore. This includes converters (more than 26GW delivered), generators (DFIG, SCIG & Permanent Magnet based, of various speeds) and electrical collection and connection to the wind farm grid.

Product evolution, it's one of the things GE does best, especially when it comes to the next generation of wind turbines. Building on a strong power generation heritage spanning more than a century, GE's onshore wind turbines deliver proven performance, availability and reliability - creating more value for GE's customers. As one of the world's leading wind turbine suppliers, GE Energy's current product portfolio includes wind turbines with rated capacities ranging from 1.5 MW–4.1 MW and support services extending from development assistance to operation and maintenance.

GE continues to advance its 1.5 MW wind turbine series product line with its 1.6-82.5 wind turbine. GE's 1.6-82.5 wind turbine provides additional annual energy production relative to the 1.5-82.5 wind turbine. Coupled with industry-leading low cost of electricity, this additional output equates to higher customer value. Focusing on performance, reliability, efficiency, and multi-generational product evolution, GE's 1.6-82.5 wind turbine continues to deliver wind product leadership.

Some major features & benefits of GE 1.6-82.5 WTG are mentioned below:

- Higher AEP than its 1.5 predecessors
- Capacity factor leadership in Class II winds
- Designed to meet or exceed the 1.5 MW platform's historic high availability
- Grid friendly options are available - Enhanced Reactive Power, Voltage Ride Thru, Power Factor Control
- Wind Farm Control System; WindSCADA™
- Sharing of components with family products
- Available in both 50 Hz and 60 Hz versions for global suitability

GE's 1.6-82.5 wind turbine has a rotor diameter of 82.5 meters. This wind turbine also incorporates advanced load controls which reduces the loads on the blades and other mechanical components to allow increased power production while maintaining a 20-year design life. Enhancements to GE's 1.6-82.5 wind turbine include: strengthened generator frames, an improved gearbox design and an upgraded pitch system. GE's 1.6-82.5 wind turbine utilizes GE Energy's proven Mark VIe* controller and advanced diagnostic capability to increase troubleshooting efficiency.

Check List for Examination of License Application
For New Generation Facility (Wind)
(Regulation 3 read with 3(6)(A) of AMPR)

Name of Company	: **M/s Jhimpir Power Private Limited** *(former Dewan Energy Private Limited)*
Capacity	: 49.60MW, Wind power plant

Annexure B: *Point 2; Technology, size of plant, number of units*

Technology	:	GE
WTG Model	:	1.6-82.5-50Hz
Size of Plant	:	49.6MW
Number of Units	:	31

Check List for Examination of License Application
For New Generation Facility (Wind)
(Regulation 3 read with 3(6)(A) of AMPR)

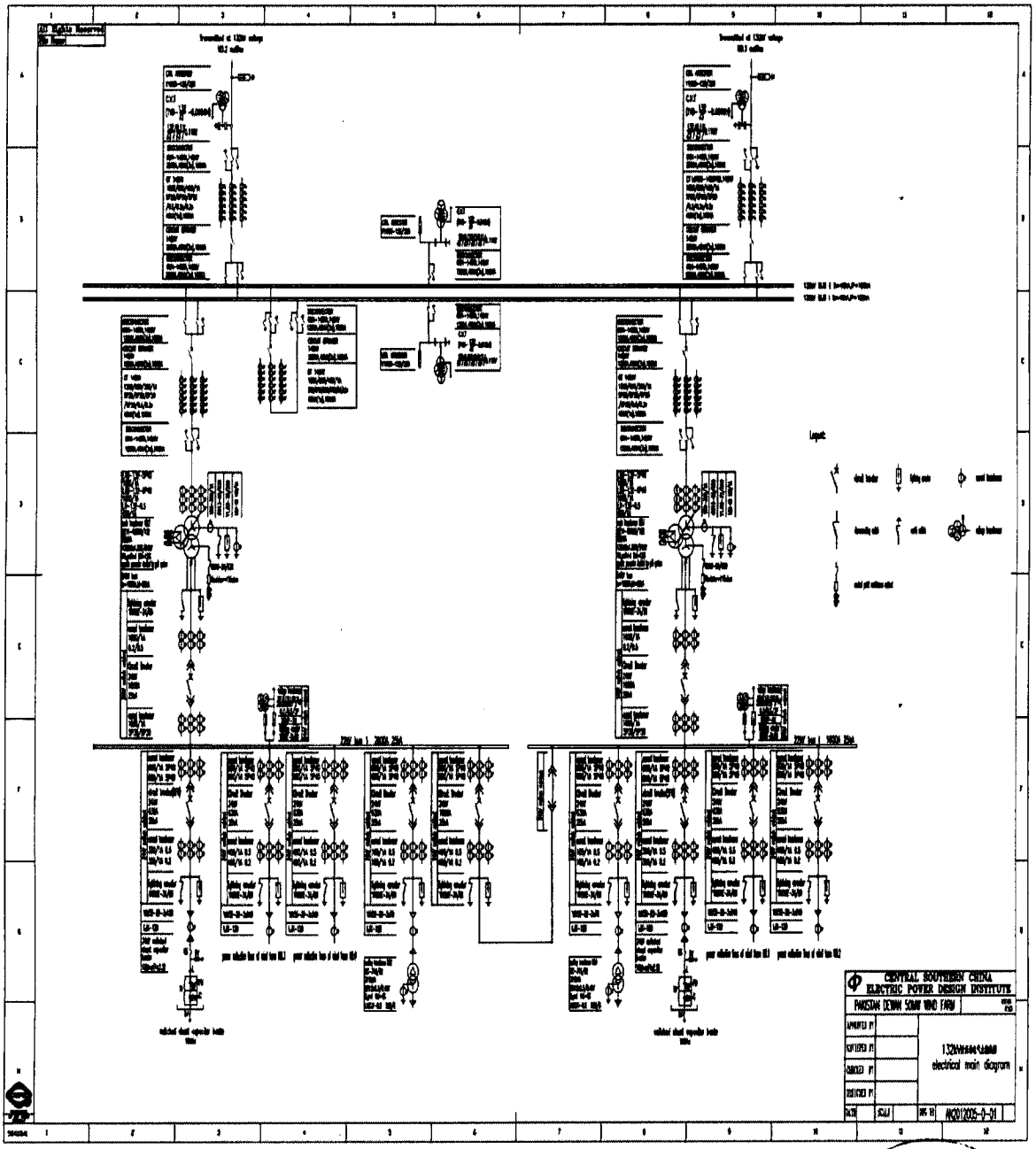
Name of Company	: **M/s Jhimpir Power Private Limited** *(former Dewan Energy Private Limited)*
Capacity	: 49.60MW, Wind power plant

Annexure C: *Point 6; Interconnection with National Grid Co. distance and name of nearest grid, voltage level (single line diagram)*

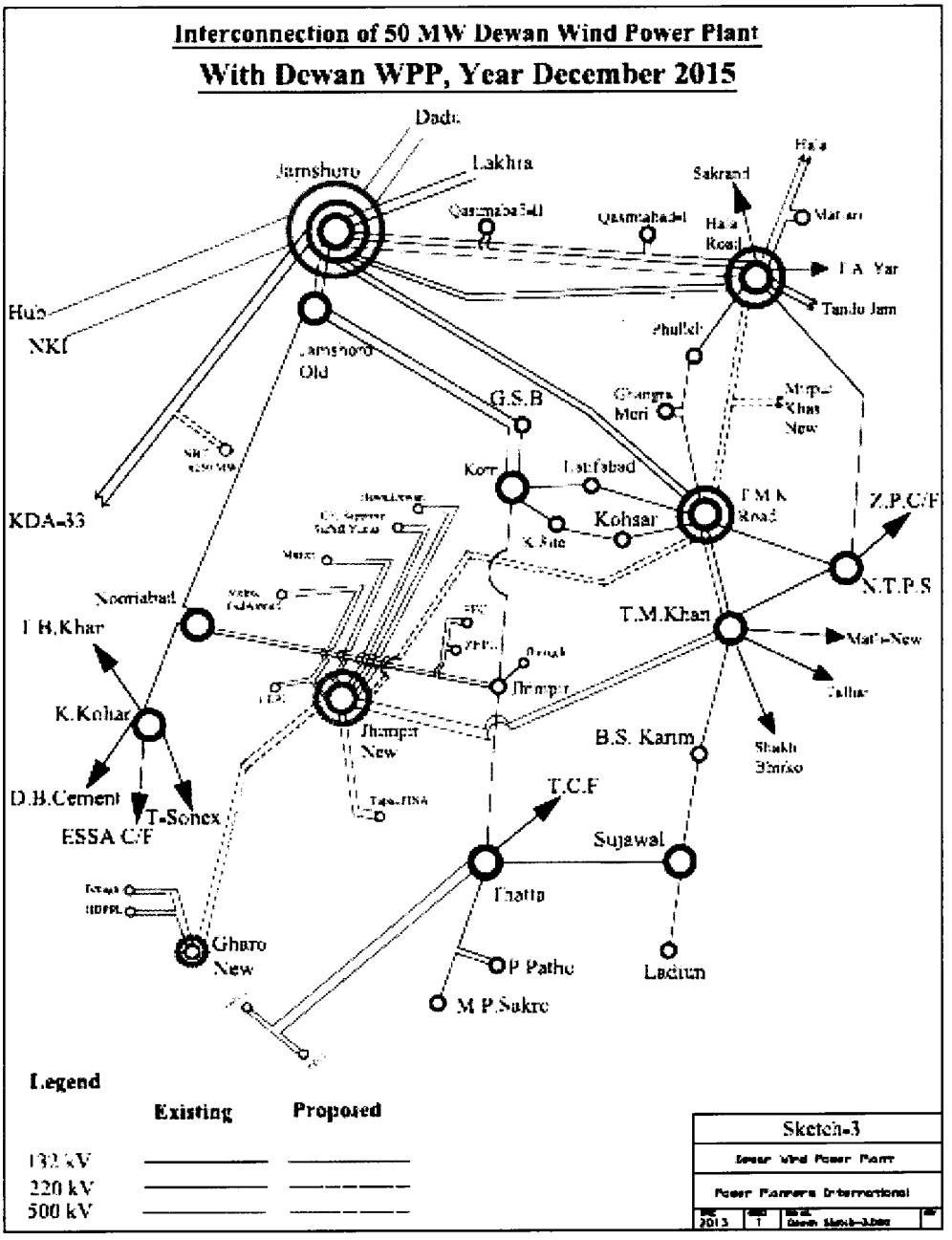
Project will be connected to 220/132KV Jhimpir-New grid station. Approximate distance from project site to Jhimpir New Grid station is 17KM. Final route/distance of transmission line has not been confirmed by NTDC.

Name of nearest grid	:	Jhimpir-New
Voltage level	:	132kV
Single Line diagram	:	Annexure C.1 & Annexure C.2

Single Line Diagram of Electrical System of Wind Farm



Schematic Diagram for Interconnection/Transmission Arrangement for Dispersal of Power from the Project



INTERCONNECTION
ARRANGEMENT FOR DISPERSAL OF POWER
FROM THE WIND FARM

- The power generated from the Wind Farm (WF) shall be dispersed to the Load Center/Ring of NTDC, at 132 KV voltage level.
- Project would be connected by a double circuit of 132kV looping in-out with a sub cluster already connecting 50MW HAWA Wind Power Plant to Jhimpir-New 132kV collector substation.
- Any change in the final Interconnection and Transmission Arrangement(s), for the dispersal of power other than the above, as agreed among Project Company, NTDC and HESCO shall be communicated to NEPRA in due course of time.

SCHEDULE-II

The Installed/ISO Capacity (MW), De-Rated Capacity at Mean Site Conditions (MW), Auxiliary Consumption (MW) and the Net Capacity at Mean Site Conditions (MW) of the Generation Facilities of Licensee is given in this Schedule

SCHEDULE-II

1	Total Installed Capacity of the plant (Gross ISO)	49.60 MW
2	De-rated Capacity at Mean Site Conditions (on account of Air density, humidity, temperature, Wake effect, wind direction, rain etc)	46.31 MW
3	Auxiliary Consumption & EBOP losses	1.80 MW
4	Total Net Capacity of the Plant at Mean Site Conditions	44.51MW

Note:

All the above figures are indicative as provided by the Licensee. The Net Capacity available to NTDC for dispatch and provision to purchasers will be determined through procedures contained in the Agreements or Grid Code.

Detail of Generation Facility/Wind Farm

A. General Information

i.	Name of Applicant Company	Jhimpir Power Private Limited (formerly Dewan Energy Private Limited)
ii.	Registered/Business Office	Ground Floor, OICCI Building, Talpur Road, Karachi
iii.	Plant Location	District Thatta, Sindh
iv.	Type of Generation Facility	Wind Power

B. Wind Farm Capacity & Configuration

i.	Wind Turbine Type, Make & Model	GE 1.6-82.5-50Hz
ii.	Installed Capacity of Wind Farm (MW)	49.6 MW
iii.	Number of Wind Turbine Units/Size of each Unit (KW)	31 x 1.6 MW

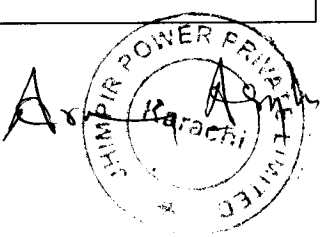
C. Wind Turbine Details

a. Rotor		
i.	Number of Blades	3
ii.	Rotor Speed	9 – 18 rpm
iii.	Rotor Diameter	82.5 m
iv.	Swept Area	5346 m^2
v.	Power Regulation	Combination of blade pitch angle adjustment, and generator/converter torque control.
vi.	Rated power at	12 m/s (air density = 1.225 kg/m^3)
vii.	Cut-in Wind Speed	3.5 m/s 10minute average
viii.	Cut-out Wind Speed	25 m/s 10minute average
ix.	Survival Wind Speed	40m/s 10minute average & 56m/s 3second average
x.	Pitch Regulation	Electric motor drives a ring gear mounted to the inner race of the blade pitch bearing
b. Blades		
i.	Blade Length	40.3 m
ii.	Material	Fiber glass enforced epoxy resin
iii.	Weight	6100 kg
c. Gear Box		
i.	Type	Multi-stage planetary
ii.	Gear Ratio	1:107.368
iii.	Weight	15,800 kg
iv.	Oil Quantity	300 – 450 litres
v.	Main Shaft Bearing	Roller bearing mounted in a pillow-block housing arrangement
d. Generator		
i.	Power	1,600 kW
ii.	Voltage	690 V
iii.	Type	Doubly-fed induction type
iv.	Speed	Range: 1000-2090 rpm; Synchronous Speed: 1500 rpm; Speed at rated power: 1800 rpm
v.	Enclosure Class	IP 54
vi.	Coupling	Flexible coupling
vii.	Efficiency	≥97%
viii.	Weight	8,450 kg

ix.	Power Factor	±0.9
e. Yaw System		
i.	Yaw Bearing	Roller Bearing
ii.	Brake	Planetary yaw drives (with brakes that engage when the drive is disabled)
iii.	Yaw Drive	4 planetary yaw drives
iv.	Speed	0.5degrees/sec
f. Control System		
i.	Type	Automatic or manually controlled
ii.	Grid Connection	Via back-to-back AC-DC-AC power electronics converter connected to rotor winding
iii.	Scope of Monitoring	Remote monitoring of more than 300 different parameters, e.g. temperature sensors, pitch parameters, speed, generator torque, wind speed & direction, etc.
iv.	Recording	Production data, event list, long & short term trends
g. Brake		
i.	Design	Three independent systems, fail safe (individual pitch)
ii.	Operational Brake	Aerodynamic brake achieved by feathering blades
iii.	Secondary Brake	Mechanical brake located at the output (high-speed) shaft of the gearbox
h. Tower		
i.	Type	Cylindrical tubular steel tower
ii.	Hub Heights	Tubular tower 80 m

D. Other Details

i.	Project Commissioning Date (Anticipated)	December 31st 2015
ii.	Expected Life of the Project from Commercial Operation Date (COD)	20 Years



Check List for Examination of License Application
For New Generation Facility (Wind)
(Regulation 3 read with 3(6)(A) of AMPR)

Name of Company	: **M/s Jhimpir Power Private Limited** *(former Dewan Energy Private Limited)*
Capacity	: 49.60MW, Wind power plant

Annexure D: *Point 7; Infrastructure: roads, rail, staff colony, amenities*

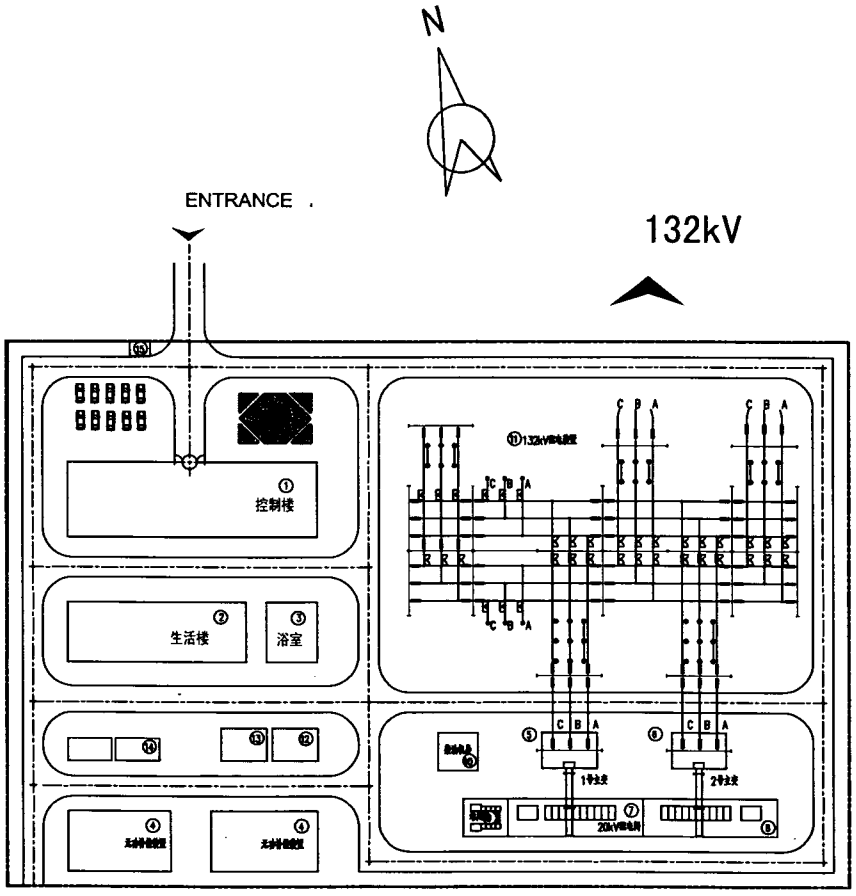
Staff colony	:	Annexure D.1
Project layout	:	Annexure D.2

Z-02

设计证书221001815

A LIST OF BUILDINGS & STRUCTURES

①	MAIN COMTROL BUILDING
②	LIVING AREA
③	SHOWER ROOM
④	REACTIVE POWER COMPENSATION
⑤	1# MAIN TRANSFORMER
⑥	2# MAIN TRANSFORMER
⑦	1# 270KV DISTRIOUTON OF THE HOUSING
⑧	2# 270KV DISTRIOUTON OF THE HOUSING
⑨	SWITCH BOARD ROOM
⑩	DIESEL ENGINE
⑪	132KV VOLT POWER DISTRIBUTION DEVICE
⑫	FIRE PUMP HOUSE
⑬	FIRE POOL
⑭	SEPTIC TANK
⑮	GUARD



note: The design of substation of the total land area of 18309.4305m^2 (168.3584m x 108.7527m)

序号	日期	修改内容摘要	修改	校核	批准

大连东电电力设计有限责任公司
DALIAN DONG DIAN ELECTRIC POWER DESIGN LTD.

工程 | 设计阶段

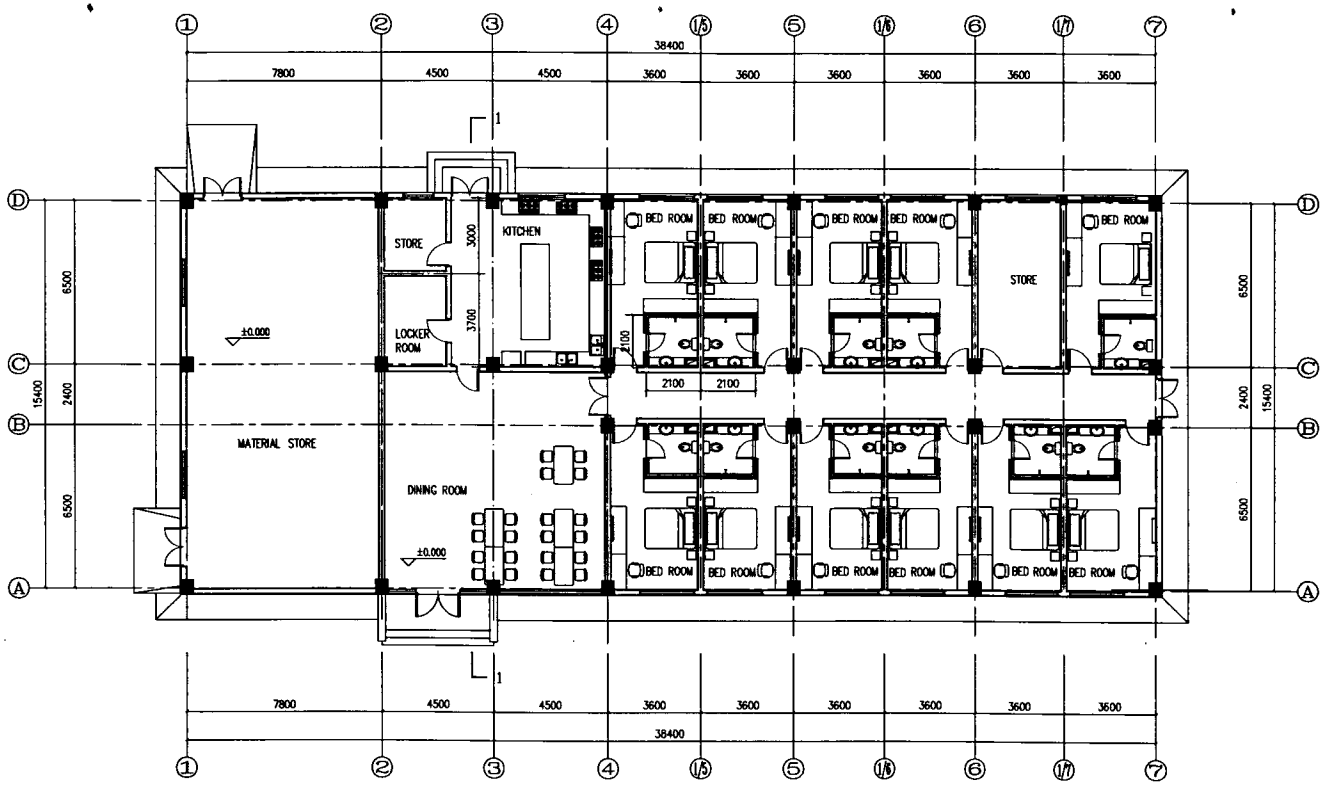
批准		校核	
审核		设计	
日期	年 月 日	比例	

GENERAL LAYOUT DRAWING

图号 Z-02

专业	会签	日期

File Name



±0.000m PLAN

CENTRAL SOUTHERN CHINA ELECTRIC POWER DESIGN INSTITUTE	
PAKISTAN DEHRAN SOMN WIND FARM	BIDDING
APPROVED BY	
REVIEWED BY	
CHECKED BY	LIVING AREA ±0.000m PLAN
DESIGNED BY	
DATE / SCALE / DRG No	AN2012005-T-03

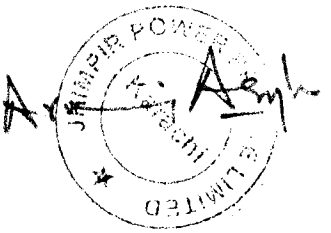
594X841

Check List for Examination of License Application
For New Generation Facility (Wind)
(Regulation 3 read with 3(6)(A) of AMPR)

Name of Company : **M/s Jhimpir Power Private Limited**
(former Dewan Energy Private Limited)
Capacity : 49.60MW, Wind power plant

Annexure E: *Point 8; Project cost, information regarding sources and amounts of equity, debt*

Project Cost	:	Up to US$ 135.3 million
Debt from OPIC	:	Up to US$ 101.5 million (Annexure 6A & 6B)
Equity	:	Up to 33.8 million

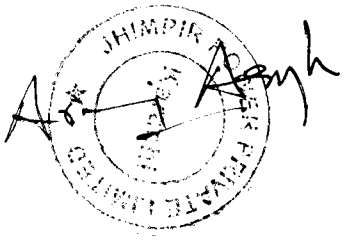


Check List for Examination of License Application
For New Generation Facility (Wind)
(Regulation 3 read with 3(6)(A) of AMPR)

Name of Company	: **M/s Jhimpir Power Private Limited** *(former Dewan Energy Private Limited)*
Capacity	: 49.60MW, Wind power plant

Annexure F: *Point 9; Project commencement and completion schedule with milestones*

Project Construction Commencement	:	1st September 2014
Completion schedule with milestone	:	Annexure F.1



Dewan Wind Project Schedule

Month / Project	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
received the soil investigation data	1																
Order of equipment			1.5														
design				5.0													
Equipment delivery									6.0								
Construction preparation				2.0													
1#-11# WTG foundation						3.0											
12#-21# WTG foundation								3.0									
22#-31# WTG foundation										3.0							
1#-11# WTG erection											2.0						
12#-21# WTG erection												2.0					
22#-31# WTG erection													2.0				
Checking, debugging													2.0				
WTG commisioning															4.5		
Substation civil construction										9.0							
132KV Equipment installation										5.5							
132kv Substation Commissioning													2.0				
MV cable line in wind famer										5.0							
road in wind famer										6.5							
run test and TOC																	1

Remark: before 12th month , transmission line connected to gird need to be completed by the Owner

JHIMPIR POWER PRIVATE LIMITED Karachi

ENVIRONMENT AND SOCIAL RESPONSIBILITY

1. GENERAL

As per the requirements of Section 12 of Pakistan Environmental Protection Act (PEPA), 1997, Jhimpir Power Private Limited *(formerly Dewan Energy Private Limited)* (the "**Project Company**") has completed the Initial Environmental Examination ("**IEE**") report for 50MW wind power project (the "**Project**") in Jhimpir (the "**Project Site**"). Project Company engaged ECTECH Environment Consultants to determine the social & environmental impact on environment due to installation of a wind farm in the Jhimpir area..

The key environment related issues identified for detailed evaluation were;

- Collisions of migratory birds /avian impact
- Noise
- Health and safety
- Shadow
- Visibility
- Atmospheric emissions
- Clearing of land for road and building construction
- Delivery of equipment at site
- Foundations of tower and cranes construction
- Tower assembly and installation
- Wild life disturbance
- Maintenance activities at later stages
- Global environment issues
- Historical heritage
- Solid waste management

Based on the study, it was concluded that the intensity of all possible impacts varies between minor to medium, and Project activity has no probable environmental degradation in the Project area.

The comprehensive IEE report highlights the policy, legal, and administrative framework applicable on the Project. The methodology for anticipating environmental impacts during construction and operational phases was also evaluated.

2. THE SITE

2.1 General

The Project Site for the proposed wind farm is located in the Indus delta at a distance of approximately 110 km along the Super highway from Karachi to Hyderabad. The Project Site is a barren tract of land with small scanty bushes scattered here and there. Human settlements in the form of small villages (Goths) are situated far off from the Project Site. There are no endangered habitats, parks, forests, wildlife, estuaries, historical or cultural resources within the area of influence of the Project.

2.2 Geological Setting

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 Karachi-Jati-Allah Bund Fault. The main faults between Karachi and Rann of Kutch are generally easterly oriented and slightly concave to the north. Project Site doesn't fall under the fault line hence it is

safe from earthquake effects. The damage Zone classification of the Thatta Region, where the WF site is located, is in Zone II b (moderate to severe damage) and the G factor is g=0.1-0.3.

2.3 Soils

The land in this area consists of alluvial soil deposited by the waters of the river Indus, so it is naturally very fertile. Combined with water it develops into rich mould and in the absence of water it degenerates into desert.

2.4 Temperatures, Humidity, & Rainfall

Average temperature in the Project area is 28°C. Temperatures in the Project area frequently rise above 46 C (115 F) between May and August, and below 2°C (36 F) between December and January. July, August, and September are the most humid months in the area, whereas May and June are the least humid months.

Average annual rainfall in the Project area ranges between 110 mm (Jacobabad) and 222 mm (Badin). Maximum rainfall (about 60% of the total annual) occurs during the Monsoon season (July, August, and September), while the period of minimum rainfall or drier period is October and November.

3. AIR QUALITY

Environmental monitoring on site ambient was carried out to assess the state of environment on the Project Site. It is expected that during construction and operations, there will be some environmental pollution. Sponsors are determined to take all the necessary measures according to the guidelines of National Environmental Quality Standards ("**NEQs**") and National Environmental Quality Standards for Ambient Air ("**NEQSAA**") 2010, National Environmental Quality Standards for Drinking Water Quality ("**NEQSDW**") 2010, and National Environmental Quality Standards for Noise ("**NEQSN**") 2010 to handle such specific environmental pollutants. Implementation of the proposed EMMP further guarantees protection of the environmental settings as they exist now. During operation, the wind farm will work as a pollution free power plant and contribute to power generation without emitting a single gram of GHG gases.

4. WASTE DISPOSAL

The wind power plant does not generate any waste whether it is gaseous, liquid or solid hazardous chemicals during its construction & operation. The issue of disposing off the normal spent lubricants in very limited quantities is not of any significant concern. There are standard practices to dispose of these lubricants and the Project Company will follow the same. The packing material is largely re-usable.

5. WATER USE & QUALITY

The Project requirement of water for drinking, domestic purposes, and for foundation construction will not have any impact on groundwater resources. The roads within the wind farm will be developed such that the natural drainage pattern will not be impeded. It is in the betterment of the Project that the natural drainage of the site will remain un-changed so that during rains, there should be good slope available for effective surface rain water flow.

6. IMPACT ON BIRDS

One of the significant issues for installing wind masts can be related to the migratory birds' and their collision with the wind turbines and associated infrastructure. According to a survey conducted by WWF in 2009; the quantum of birds in and around Keenjhar Lake has reduced drastically. By nature, local birds avoid wind turbines by flying around them, and migrating birds tend to fly well above the height of wind turbine. These birds have tendency to fly at an altitude of 400 to 500 meters and turbine blades will be at around 120 meter height from the ground level, hence, there is no chance of collision with the wind towers & turbine blades at the Project Site.

7. AVIATION HAZARD

No aviation hazard will be created by the Project as it is located 110 km from the nearest airport at Karachi. Moreover, the hub height of the wind turbine will be only around 80m, not posing any hazard to the aircrafts. In addition, the towers will be provided with air traffic warning lights to make the structure more visible / detectable at night.

8. NOISE

Noise of wind turbine and background noise level increases with the increase in wind speed. However, noise level is at a low level when wind turbines cut-in. Noise generation from most of the wind turbines (running at full swing) is estimated to be less than 45dB(A). With the increase in distance between the source and receptor, the noise level decreases. No potential threat was established. Noise of wind turbines will be kept within the parameters given in NEQSN.

9. SHADOW/FLICKERING EFFECT

Rotating rotor blades make moving shadows during sun shine and normally affect the visibility close to the turbine, whereas shadow may spread over long distance on a sunny day, which may be inconvenient for the people around. Correct positioning of wind turbines, and a minimum distance from dwellings will suffice to avoid this problem. The distance between the proposed wind farm Site and the nearest population village (Goth) is about 3 km, therefore, shadow/flickering effect will not have any adverse impact on the local population..

10. VISIBILITY

Wind turbines comprise of large structures. Surveys conducted indicate that by and large, majority of the local people were in favor of development of wind power plants. Local residents are used to the visibility of tall towers as 2 wind power projects 50MW each are already operating in the area, and a number of meteorological masts are also installed, therefore the new wind farm will not create unpleasant situation for the local residents. Under the given situation severity of this issue is categorized as low.

11. LAND CLEARING FOR ROADS AND BUILDING CONSTRUCTION

Indiscriminate removal of bushes and shrubs will be avoided and will only be restricted to those areas where civil work is required. The severity of this issue is categorized as low.

12. TRANSPORTATION ROUTE OF EQUIPMENTS AT SITE

The imported equipment will be transported from Port Qasim to the Project Site. Of the two different modes of transportation – rail & road - the road route is preferable on the basis of technical limitations. Presently available road infrastructure is stable and can accommodate the expected traffic from Project activity. The severity of this issue can be categorized as moderate to low.

13. FOUNDATION CONSTRUCTION -TOWER AND CRANES PLATEFORM

Approximately 20m x 30m area will be leveled and compacted for the cranes at each turbine site. Heavy duty cranes will be used to lift the tower sections & wind turbine generator. During construction of tower foundations & crane platform, topsoil will be stripped off and stored separately from the subsoil. After installation of wind turbines, the subsoil will be used as backfill which will be covered by stripped off topsoil, thus completing the backfilling rehabilitation work. Damage to vegetation will be minimized by restricting the earth based activity to the minimum possible area. The severity of this issue can be categorized as moderate to minimal.

14. HISTORICAL HERITAGE

There are no formally registered sites of historic or historic archaeological significance at Jhimpir Site. During geo-technical investigations no archaeological findings were observed. The nearest ones, which are far away from project site, are Bhambhore, Amri, Harappa & Mohenjo-daro.

15. RESETTLEMENT

No resettlement is required as the Project is located on Government-owned barren land. Settlements and individual dwellings in the local area are located at least 3 - 4km away, thus the development will not require any rehabilitation or resettlement. Moreover, the project will not cause any negative effect on the population as there will be no emissions.

16. SOCIAL RESPONSIBILITY

Project Company always regards corporate social responsibility as an important force in building a harmonious society, and is committed to develop a Corporate Social Responsibility Plan to ensure that its daily activities adhere to a set of morals and respect for people and the environment. It also believes in paying full attention to human factors, exercising environmental protections and conservation, increasing employment, and helping build the community.

Being a responsible corporate citizen, Project Company firmly believes in giving back to the communities it operates in and provides support and encouragement to the people who need it the most. Every year Project Sponsors support numerous educational, sporting, and charity programs designed to help a wide range of people. Sponsors have always shown commitment and support for public health & education, and have participated in awareness initiatives.

The people of the area believe that installation of the power plant in their area will open up numerous employment opportunities, especially during construction, which in turn follows a chain of indirect socio-economic benefits. Either directly or indirectly, a reasonable number of local people will get employment and business from the installation of the Plant, e.g. shop keepers, traders, suppliers, contractors, transporters, technicians etc. Operations of the Plant will also provide job opportunities especially to the local people. Poverty alleviation, though at minor scale, will be a benefit besides meeting power shortage in Pakistan.

CONCLUSION

The proposed Project is not likely to have any significant adverse environmental impacts which could be irreversible or could affect sensitive eco-system. Involuntary resettlement will not be required because of the Project construction & operation; the Project has no gaseous and PM emissions. The Project is also not located in the vicinity of sensitive location of national importance. Therefore, Project falls under Category "B" according to "Pakistan Environmental Protection Agency, Review of IEE & EIA Regulations 1997/2000 (revised)".

Sindh Environmental Protection Agency has issued No Objection Certificate ("NOC") to the Project Company on January 07, 2013.

* * *

Reference No: EPA/2012/12/03/IEE/53

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: 07-01-2013

DECISION ON INITIAL ENVIRONMENTAL EXAMINATION (IEE).

1. **Name & Address of Proponent:** Mr. M Zaki
Company Secretary,
M/s Dewan Energy (Pvt) Limited
Registered & Corporate Office: 7th Floor,
Finance & Trade Centre
Shahrah-e-Faisal, Karachi.

2. **Description of Project:** 49.5 MW Wind Power Project

3. **Location of Project:** Jhimpir, District Thatta, Sindh.

4. **Date of Filing of IEE:** 03-12-2012

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Rafiuddin
Director General

Check List for Examination of License Application
For New Generation Facility (Wind)
(Regulation 3 read with 3(6)(A) of AMPR)

Name of Company	: **M/s Jhimpir Power Private Limited** *(former Dewan Energy Private Limited)*
Capacity	: 49.60MW, Wind power plant

Annexure H: *Point 11; Safety plans, emergency plans*

Project Company will adopt EPC Contractors 'Environment, Health and Safety Management Manual'.

Environment, Health and Safety Management Manual Annexure H.1

Environment, Health and Safety Management Manual

Compiled by: Lin Bo, Jin Gangzhu, Chen Yingjie

Examined by: Wu Xiaoying

Reviewed by: Yang Qingli

Approved by:

Approval Order

"*Environment, Health and Safety Management Manual*" was compiled under direction of management representative, in accordance with requirements of OHSAS 18001-2007 and Standard GB/T 2004-2000 idt ISO 14001:2004, relying on operational characteristics and managerial experiences of the Company.

"*Environment, Health ad Safety Management Manual*" is a guidance document for the operation of EHS (Environment, Health and Safety) management system. In order to fulfill EHS policy and objectives of the Company, all employees are required to abide by requirements in this Manual, during operation of the EHS management system.

General Manager:

1st June, 2009

Notice on Appointing Yang Qingli as Management Representative of HPE

Ministries, institutions, and oversea offices:

I hereby appoint deputy general manager Yang Qingli as management representative of HPE, who is responsible for the Company's environmental, health and safety management, with the following responsibilities and authorities, in additional to his current duties:

1. Establishment, execution and maintenance of Environment, Health and Safety (EHS) management system for Harbin Power Engineering Company Limited according to requirements of relevant standards;
2. Reporting operating conditions and performance of EHS management system to top management, for further evaluation and as basis for improvement of the EHS system;
3. Offering suggestions on improvement of the EHS management system to top management;
4. External affairs related to EHS management system.

General Manager:

1st June, 2009

I. EHS Policy

To Observe Disciplines and Abide by Laws　Prevention First　To Care for Employees

To Optimize the Environment　To Ensure Safety　Continuous Improvement

II. OHS Objectives

To eliminate conflagration and explosion accidents;

Zero major or fatal accident;

Incidence rate for minor injuries: lower than 5‰

III. Environmental Objectives

No major environmental pollution accident;

All purchased equipment and products meeting environmental protection requirements;

Vehicular emission meeting local environmental protection standards;

General Manager: 

1st June, 2009

As a subsidiary of Harbin Electric Corporation, Harbin Power Engineering Company Limited (HPE for short) is a key supplier and exporter of complete sets of large-scale power equipment, as well as a general contractor of power plant projects. In 2007, it ranked the 102nd in ENR's Top 225 International Contractors. Currently, with 6 oversea offices, HPE is mainly involved in EPC contracting of thermal, hydro and combined cycle power plants and equipment engineering, as well as engineering of power transmission and transformation facilities & utilities related to power plants.

HPE is the first professional power engineering company in China, which has passed the certification of ISO 9001 Quality Management System. Its environmental, health and safety (EHS) management system has been established for implementation based on OHSAS 18001-2007 and standard GB/T 24001-2004 idt ISO 14001-2004. The Company not only has world class project management technology, but has adopted advanced P3 project management software, PMS software and international-standard construction, so that to realize network management of projects.

As an export company of complete sets of large-scale power equipment in China, HPE is capable to undertake several good-sized power projects simultaneously. Moreover, the Company has maintained long-term technical cooperation and communication with world famous foreign companies, and jointly contracted many large power projects.

For more than two decades, HPE has extended its business to many countries, including Pakistan, Philippines, Vietnam, Iran, Bengal, Kampuchea, Sudan, India and Indonesia, etc. Up till now, HPE has undertaken multiple large turn-key projects and supplied a large number of complete sets of power equipment, with a total installed capacity of more than 13,000MW, which have won great international reputations for the Company.

HPE is expecting to establish wide cooperation with various circles both domestically and abroad, so as to provide more top-quality services for clients.

Add: Block B, No.39, Sandadongli Road, Xiangfang District, Harbin, China
P.C: 150040
Phone: +86 (451) -82136688
Fax: +86 (451) -82135566 +86 (451) -82682279
Web: http://www.chinahpe.com
E-mail: hpe@hpechina.com

1. Final Review and Approval

Before issuance, the Environmental, Health and Safety Management Manual (hereinafter referred to as "EHS Manual") should be reviewed by the director of Quality Control Department, examined by management representative and approved by general manager, to guarantee its legibility, accuracy, applicability and reasonableness of structure. Each version shall be attached with an approval order signed and issued by the general manager.

2. Distribution of EHS Manual

EHS Manuals should be sequentially numbered and distributed to all relevant employees in each department of the Company. Recipients are required to sign their names in document receiving/distribution record.

3. Coordination of Changes

Modification, revision and supplementation of EHS Manual, in the charge of director of Quality Control Department, should be reported to management representative for review, and go through the same approval process with EHS Manual compilation.

4. Issue and Change Control

In order to maintain effectiveness of the existing EHS Manuals, modification pages of the EHS Manuals should be clipped between the current Manuals, after the holders sign their names for receipt. Alternatively, table of contents and loose leaves may be used to ensure that the modified EHS Manuals are approved.

5. Reclaim Control

When the holder of an EHS Manual is transferred to another department or leaves the

Company, he/she shall go through hand-over formalities in the original distribution department.

6. Non-Controlled Version

EHS Manuals provided to clients for tendering or distributed for other purposes should be taken as non-controlled versions and marked with "Non-Controlled", if change control is not necessary. But issue numbers for such EHS Manuals are required.

7. Version Number of EHS Manual

Version number of this EHS Manual is HPE-15-A101 and its revision number is 0. If the version is changed, version number and revision number shall be recompiled.

8. English Version of EHS Manual

Quality Control Department should cooperate with relevant employees of the Company to provide an English version of the Chinese EHS Manual.

1. Objective and Application Scope

1.1 Objective

In order to provide clients with better EPC contracting services for power plant construction projects, equipment engineering services, and power engineering services, as well as utilities engineering services related to power plants, to implement systematical standardized control and management on environment, health and safety in the whole service process, HPE will establish and execute an EHS management system and guarantee its maintenance and continuous improvement, in accordance with requirements of OHSAS 18001-2007 and Standard GB/T 24001-2004 idt ISO 14001:2004.

1.2 Application Scope

1.2.1 This Manual includes all requirements in OHSAS 18001—2007 and GB/T 24001—2004 idt ISO 14001:2004.

1.2.2 The Manual is applicable to products, departments and workplaces covered by the EHS management system, including project construction sites, as well as products and services provided internally or externally (including certification authority), to evaluate or confirm the Company's capability to satisfy client demands.

1.2.3 Products Covered by this Manual:

Power projects EPC contracting services, EPC contracting services of power transmission and transformation projects, equipment engineering services, power plant engineering services and utilities engineering services related to power plants;

2. Normative Quoted Documents

Articles in the following documents are quoted in this Manual and become part of it. If a quoted document is dated, the modified (excluding contents in corrigendum) or revised versions will not be applicable to this Manual, but parties involved in agreements concluded under this Manual are encouraged to study applicability of the latest versions of such document. If a quoted document is not dated, its latest version will be applicable to this standard.

OHSAS 18001—2007 Occupational Health and Safety Management Systems-Requirements

GB/T 24001—2004 Environment Management Systems-Requirements with Guidance for Use

3. Terms and Definitions

Terms and Definitions adopted in this Manual are in accordance with GB/T 24001:2004 "*Environmental Management Systems-Requirements with Guidance for Use*" and OHSAS 18001:2007 "*Occupational Health and Safety Management Systems-Requirements*".

3.1 Client

An organization, whose construction project is entrusted to a construction company in the form of agreement or contract, including authorizer of a construction company, also known as "development organization", "owner", "Party A" or "buyer" etc. in construction activities;

3.2 Engineering, Procurement, Construction (EPC)

Entrusted by Client, general contractor's contracting for the whole process or several phases of a project, in terms of design, procurement, construction and trial operation, etc., in accordance with relevant contracts;

3.3 Project Manager

An entrusted agent of corporate representative for an EPC project;

3.4 Project Department

A project management organization, set up under the leadership of Project Manager, with authorization and support of corporate representative from general contracting company;

3.5 Subcontractor

An organization, with qualification in project subcontracting and capable to undertake part(s) of engineering services and labor services, agreed in relevant contract(s) or agreement(s) and approved by the Company; a kind of "supplier" mentioned in relevant standards, also known as subcontracting organization or subcontracting party;

3.6 Interested Parties

Client, supervisor, design institute, government supervision organization, employees, family members of employees, shareholders, contracting parties, and external personnel,

etc., with the permission to entering a workplace;

3.7 Design

The process of transforming an owner's requirements into project product descriptions; or the process of compiling design documents for construction projects in accordance with contract requirements;

3.8 Procurement

The process of acquiring goods or services from outside of an organization, for fulfillment of a project, including equipment and material procurement and procurement of design, construction, and labor service, etc.

3.9 Casualty Accidents to Staff and Workers

Personal injuries or acute intoxication accidents to staff and workers, when they are working in their own positions; accidents to staff and workers due to unsafe equipment and facilities or undesirable work conditions and working environment, when they are not working in their own positions;

3.10 Occupational Diseases

Diseases caused by laborers' exposure to dusts, radioactive substances, or other toxic and hazardous substances, etc. during their vocational activities.

4. EHS Management System

4.1 General Requirements

Environmental, health and safety management system (EHS management system) is an indispensable component for the whole management and operation of the Company. EHS management activities are deemed as an essential content of HPE's construction for a people-oriented harmonious enterprise. Top management promises to establish an EHS management system, in accordance with requirements of GB/T 24001-2004 "*Environmental Management Systems-Requirements with Guidance for Use*" and OHSAS18001-2007 "*Occupational Health and Safety Management Systems-Requirements*", relying on actual situation of the Company, so that to get major hazard sources and environmental factors under control, and eliminate or reduce environmental impact on the Company's operating activities, power plant products and EPC contracting services, as well as losses caused by OHS risks, by formulating and executing EHS policy, objectives and management schemes. The EHS management system, which is in a dynamic and circular process of "planning, implementing, checking and reviewing", will keep operating for continuous improvement of the Company's EHS management performance. And harmonious development of the enterprise, environment and people will be realized by joint efforts of all employees.

4.2 EHS Policy

EHS policy of HPE is:

To Observe Disciplines and Abide by Laws Prevention First To Care for Employees

To Optimize the Environment To Ensure Safety Continuous Improvement

4.2.1 General Principle

EHS policy is the aim and operating criterion of EHS management system of the Company, as well as a commitment made by the Company in terms of abidance by laws and regulations and continuous improvement of EHS performance. Moreover, as an environmental and safety criterion which must be observed by all employees, EHS policy also provides a framework for establishment and implementation of the Company's EHS

management system and formulation of review objectives and indices.

4.2.2 Implications of EHS policy are as follows:

HPE is mainly engaged in EPC contracting services of power projects, power transmission and transformation engineering services and equipment engineering services domestically and abroad, as well as power engineering services and utilities engineering services related to power plants.

Abiding by national and local laws and regulations in host countries on environmental, health and safety protection is a precondition for the development of the Company's production and operating activities. Establishment of EHS management system for standardized management fully embodies HPE's determination of eliminating all hidden OHS hazards by taking preventive measures for safe construction, based on the philosophy of "Safety First, Precaution Crucial".

To control and prevent risks in construction, from equipment and raw material procurement to project final acceptance; to attach importance to health and safety protection of employees and constructors, so that to guarantee safe and civilized construction; to select qualified construction organizations with advanced technology, excellent equipment, and satisfactory construction safety management capabilities via scientific management; and to effectively control hazard sources and prevent the occurrence of OHS accidents, based on sufficient safety input and safety technical measures, as well as necessary labor protection products;

HPE promises to take measures to control dusts, sewage, noise and other elements which may cause undesirable impacts on the environment, generated during construction process, under the premise of observing laws and regulations, and to minimize harms and save water, electricity and raw materials.

To raise employees' safety awareness and environmental protection consciousness through trainings; to transform from "require me to be safe" into "I want to be safe"; to reduce environmental pollution in operating activities; and to develop health, safety and

environmental protection into conscious activities of all employees through joint participation;

Prevention first, prevention is better than cure; continuous improvement is an eternal theme of company development; to achieve sound development of health, safety and environment by identifying and controlling major hazard sources and major environmental factors, restricting violation behaviors in accordance with laws and regulations, and discovering and making up for deficiencies in management through internal review and management review.

4.2.3 Requirements on "Policy" management are as follows:

Top management is responsible for formulation of to the Policy; management representative is in charge of revision and review of the Policy and employees' opinions collection. The Policy must be approved by general manager prior to its issuance and taking effect.

Management representative takes charge of publicity of the Policy among all employees, by means of document distribution, meetings, bulletin board and trainings, etc.

Quality Control Department is responsible for trainings of the Policy and relevant documents for all employees, so as to ensure thorough understanding of the Policy.

During management reviews, suitability of EHS Policy will be reviewed. If necessary, the Policy should be renewed or revised.

The Company may promote its environmental and safety policy among interested parties, through advertising pages and slogans, etc.

Encourage interested parties to improve their EHS operations by exerting influence.

4.3 Planning

4.3.1 Hazard Sources and Environmental Factors

4.3.1.1 Hazard Source Identification, Risk Evaluation, and Control Measure Determination

The Company should formulate and maintain "*Control Procedures for Hazard Source Identification and Risk Evaluation*", to identify, evaluate and control hazard sources in

activities, products or services of the Company.

4.3.1.1.1 Methods for hazard source identification and risk evaluation should be determined according to scope, property and realization of risks. Priority ranking of risk identification and determination should be regulated in the Procedures and documented.

4.3.1.1.2 Hazard source identification: is involved in operations, products and services of the Company, as well as supervisions during construction processes of subcontractors.

4.3.1.1.3 Risk evaluation: carrying out qualitative and quantitative evaluations for existing risks according to needs, by means of direct judgment or LEC method.

4.3.1.1.4 Major hazard sources: hazard sources at variance with laws and regulations; hazard sources having caused accidents but still with no effective measures; hazard sources directly observed; hazard sources with Grade I or Grade II risks according to LEC Method.

4.3.1.1.5 Quality Control Department is responsible for organizing Project Department and other relevant departments to analyze, generalize and evaluate all hazard sources, determine major hazard sources and submit results to management representative for approval.

4.3.1.1.6 Considerations on identification and evaluation of hazard sources:

(1) Routine activities of the Company: such as routine work, power project EPC contracting, equipment engineering, power engineering and utilities engineering services related to power plants;

Non-routine activities: temporary or unexpected activities, contingent activities;

(2) Activities of personnel (including personnel of subcontracting organizations and visitors) entering workplaces (office area, and particularly, construction site);

(3) Human behaviors, human abilities, and other human factors, such as personnel activities, and abilities required by relevant activities, for example, knowledge on occupational contraindication;

(4) Identifying hazard sources from outside of workplace, possible to cause adverse impact to the health and safety of personnel within the workplace controlled by the Company; OHS in this Manual does not involve earthquake, typhoon, torrential flood, mud-rock flow and

other natural disasters or political factors, such as kidnapping, terrorist attack, etc.;

(5) Hazard sources (also known as environmental factors), in surrounding area of a workplace, caused by activities related to operations under the control of the Company, include but are not limited to major hazard sources around workplaces, which may cause harm to personnel entering the workplaces, such as oil depots, chemical plants, and production or storage places of hazardous chemicals, etc.;

(6) All infrastructures, equipment and materials within workplaces, such as large construction equipment in construction sites, roads leading to construction sites, and storage of construction materials, etc.;

(7) Changes in organization structure, products or materials, or change of proposals;

(8) Modifications on OHS management system, including temporary changes, and their influences on operations, processes and other activities.

(9) Legal requirements related to risk evaluation and implementation of necessary control measures, for instance, changes in laws and regulations may cause new risks;

(10) Management and control requirements on planning and selection of work areas, processes, facilities, machinery, and operation procedures and organization structure design, including their adaptability to personnel abilities, should be taken into full consideration;

4.3.1.1.7 Establish control measures for determined major hazard sources. If an existing control measure is decided or planned to be changed, risk reduction should be taken into consideration in the following sequence:

(1) Elimination;

(2) Replacement;

(3) Engineering control;

(4) Marking, warning or management control;

(5) Personal protective measures.

4.3.1.1.8 When any of the following situations occurs, identify relevant hazard sources

promptly or supplementarily and evaluate them to see if it is necessary to determine new major hazard sources or modify the existing major hazard sources, to ensure continuous effectiveness of the EHS management system:

(1) Adding new construction project or producing new product;

(2) Brining in new process, new product and new technology;

(3) Renewal or change of laws and regulations;

(4) Other aspects.

4.3.1.2 Identification and Evaluation of Environmental Factors

The Company should establish "*Control Procedures for Identification and Evaluation of Environmental Factors*" to determine controllable environmental factors and environmental factors, on which influences can be exerted, for the Company's activities, products and services, so that to identify major environmental factors, specify key control objects of environmental management system, and determine environmental objectives and management schemes accordingly.

Environmental factors and major environmental factors identified by the Company should be documented and updated promptly.

4.3.1.2.1 Identification of environmental factors: is involved in all aspects of the Company's operations, products and services, including controllable environmental factors and environmental factors, on which influences can be exerted.

4.3.1.2.2 The following factors should be taken into account in identification of environmental factors: past, present and further tenses; normal, abnormal and emergent states; air pollution, water pollution, wastes and by-products, light and thermal noises, vibration, soil pollution, energy utilization, consumption of raw materials and natural resources, and physical properties, such as changes in shape, size and appearance, etc.

4.3.1.2.3 Identification of environmental factors should adopt process analysis approach or assisted by field observation method.

4.3.1.2.4 Scope and degree of influence, occurrence frequency, duration, control degree,

interested parties' opinions, laws and regulations, and resources and energy consumption, etc. should be taken into consideration in evaluation of major environmental factors.

4.3.1.2.5 Direct judgment and composite grade method should be used for evaluation of major environmental factors. M=a+b+c+d+e, if M≥15, the environmental factor will be judged as a major environmental factor.

4.3.1.2.6 Formulate and execute control measures for major environmental factors.

4.3.1.2.7 Quality Control Department is responsible for organizing and leading the identification and evaluation of environmental factors, and in charge of collection and management of the Company's environmental factors, determination of major environmental factors and submitting results to management representative for approval.

4.3.1.2.8 In the following special cases, prompt identification and renewal of environmental factors in accordance with "*Control Procedures for Identification and Evaluation of Environmental Factors*" are required:

(1) Changes in relevant laws and regulations or other requirements;

(2) Changes in the Company's activities, products and services (such as adding new equipment, process modification, and new, extension and reconstruction projects, etc.).

4.3.2 Laws, Regulations and Other Requirements

Formulating and maintaining "*Control Procedures for Laws, Regulations and Other Requirements*", the Company should take full advantage of relevant channels to acquire laws, regulations and other requirements on EHS management applicable to the Company.

4.3.2.1 Department of Legal Affairs is in charge of acquiring laws, regulations and other requirements on EHS, and offering relevant information to related departments and interested parties.

4.3.2.2 Relevant functional departments should acquire necessary laws and regulations from superior departments and relevant government departments, and provide them to the Department of Legal Affairs.

4.3.2.3 Each project department is responsible for acquisition of laws, regulations and other

requirements (including laws, regulations and other requirements in host countries of foreign projects) within respective own scope of work, determining their adaptability and offering relevant information to Department of Legal Affairs of the Company.

4.3.2.4 Department of Legal Affairs should renew information on adaptability of relevant laws, regulations and other requirements promptly.

4.3.3 EHS Management Objectives, Indices and Schemes

In order to implement environmental policy and OHS policy, the Company should specify concrete objectives of EHS management involved in its operating activities, so that to fulfill its policy commitment and organizational commitment.

4.3.3.1 Basis for establishing objectives:

（1）In accordance with EHS policy of the Company;

（2）Taking advancement of technology and optional schemes into account;

（3）Expectations and requirements of interested parties, requirements of laws and regulations;

（4）Financial, operating and service requirements;

（5）Commitment on harm and disease prevention and continuous improvement;

Objectives should be operable and adjustable. If an objective is feasible, try to quantify it. For specific EHS objectives, see Chapter 0.4 of the Manual.

4.3.3.2 OHS objectives should focus on continuous improvement of occupational health and safety protective measures for employees.

4.3.3.3 Quality Control Department is responsible for routine inspection, examination and supervision of EHS management objectives, which will be issued after approved by general manager of the Company. If necessary, EHS objectives may be revised through management review.

4.3.3.4 Company objectives should be decomposed and assigned to each department and Project Department, which is in charge of decomposition, specification and implementation of respective EHS objectives.

4.3.3.5 Quality Control Department should organize personnel to measure the implementation of EHS objectives once a year; if necessary, increase measurement frequency.

4.3.3.6 Each department/project department should inspect and control fulfillment process of decomposed objectives according to the implementation of EHS management schemes. If there is any change in major hazard sources (major environmental factors), revise the objectives in due time.

4.3.3.7 Modifications and revision of Company objectives must be examined and approved by the general manager. Objectives of each department/project department shall be approved by director of the department and reported to Quality Control Department for filing.

4.3.3.8 Quality Control Department is responsible for compilation, revision and supervision of EHS management schemes of the Company, to guarantee the fulfillment of OHS objectives and environmental objectives.

4.3.3.9 Management representative is in charge of examination and approval of the Company's EHS management schemes.

4.3.3.10 Each project department should work out a filed management scheme according to Environmental, Health and Safety Management Manual of the Company, decompose safety and environmental objectives, and take charge of compilation, modification, implementation and supervision of respective management scheme.

4.3.3.11 Management scheme should include the following contents:

(1) Specification of objectives to be fulfilled, feasible measures and methods, allocation of resources, time limit and schedule;

(2) Determining the departments responsible for implementation of each requirement;

(3) EHS management scheme should be operable and achievable;

4.3.3.12 Quality Control Department should examine the completion of EHS management scheme, according to requirements of the scheme, report and record the results in time.

4.3.3.13 If there is any major change in EHS objectives, indices, or other objective conditions, each corresponding functional department should organize relevant departments for

modification or supplementation of EHS management scheme, and examination and approval in accordance with procedure stipulations.

4.3.3.14 When any change in measures (or methods) and objectives occurs, or if the Company has involvement in new product development, new or modified activities, products and services, etc., review and modification of management schemes are required.

4.4 Implementation and Operation

In order to achieve effective implementation of EHS management, responsibilities, authorities and functions of departments and personnel at all levels in the Company should be explicitly stipulated, to ensure that the EHS management system is established, implemented and maintained in accordance with specifications.

4.4.1 Resources, Functions, Responsibilities, Duties and Authorities

4.4.1.1 Top management shall allocate necessary resources, including human resources, equipment facilities, technology, information and financial resources for establishment, implementation, maintenance and improvement of EHS management system.

4.4.1.2 Organization chart for EHS management system of HPE (see Appendix A1);

4.4.1.3 Functions and responsibilities of personnel at all levels

(1) General Manager:

Main EHS responsibilities are as follows:

1) Compilation of and approval of EHS policy and objectives of the Company;
2) Approving EHS Management Manual and issuing Approval Order;
3) Appointing EHS management representative;
4) Presiding over management review meetings, examining and approving management review reports;
5) Ensuring necessary human resources, financial resources and material resources for continuous and effective operation of EHS management system;
6) Approval of management responsibilities of EHS management organizations and each department;

7) Executing national and local laws, laws, regulations and standards, and shouldering ultimate liability;

(2) Management Representative:

Main EHS responsibilities are as follows:

1) Establishment, implantation and maintenance of EHS management system;

2) Approval of EHS Management Manual and procedure documents;

3) Final confirmation of major hazard sources and major environmental factors of the Company;

4) Approving internal review plan, organizing and implementing resolutions of management reviews;

5) Submitting EHS performance report to top management for review and as a basis for improvement of the EHS management system;

6)Reporting operating conditions of EHS management system to top management and putting forward improvement suggestions;

7) Representing the Company to conduct external affairs related to environmental and OHS management certification;

8) Coordinating and solving major problems occurring during operation of the EHS management system;

(3) Deputy General Manager:

Responsible for assigned businesses and departments, as well as Project Department's performance of duties related to EHS, so as to guarantee the implementation of EHS management system in relevant businesses;

(4) Quality Control Department:

Main EHS responsibilities are as follows:

1) As a special department for the Company's EHS management, assisting management representative in establishment and maintenance of EHS management system;

2) Formulation of EHS objectives of Quality Control Department, which come into force after

approval by director of the Department;

3) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

4) Organizing relevant departments for planning, management and control of operations and activities associated with risks requiring control measures;

5) Centralized management of construction safety and environment, compilation of construction safety and environmental management regulations, as well as collection, statistics and report of information on construction safety and environment;

6) Management of discrepancies, corrective measures and preventive measures of EHS management system;

7) Investigation and disposal of construction safety and environmental accidents;

8) Performance measurement and supervision of EHS system;

9) Continuous improvement of the Company's EHS management system;

10) Evaluating EHS management of suppliers and subcontractors, and exerting influences;

11) Internal review management for the EHS management system;

12) Management of documents and records on EHS management system of the Company;

13) In charge of EHS compliance evaluation for construction companies.

(5) General Manager Office

General Manager Office is a special department, responsible for routine management of the Company, including logistics, infrastructure, fixed assets, vehicles, communication, welfare, water, electricity, energy, and fire control, etc, with the following main EHS responsibilities:

1) Formulation of EHS objectives of the Department, which take effect after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for

the Department, and timely renewal of the lists;

3) Water, electricity and energy management of the Company, and compilation of seasonal statistical table of water, electricity, oil and energy consumption and report on energy saving and emission reduction work;

4) Food safety management of the Company;

5) EHS management, including fixed assets and infrastructure management of the Company;

6) Traffic safety management of the Company;

7) Fire control management for headquarter of the Company and centralized management on fire control of the Company;

8) Emergency response and emergency disposal for the Company;

9) Analysis and investigation on causes of major accidents not occurring during construction process, and relevant disposal;

(6) Human Resources Department

Human Resources Department is a special department, for centralized management of human resources, salary, foreign affairs, security work, medical service, and labor protection of the Company, with the following main EHS responsibilities:

1) Formulation of EHS objectives of HR Department, which are executed after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

3) Compilation and implementation of human resources planning of the Company;

4) Organization structuring and responsibility assignment planning for the Company;

5) Centralized management of EHS training, assessment and ability evaluation;

6) Safety education for personnel going abroad;

7) Management on health examination, disease prevention, and medical insurance, etc. for employees of the Company;

8) Centralized management of labor protection for the Company;

9) Security work of the Company;

10) Participation in coordination and disposal of personal safety accidents and unexpected incidents;

(7) Planning & Development Department

Planning & Development Department is mainly responsible for comprehensive planning, budget management, cost analysis and statistics of the Company, with the following main EHS responsibilities:

1) Formulation of EHS objectives of the Department, which become effective after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

3) Compiling annual comprehensive plan (including environment and safety plan) for the Company, and controlling, analyzing, examining and assessing its execution;

4) Centralized management of project subcontracting and procurement plan;

5) Assessment of project subcontracting and procurement contract;

6) Organizing performance assessment (including safety and environmental performance) for business department;

(8) Department of Legal Affairs

Department of Legal Affairs is a special department in charge of legal affairs of the Company, with the following main EHS responsibilities:

1) Formulation of EHS objectives of the Department, which come into force after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

3) Formulation of list of laws and regulations on EHS for the Company, and timely renewal of the list;

4) Acquisition and timely renewal of applicable laws, regulations and other requirements on EHS of the Company, and their distribution to relevant departments of the Company and interested parties;

5) Proposing legal advices for articles concerning legal affairs in bidding documents and domestic/overseas contracts of the Company;

6) Coordinating with relevant departments for settlement of external economic disputes and other legal affairs, and providing legal consulting and other services for other departments of the Company;

7) Studying international conventions related to the Company's business, understanding relevant laws and regulations, so that to offer legal services for business development of the Company.

(9) Marketing & Development Department

Marketing & Development Department is a special department for market development and management of the Company, with the following main EHS responsibilities:

1) Formulation of EHS objectives of the Department, which enter into force after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

3) Acquisition, identification and timely renewal of laws and regulations within contract range (including those of host countries), and their distribution to Department of Legal Affairs of the Company and interested parties;

4) Market development and bidding affairs;

5) Indentifying and determining EHS requirements in bidding documents and contracts;

6) Collecting and replying to requirements of the market and potential clients on EHS

management of the Company;

7) Safety and environmental management for personnel in overseas offices of Project Department;

8) Transmitting EHS policy and philosophy of the Company, requirements of relevant laws and regulations, and other information on EHS to interested parties;

9) Acquisition, identification and timely renewal of technical standards, product standards and specifications on EHS within contract range (including those of host countries);

10) Compilation and examination of technical tenders and proposals for the Company during project development process;

11) Clarification of technical tenders and proposals for the Company and technical contract negotiation during project development process;

12) Exerting influence on interested parties in terms of EHS management, in view of technology;

(10) Financial Department

Financial Department is a special department responsible for financial management, financial accounting, tax planning, financing service, intermediary service, and insurance service of the Company, with the following main EHS responsibilities:

1) Formulation of EHS objectives of Financial Department, which take effect after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

3) Assisting General Manager Office in providing original data for seasonal statistical table of water, electricity, oil and energy consumption of the Company;

4) Statistical summary of EHS input, and reporting results to Quality Control Department;

(11) Storage & Transportation Department

Storage & Transportation Department is a special department for centralized

management of storage and transportation for projects of the Company, and also an executive department for storage and transportation of projects, taking charge of whole-processing management of projects' storage and transportation, with the following main EHS responsibilities:

1) Formulation of EHS objectives of the Department, which become effective after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

3) EHS management during storage and transportation;

4) Compilation and implementation of storage and transportation schemes and plans for projects;

5) Bidding and subcontracting operations for projects of the Company and management of subcontractors for storage and transportation;

6) Indentifying and determining EHS requirements of articles in project bidding documents and contracts, publicizing externally EHS policy and philosophy of the Company, and conveying requirements of relevant laws and regulations.

(12) Customer Service Department

Customer Service Department is a department of the Company for after-sale service management, with the following main EHS responsibilities:

1) Formulation of EHS objectives of the Department, which enter into force after approval by director of the Department;

2) Identification, evaluation and control of hazard sources/environmental factors within its assigned scope, compilation of list of hazard sources and list of environmental factors for the Department, and timely renewal of the lists;

3) Market development and bidding quotation for projects of the Company, except power generating equipment;

4) Identification and determination of EHS requirements of articles in bidding documents and contracts;

5) Collecting and replying to requirements of the market and potential clients on EHS management of the Company;

6) Purchasing equipment/materials in accordance with EHS requirements;

7) Overhaul and reconstruction of power plants and spare parts supply;

8) Transmitting EHS policy and philosophy of the Company, as well as requirements of laws and regulations to interested parties;

(13) Project Department

Project Department is an executive department for specific engineering projects, in charge of project management during project execution process, with the following main EHS responsibilities:

1) Formulation of EHS objectives of respective Project Department, which come into operation after approval by director of the Department;

2) Identification of environmental factors and hazard sources, risk evaluation and control measures, as well as determination of major environmental factors and major hazard sources;

3) Acquiring and indentifying laws and regulations in host countries, timely renewing and distributing them to Department of Legal Affairs and interested parties;

4) Drawing up management schemes of objectives and indices for Project Department, and monitoring their execution;

5) Formulation and implementation of EHS input plan;

6) Bid inviting, bid negotiation and contract signing for subcontracting work;

7) Procurement and management of project equipment, materials, ensuring purchased equipment/materials in accordance with EHS requirements;

8) Review of technical measures related to EHS in construction schemes;

9) Providing guidance of EHS management for subcontractors, evaluating

subcontractors' EHS, and exerting influences;

10) Management, supervision and inspection for EHS in construction site of project;

11) Formulation of emergency preplan for this project, practice and implementation of the emergency preplan;

12) Providing EHS education and training for employees of the Department, interested parties and other personnel entering work site;

13) Timely reporting of EHS accidents and incidents;

14) Logistics management, vehicles management, and traffic safety management of project;

15) Procurement and distribution management of labor protective products for project;

16) Fire control management of project work site;

17) Water, electricity and energy management in the work site of Project Department;

18) Documents and records management for Project Department;

(14) Labor Union: Its main EHS responsibilities are as follows:

1) Participating in information communication related to EHS of the Company, participating in formulation and review of policies and procedure documents, and participating in discussions on things influencing EHS in workplaces;

2) Participating in implementation of laws and regulations related to environmental and labor protection;

3) Participating in investigation and disposal of EHS accidents;

4) Democratic management and supervision, protecting employees' legitimate rights and interests;

4.4.2 Training, Awareness and Ability

"*HR Control Procedures*" of the Company should be formulated and executed, for determination and development of trainings for employees at different levels, according property and scale of the Company and employee quality, so as to ensure that all staffs are aware of and capable to meet EHS requirements. Human Resources Department is in charge of personnel ability, awareness and training management of the Company.

4.4.2.1 The Company should determine ability and quality requirements (including education, technical ability and experience) for employees in different positions, and specify them in a document, according to requirements of the EHS management system.

4.4.2.2 Determine training requirements, methods and expected effects for different kinds of employees, carry out special trainings for employees at key positions and positions associated with major risks or major environmental factors, and evaluate effectiveness of trainings or measures, so as to ensure that all staffs, under the control of the Company, engaged in operations which may influence EHS of workplaces, have corresponding abilities..

4.4.2.3 After trainings, all staffs should be aware of:

1) the importance of abiding by EHS policy, procedures, and management system requirements, their own functions and responsibilities in the system and emergency preparation and response;

2) major environmental factors and major hazard sources in working activities and behaviors, real and potential environmental and OHS consequences, and environmental and safety benefits brought by personal work improvement;

3) potential consequences of deviating from standard operating procedures;

4.4.2.4 Methods of safety and environmental trainings: lessons, internal meetings, regular meetings on safety, and web-based trainings, etc.

4.4.2.5 Relevant records should be retained;

4.4.3 Information Communication and Negotiation

The Company should formulate and implement "*Control Procedures for Negotiation and Communication*", and establish external and internal communication channels for EHS management information, so as to facilitate OHS problems solving and negotiation through communications among the Company, employees and interested parties. Quality Control Department is a special department for centralized management of information communication and negotiation.

4.4.3.1 Information communication should be timely and smooth, with clear-cut assignment

of responsibility, including internal and external information communication. Information on OHS should be collected and transmitted promptly to corresponding functional departments in the Company. Information communication between the Company and external parties should be well received, written, replied and recorded.

4.4.3.2 Labor Union is responsible for collecting, solving and replying to OHS problems, about which employees are concerned.

4.4.3.3 General Manager Department, Operation & Development Department, Department of Legal Affairs, and Project Department are in charge of receiving EHS information from external interested parties, and reporting major information immediately to Quality Control Department and management representative of the Company. The management representative or authorized Quality Control Department will dispatch relevant department/project department for uniform disposal. General information should be processed and replied by the receiving department/Project Department, and submitted to Quality Control Department for filing.

4.4.3.4 Each department should be responsible for information communication of hazard resources or environmental factors and EHS within respective designed business scope.

4.4.3.5 Internal and external information communication may be achieved by means of regular contact, meanings, routine report, bulletin board, phone call and face-to-face contact, etc.

4.4.3.6 Each department is in charge of preserving relevant records on negotiations related to OHS or environment and records on information communication.

4.4.3.7 Employees should participate in negotiations on at least the following issues:

1) Formulation and review of EHS policy, objectives and procedures;

2) Moderate involvement in planning and modification review of the EHS management system;

3) Identification and evaluation of major environmental factors and major hazard factors, and formulation and modification of relevant control measures;

4）Investigation and disposal of incidents;

5）Changes in working environment, environmental protection and safety facilities;

4.4.3.8 Establish a mechanism for the Company's negotiations with interested parties on influences in terms of environment, health and safety.

4.4.4 Documents

Documents for EHS management system of the Company should be established and preserved, stipulating EHS policy and objectives, describing key elements of EHS management system and their functions, and specifying work procedures and approaches to inquirying relevant documents, for regulated operations and activities of the system.

4.4.4.1 Documents of EHS management system of the Company include: EHS policy and objectives; management manual and procedure documents; and procedures, environmental and safety management system, and operation documents and records related to operation control, these three levels.

4.4.4.2 Establish procedures required by EHS management system, and document the procedures.

4.4.4.3 In order to guarantee effective operation of the EHS management system, compile corresponding operation documents and records, etc. according to actual needs.

4.4.4.4 EHS Management Manual is a programmatic document, elaborating EHS policy of the Company and describing EHS management system, mainly including the following contents: description of EHS policy, objectives and indices, and key elements of the EHS management system. Procedure document is a supporting document of the Management Manual, describing methods, processes and approaches to carrying out EHS management of the Company, as well as specific working procedures for implementation of each element. Operation document is a guiding document focusing on a particular activity.

4.4.4.5 Pay full attention to adaptability and practicability when formulating documents for EHS management system, which should be minimized, easy to understand, and convenient to operate for employees. If there is any quotation, sources of quoted documents shall be marked

for further reference. For inquiry of relevant documents, see Appendix B of the Manual (List for Procedure Documents of EHS Management System).

4.4.5 Document Control

"*Document Control Procedures*" of the Company should be worked out and maintained, to ensure effective control over documents and materials related to EHS management system. Quality Control Department takes charge of document control of the EHS management system.

4.4.5.1 Examine the documents before issuance to guarantee their sufficiency and adaptability;

4.4.5.2 If necessary, review, renew and re-examine the documents;

4.4.5.3 Indentify modifications and current revision status of documents;

4.4.5.4 Ensure that all system documents are controlled and all documents used in system implementation are valid; guarantee that relevant versions of applicable documents are available in their application places;

4.4.5.5 Documents should be readable and legible;

4.4.5.6 Mark external documents needed for planning and operation of EHS management system, and control distribution of such documents;

4.4.5.7 Invalid and cancelled documents and materials should be reclaimed by distribution department according to distribution registration. If such documents must be retained, cancellation marks are required, in case of misuse.

4.4.6 Operation Control

The Company should formulate "*Operation Control Procedures*" and relevant supporting documents for OHS management, so that to guarantee effective control on OHS risks and effective environmental protection during operation, production and service processes.

4.4.6.1 Determine operations and activities related to major hazard sources and environmental factors, and work out corresponding procedures. Requirements on operation control should be explicitly specified in corresponding operation control procedures or operation documents, for

fear of deviating from EHS policy and objectives due to lack of procedures.

4.4.6.2 Specify operating criteria explicitly in operation control documents, determine and control hazard factors (environmental factors) and relevant activities, products and services or interested parties, for fear of deviating from EHS policy and objectives due to lack of operating criteria.

4.4.6.3 Control or exert influence on major hazard sources and environmental factors in equipment and material procurement and subcontracting activities of the Company.

4.4.6.4 Help all staffs entering construction site to understand possible risks to personal safety and correct self-protection methods through appropriate approaches.

4.4.7 Emergency Preparation and Response

The Company should formulate, maintain and execute "*Control Procedures for Emergency Preparation and Response*", work out corresponding preplan for potential accidents or emergencies, and practice according to the preplan, so that to reduce or avoid harms and influences caused by the accidents.

4.4.7.1 Management representative takes charge of review of emergency preplan and response plan.

4.4.7.2 Quality Control Department is responsible for supervision of emergency preplan and response.

4.4.7.3 General Manager Office is a special department for centralized management of emergency preparation and response of the Company, in charge of compiling emergency preplan, organizing emergency actions for the Department, and providing guidance for relevant personnel to carry out regular emergency trainings and practices.

4.4.7.4 Each project department should work out respective emergency preplan according to characteristics of this project based on actual situations, such as special preplan for fire protection, flood prevention, typhoon prevention, lightning strike prevention, and unexpected personal injury prevention, etc, and guarantee materials, personnel and communication preparations as well as preparations for rescue and aid, according to the preplans.

4.4.7.5 Each project department is in charge of carrying out regular practice of respective emergency preplan for this project, and recording scales and effects of trainings and tests.

4.4.7.6 Quality Control Department of the Company is responsible for supervising regular practice of emergency preparation and response procedures of each project department.

4.4.7.7 In case of emergency, relevant departments should response promptly.

4.4.7.8 Documents should be reviewed and modified in terms of adaptability, according to actual effect of emergency and response practices.

4.5 Inspection

4.5.1 Performance Measurement and Monitoring

"*Control Procedures for Performance Measurement and Monitoring*" shall be worked out and implemented, for monitoring and measurement of EHS performance of the Company, so that to ensure effective control over major hazard sources and major environmental factors.

4.5.1.1 Quality Control Department takes charge of performance measurement and monitoring management.

4.5.1.2 Each project department and relevant departments shall be responsible for respective environmental performance and OHS performance measurement and monitoring management.

4.5.1.3 Monitor the implementation of objectives, indices, management schemes, operation standards and applicable laws, regulations and other requirements, for effective control of major hazard sources (major environmental factors).

4.5.1.4 Carry out monitoring for undesirable performance, including incidents, accidents, and discrepancies, etc.

4.5.1.5 Record monitored and measured data and results sufficiently, evaluate monitoring and measurement results, which will act as basis for formulating corrective and preventive measures.

4.5.1.6 Active measurements: monitoring conformance of environmental objectives, management schemes, operation standards and applicable laws, regulations and other

requirements, and routine EHS inspection.

4.5.1.7 Passive measurements: the process of inspecting and indentifying historical evidences for incidents, accidents, and other undesired performance.

4.5.1.8 Project Department is responsible for contacting local environmental protection department for monitoring and measurement of major environmental factors and reporting relevant results to Quality Control Department of the Company.

4.5.2 Compliance Evaluation

"*Control Procedures for Compliance Evaluation*" should be established and executed, to evaluate the Company's compliance with laws, regulations and other requirements on EHS management, so as to fulfill commitment of the Company.

Compliance evaluation consists of internal evaluation and external evaluation. External evaluation includes evaluation on compliance with laws and regulations and clients and interested parties' abiding by contracts or agreements, as well as evaluation on observance of approved qualification and business scope.

Internal evaluation refers to systematical evaluation on each department's compliance with relevant laws, regulations, and other requirements during the operation of the Company's EHS system, so that to confirm the Company's compliance with laws, regulations and other requirements and fulfill the commitment of its top management.

4.5.3 Incidents Investigation, Discrepancies and Corrective and Preventive Measures

The Company should establish and maintain "*Control Procedures for Accident and Incident Investigation and Disposal*" and "*Control Procedures for Discrepancies and Corrective and Preventive Measures*", to facilitate investigation and disposal of safety and environmental accidents, incidents and discrepancies, and avoid or reduce the occurrence of similar incidents or discrepancies, by taking corrective and preventive measures.

4.5.3.1 Quality Control Department should be responsible for investigation, statistics and report of OHS accidents, as well as EHS accident, incident and discrepancy management during construction (production) process and field management, together with relevant

departments and Labor Union.

4.5.3.2 Accident and incident investigation must:

1) determine potential OHS problems and other factors which may cause or stimulate incidents;

2) identify demands for corrective measures and opportunities for preventive measures;

3) identify items requiring continuous improvement;

4) document investigation results and deliver the document to relevant personnel;

5) investigate timely and report the situation accurately;

4.5.3.3 For discrepancies and corrective and preventive measures:

1) Identify and correct discrepancies, and take measures to reduce harms and influences caused thereby;

2) Investigate and determine causes of discrepancies, and evolve corrective measures to eliminate the causes, so that to prevent reoccurance of such discrepancies;

3) Evaluate the necessity of taking preventive measures to eliminate potential causes, for fear of occurrence of discrepancy;

4) Track and verify the results of corrective measures and preventive measures, and report the results to relevant personnel;

5) Review effectiveness of corrective measures and preventive measures;

6) Bring modifications, caused by implementation of corrective measures and preventive measures, into documents of EHS management system.

4.5.3.4 Determine discrepancies and analyze main causes of the discrepancies, through routine monitoring, internal review, management review, and third-party review.

4.5.3.5 The Company should adopt management at different levels for discrepancies and classified evaluation according to specified responsibilities and authorities, occurrence causes and their possible harms and losses, and degree of environmental impact, to take corrective measures and preventive measures.

4.5.3.6 Quality Control Department should track the implementation of corrective measures

and preventive measures, and evaluate effectiveness of the measures.

4.5.4 Recording and Records Management

"*Records Control Procedures*" for the Company should be established and maintained, for marking, preservation and treatment of records related to EHS, providing objective evidences for the operation of EHS management system.

4.5.4.1 Quality Control Department is a special department responsible for EHS records management; information center of General Manager Office is an executive department for collecting, storing and keeping documents and records. Each department shall supervise and preserve its EHS records according to allocation of responsibilities for key elements of EHS system.

4.5.4.2 EHS records are mainly in written form, and may also be in electronic form or in photos and films.

4.5.4.3 EHS records shall be clearly marked, traceable in term of relevant activities, products or services for easy reference, legible and promptly filled, with complete and accurate contents.

4.5.4.4 Each department/project department should sort out, bind up, catalog, file and preserve EHS records timely in accordance with requirements, at the end of each year or after the completion of a project.

4.5.4.5 Preservation, storage life and destroy of controlled EHS records shall comply with specific stipulations in "*Records Control Procedures*".

4.5.5 Internal Review

"*Control Procedures for Internal Review*" should be formulated for review of EHS management system of the Company, so as to confirm compliance of EHS management system and guarantee continuity, adaptability and effectiveness of the operation of EHS management system.

4.5.5.1 Management representative takes charge of the review of EHS management system, and appointment of review team leader.

4.5.5.2 Quality Control Department is responsible for carrying out internal review of the EHS management system, formulating annual internal review plan and implementation plan, and determining objectives, scope, criteria and frequency of review, according to operation conditions and importance of the system.

4.5.5.3 Internal review should be carried out at least once a year. If any major change in EHS of the Company occurs, conduct an internal review promptly

4.5.5.4 Participants attending internal reviews must have internal reviewer qualification certificates. The review team leader is in charge of selection for qualified internal reviewers who do not bear direct responsibility for the department to be reviewed.

4.5.5.5 Members of the review team are composed of qualified internal reviewers who do not bear any responsibilities for the department to be reviewed. After the completion of a review, members of the review team should compile a review report. Head of the reviewed department shall work out corrective measures, according to discrepancies or existing deficiencies put forward in the review report, for timely correction or improvement. The review team should track, inspect, and verify correction condition and the result.

4.5.5.6 All review documents and records should be kept properly by the Quality Control Department. And annual review report should be submitted as input data of management review.

4.5.5.7 Each department/project department may carry out routine internal review and inspection.

4.6 Management Review

The Company conducts management review for the EHS management system on a regular basis each year, to ensure continuity, suitability, sufficiency and effectiveness of the system.

4.6.1 Top management plans and presides over management review meetings and signs review reports. Principal of the company and director of each department/project department should attend management review.

4.6.2 Management review should be carried out at least once a year, with time interval between two reviews no more than 12 months. Increase frequency of management review, when any of the following situations apply:

1) Change in EHS management system policy or objective of the Company occurs;

2) Serious deficiency emerges during the operation of EHS management system or when major accident may be caused thereby;

3) Major change or major accident occurs in EHS management system;

4) When top management considers necessary;

4.6.3 Quality Control Department is responsible for collecting and sorting out the following review documents, which act as input of management review, according to planning and requirements of management representative:

1) Internal review result and evaluation result of the Company's compliance with relevant laws, regulations and other requirements;

2) Results of participation and negotiation;

3) Communication information from external interested parties, including complains;

4) EHS performance of the Company;

5) Realization of objectives;

6) Implementation of incident (accident) investigations, discrepancies and corrective and preventive measures;

7) Follow-up measures for former management reviews;

8) Changes in objective environment, and applicable laws, regulations and other requirements of the Company;

9) Suggestions on improvement

4.6.4 Output of management review:

1) Evaluation of suitability, sufficiency and effectiveness of EHS management system;

2) Determination of environmental factors, hazard factors, major environmental factors and major risks, objectives and schemes which need be adjusted;

3) Evaluating EHS management system, determining further necessary improvements, main existing problems, and making decisions or evolving measures to realize system improvement and meet resources demand, etc.

4) Notifying EHS interested parties of management review, such as the Owner, employees and representatives;

5) For problems and improvement suggestions raised in management review, management representative should organize personnel to track and verify the effect of corrective measures adopted.

4.6.5 Management representative should compile review report based on results of management review.

Review report should be distributed to all relevant departments and staffs. Resolutions and improvement requirements proposed in the review report should be put into practice earnestly by relevant departments. Quality Control Department is responsible for tracking and verifying implementation of the improvements.

Report No. PPI-56.3-Final-Dewan/14

ELECTRICAL GRID STUDIES

For

50 MW DEWAN ENERGY WIND POWER PLANT

Final Report
(08-01-2014)

Power Planners International

UK OFFICE

3- Sylvester Road,
Sudbury Town, Middlesex
HAO 3AQ U.K.
Ph. No. +44-208-9223219
Fax +44-208-9220657

PAKISTAN OFFICE

66-H/2, Wapda Town,
Lahore
Ph. Nos. +92-42-35182835
+92-42-35224247
Fax +92-42-35183166

Email: info@powerplannersint.com
Website: www.powerplannersint.com

Executive Summary

1. The Final Report is submitted after complying all comments of NTDC vide letter no. GMPP/CEMP/TRP-380/WPP/DEL/7468-72 dated 13-11-2013in the light of the subsequent letter by NTDC No. MD/NTDCL/PS/4403-13

2. DewanEnergy Wind Power Plantwould be connected by a double circuit of 132kV looping in-out with a sub cluster already connecting another 50 MW Wind Power Plant, HAWA WPP to Jhimpir-New 220/132 kV collector substation.

3. The scheme of interconnection of Dewan WPP presupposes the following reinforcement already in place in Jhimpir and Gharo clusters by December 2015:
   - 220/132 kV Jhimpir-New substation at suitable location in Jhimpir cluster
   - 70 km long double circuit from Jhimpir-New 220 kV Substation to the existing T.M. Khan Road 220 kV Substation
   - A 132kV double circuit of 82 km using Greeley conductor would be constructed to connect Jhimpir-New 220/132 kV Substation with T.M. Khan in HESCO network.
   - 220/132 kV Gharo-New substation at suitable location in Gharo cluster
   - 75 km long 220 kV double circuit from Gharo-New 220 kV Substation to Jhimpir-New 220 kV Substation
   - Five sub-collectors groups will be connected to Jhimpir 220/132 kV collector substation through 132 kV double circuits using Greeley Conductor
   - FFC and Zorlu looped in-out with Jhimpir-Nooriabad 132 kV circuit.
   - Two WPPs in the collector system of Gharo 220/132 kV substation
   - FWEL-I and FWEL-II through a 64 km long 132 kV D/C on Greeley conductor connected to Thatta
   - Rehabilitation of the exiting 132 kV lines in the vicinity of WPP clusters, i.e. Jhimpir-Kotri, Jhimpir-Thatta, Thatta-Sujawal and Nooriabad-Jamshoro Old.

4. The grid facilities at 132 kV for the testing of individual turbines at Dewan WPP should be made available by June 2015 whereas the grid facilities for evacuating

the full output of Dewan WPP should be made available by December 2015 when the 220 kV part of the Jhimpir-New 220/132 kV Substation will be commissioned.

5. The existing grid system of HESCO and NTDC in the vicinity of Dewan WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Dewan WPP and no bottlenecks or constraints have been found in the grid system.
6. Wind Farm of Dewan has been modeled considering the GE-1.6-82.5-50 Hz WTG with capacity of 1.6 MW, which is a doubly fed induction generator (DFIG)Type-3 WTGs with terminal voltage of 0.69 kV. The medium voltage level of wind farm has been selected as 22 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Farm substation to connect to the HESCO/NTDC Grid.
7. A conceptual design of scheme of 132/22 kV substation of Dewan Wind Farm has been laid down as follows
    i. For 22 kV;
        a. Two single bus-sections of22 kV with a bus sectionalizer
        b. Fourbreaker bays to connect four collector circuits from fourcollector groups of WTGs
        c. Two breaker bays to connect two 132/22 kV transformers
        d. Two breaker bays to connect two switched shunt capacitor banks of 2 x (4x2.5) MVAR, one in each bus section
        e. Two breaker bays to connect two station auxiliary transformers 22/0.4 kV, 315 kVA
    ii. For 132 kV;
        a. Single bus with Sectionalizer if Farm substation is GIS
        b. Double bus bars with a Bus Coupler if Farm substation is AIS
        c. Two breaker bays to connect two 132/22 kV transformers

d. The protection scheme would be designed in compliance of NTDC requirements sent by Chief Engineer Protection, vide letter No.3416-19/CE/SP/MN/50MW CWE WPP Jhimpir dated 23/07/2010

e. The telecommunication scheme would be designed in compliance of NTDC requirements sent by Chief Engineer Telecommunication, vide letter No. CE (Tel)/NTDC/232/4372 dated 27/08/2010.

iii. Other Equipment:

a. Two 132/22 kV, 31.5/40/50 MVA ONAN/ONAF1/ONAF2 OLTC transformers, 132±11×1%/22kV, to fulfill N-1 criteria of Grid Code

b. Two station auxiliary transformers of 22/0.4 kV, 315 kVA

c. Two switched shunt capacitor banks each of the size of 10 MVAR (4 x 2.5 MVAR) to provide 20 MVAR at 22 kV with contactors and PLC (Programmable Logic Controller).

d. Energy meters would be installed on HV side (132 kV) of the 132/22kV transformers.

8. Load flow analysis has been carried out for December 2015 considering the COD targeted by Dewan, for the dispersal of load from Dewan WPP into HESCO Grid at 132 kV level using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme (item-2) has been evolved by performing the load flow studies testing the steady state performance for normal as well as N-1 contingency conditions fulfilling the Grid Code criteria of Wind Power Plants. The reactive power requirement at point of common coupling to meet PF of ± 0.95, voltage and line loading criteria are fulfilled by these studies. The grid facilities of HESCO are found adequate to absorb output power of DewanWPP. Load flow analysis was also carried out for the peak case of 2016-17 and an extended term scenario case of 2020. The load flow results for these scenarios also establish that the proposed scheme of interconnection of Dewan WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in

terms of absorbing all the output of Dewan WPP under normal as well as the contingency conditions.

9. Maximum and minimum short circuit levels for three-phase faults and single-phase faults have been evaluated. The maximum short circuit level has been evaluated for the year 2015-16 and 2020 and the minimum short circuit level has been evaluated for 2015-16 to evaluate the most stringent conditions, and it has been found that the proposed scheme provides maximum SC strength for the evacuation of Dewan WPP power to the grid.

   The switchgear ratings for DEL WPP substation are as follows:

   132 kV:

   Short circuit rating = 40 kA (3 sec.)

   Continuous rating = 2500 A

   22 kV:

   Short circuit rating = 25 kA (3 sec.)

   Continuous rating = 2500 A

10. Transient Stability analysis has been carried out forDewan WPP based on their selection ofType-3 WTGs, with connectivity of proposed scheme. Different disturbances have been simulated to apply stresses from the system faults on the wind farm and vice versa and it was found that Dewan WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Dewan WPP side did not cause any stress on the main grid or the power plants in HESCO area viz. Kotri, Lakhra or Jamshoro such that the whole system remained stable under all events.
11. The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault clearing due to stuck- breaker (breaker failure) reason. The simulations have proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.
12. The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and

unbalance are within the permissible limits of IEC and other International Standards.

13. There are no technical constraints whatsoever in the way of bringing in the 50 MW of Dewan Wind Power Plant at the proposed site and scheduled time of commissioning, in any respect of steady state (load flow) or short circuit or dynamic performance (stability) or power quality issues related to this plant.

Report Contents

1. Introduction

1.1 Background

There exists a huge wind corridor in coastal Sindh, starting from Gharo-Ketti Bandar up to Jhimpir and upward, that has been identified by AEDB with an actual potential of about 50,000MW. There are many entrepreneurs coming forward to tap this huge natural resource of power; fourteen of them in theJhimpir cluster who have been allocated lands by AEDB to develop wind farmsand set to achieve COD by December 2015. Dewan Energy Pvt. Ltd.is one such pioneering entrepreneur who has come forward with a Wind Power Plant within this cluster atJhimpir

The proposed wind farm shall have the installed capacity of about 50 MW of electricity. The project is being developed in the private sector and the electricity generated from this project would be supplied to power grid of HESCO / NTDC. The services of Power Planners International have been engaged to perform the impact studies of penetration of this wind power in the national grid to evolve the most feasible interconnection scheme for this plant.

1.2 Objectives

The overall objectives of this study are:

1. Impact of Dewan Wind Power Plant on the System
2. Impact of the System on Dewan Wind Power Plant

These impacts are to be studied for different operating conditions of Plant as well as the System. The operating condition of the plant may vary from its 100 % output to 0 % i.e. no output at all. The system conditions would be peak load, off-peak load under two generation dispatch scenarios with high hydro power availability and low hydro (or high thermal) power generation.

The impacts are required to be studied for steady state as well as the dynamic and disturbed conditions of the system. The specific objectives are:

1. To develop a feasible scheme of interconnections of Dewan Wind Power Plant (WPP) with HESCO/NTDC network at 132 kV for which right of

way (ROW) and space at the terminal substations would be required to be made available.

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

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

1.3 Planning Criteria

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

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

Short Circuit:

132 kV Substation Equipment Rating 40kA

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

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

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

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

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

Reactive Power and Power factor:

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

Power Quality Requirements:

As per IEC61400-21standards

1.4 Operating Criteria

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

Black Start and Islanded Operation:

Exempted

Active Power and Frequency Control:

Exempted from precise frequency control responsibility

Synchronization / De-Synchronization:

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

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

Power Generation Capability Forecasting Requirement:

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

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

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

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

1.5 Input Data

The input data of HSECO / NTDC has been used in this study as per letter No. GMPP/CEMP/TRP-380/DEPL/7995-99. The load forecast and the generation expansion plan of NTDC provided vide this letter has been used as shown in Appendix 2. In addition,NTDCvia its letter No. MD/NTDCL/PS/4403-13, has intimated that the 132 kV collector substation at Jhimpir would be completed by June 2015 and the 220 kV Collector Substations at Jhimpir and Gharo would be completed by the end of December 2015

The input data regarding Dewan Wind Farm has been provided by the client who has indicated to useGE-1.6-82.5-50 Hz WTG with capacity of 1.6 MW. It is Doubly Fed Induction Generator Type-3 WTG. The main parameters of the WTGs have been attached in Appendix-2.

2. Description of Problem & Study Approach

2.1 Description of the Problem

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

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

The existing power plants nearest to the vast wind farm areas of Jhimpir in the existing power grid are Kotri and Jamshoro having installed capacity of 120 MW and 600 MW respectively. Next to them are Hub with 1200 MW, Lakhra with 70 MW, and KESC combined generation of about 1600 MW. Apparently this amount of generation in Southern grid seems strong enough to absorb the penetration of wind power of 50MW. But there are other variables that necessitate detailed studies like strengths of nodes of connectivity, loading capacity of the transmission lines to evacuate power from Wind Farm area and dynamic response of wind turbine generators and neighboring conventional synchronous generators.

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

The above-mentioned thermal power plants do not run at their full capacity all along the whole year. During high water months when cheaper hydel power is abundantly

available in the Northern grid of NTDC, many generating units of these plants are shut down for the sake of economic dispatch. Therefore in high hydel season, which is low thermal season by default, the southern power grid would get weaker in terms of system strength, especially during off-peak hours. The dynamics of this season is different than that of high thermal season.

There are different models of different sizes and make available in the market viz. GE, Vestas, Nordex, Gamesa, Siemens, Goldwind and Vensys etc. The dynamics of each model may be different with respect to grid's dynamics.DewanEnergyis considering using GE-1.6-82.5-50 Hz WTG with capacity of 1.6 MW. This isdoubly fed induction generator WTG and thus categorized as a Type-3 WTG.

There are other wind farms going to get developed soon in the neighborhood of Dewanwindfarm. With the increase of penetration of more wind power in the same power grid, the impact studies would become even more involving from the point of view of dynamic stability.

2.2 Approach to the problem

We will apply the following approaches to the problem:

- The COD of Dewan WPP as provided by the Client Dewan Energy Pvt. Limited and AEDB is December2015. Therefore we have decided to perform our analysis for the scenario ofDecember 2015 to judge the maximum impact of the plantafter the COD of the plant when the 220 kV Substation of Jhimpir is commissioned in December 2015.
- The base case for the year 2015-16comprising all 500kV, 220kV and 132 kV, and 66kV system would be prepared envisaging the load forecast, the generation additions and transmission expansions for each year particularly in the Southern parts of the country. The case would include the Wind Power Plants which are developing on fast track basis and are expected to be commissioned by December2015 as per the latest schedule of AEDB.
- Interconnection scheme without any physical constraints, like right of way or availability of space in the terminal substations, would be identified.

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

3. Analysis of Network Prior to Dewan WPP Interconnection

3.1 Description of the Network

The electrical grid, which is relevant for interconnection of Dewan Wind PP, is the 132 kV network that stretches through South of Hyderabad and Jamshoro up to coastal areas of Southern Sind. This network, as it stands today is shown in Sketch-1 in Appendix-4. It comprises the following NTDC grid stations;

- Existing 500/220/132 kV grid station at Jamshoro connected through double circuits of 500 kV with Dadu in the North and Hub/New-Karachi in the South.
- Existing 220/132 kV Hala Road connected to Jamshoro 500/220/132 kV grid through a double circuit of 220 kV
- Existing T. M. Khan Road 220/132 kV grid station connected to Jamshoro 500/220/132 kV grid station by a double circuit of 220 kV

The 132 kV network under HESCO has been shown only for the circuits that emanate from Hyderabad, Jamshoro and Kotri to connect to the substations of 132 kV lying South of Hyderabad. There are four existing branches of network of 132 kV that stretch southward and pass close to Dewan WPP near Jhimpir, as follows:

- Jamshoro-Old - Nooriabad – Kalukuhar 132 kV single circuit
- Kotri-Jhimpir-Thatta-P.Patho-M.P.Sakro-Garho 132 kV single circuit
- Hyderabad-T.M.Khan-B.S.Karim-Sujawal-Thatta 132 kV single circuit
- The Jhimpir-Nooriabad 132 kV single circuit on double-circuit-towers (SDT) provides parallel reliability with the other two branches up to Thatta and Nooriabad.

Two of the branches connecting Thatta provide parallel reliability to each other up to Thatta. However the single circuit South of Thatta going to Garho via P.Patho and M.P.Sakro does not support the supply to these substations under an outage condition. The Jhimpir-Nooriabad 132 kV S/C would be the nearest electrical grid passing by the site of Dewan WPP, that lies in between Jhimpir and Nooriabad. This line has been built using double-circuit towers (SDT) and the work of stringing of second circuit is in progress these days and is nearing completion.

The network as it is planned with wind power plants scheduled prior to commissioning of Dewan WPP in December 2015 is shown in Sketch-2 in Apendix-4. FFC and Zorluarealready in operation,anotherone i.e. TGF is going to be in operation by December 2014 and Sapphire WPP is expected to be in operation by March 2015. For further addition of WPPs,NTDC,via its letter No. MD/NTDCL/PS/4403-13, has intimated that the 132 kV collector substation at Jhimpir would be completed by June 2015 and the 220 kV Collector Substations at Jhimpir and Gharo would be completed by the end of December 2015. Based on this letter, the following interconnection facilities will be in place by the end of December 2015:

- 220/132 kV Jhimpir-New substation at suitable location in Jhimpir cluster
- 70 km long double circuit from Jhimpir-New 220 kV Substation to the existing T.M. Khan Road 220 kV Substation
- A 132kV double circuit of 82 km using Greeley conductor would be constructed to connect Jhimpir-New 220/132 kV Substation with T.M. Khan in HESCO network.
- 220/132 kV Gharo-New substation at suitable location in Gharo cluster
- 75 km long 220 kV double circuit from Gharo-New 220 kV Substation to Jhimpir-New 220 kV Substation
- Five sub-collectors groups will be connected to Jhimpir 220/132 kV collector substation through 132 kV double circuits
- FFC and Zorlu looped in-out with Jhimpir-Nooriabad 132 kV circuit.
- Two WPPs in the collector system of Gharo 220/132 kV substation
- FWEL-I and FWEL-II through a 64 km long 132 kV D/C on Greeley conductor connected to Thatta
- Rehabilitation of the exiting 132 kV lines in the vicinity of WPP clusters, i.e. Jhimpir-Kotri, Jhimpir-Thatta, Thatta-Sujawal and Nooriabad-Jamshoro Old.

Of the two sub clusters developed in Jhimpir area, one sub-cluster will comprise FFC and Zorlu looped in-out on one circuit of the Jhimpir-Nooriabad 132 kV double circuit whereas the other sub-cluster would comprise the Jhimpir-New 220/132 kV Collector

Substation and would connect five sub-collectors groups through 132 kV double circuits.

We have carried out the studies of the case "without" Dewan WPP but including all the other WPPs which have COD by December 2015 according to the latest schedule by AEDB to ascertain if there are any constraints in the system prior to Dewan WPP's commissioning.

3.1.2 Load Forecast

The load forecast of NTDC attached in Appendix-2 has been used and in addition 650 MW export to KESC has been assumed.

3.1.3 Transmission Expansion

Because of sizable additions of generation scheduled in South, the following transmission expansion has been planned to reinforce 500 kV and 220 kV network in South;

500 kV

- Guddu-Multan 2nd circuit 500 kV In-Out at D. G. Khan 2013-14
- Guddu-Multan 3rd circuit 500 kV In-Out at R. Y. Khan 2013-14
- Guddu-R.Y. Khan 500 kV circuit In-Out at Guddu-New PP 2013-14
- Guddu-New Power Plant to M. Garh 500 kV S/C 2013-14
- Guddu-Dadu 1st circuit 500 kV In-Out at Shikarpur New 2014-15
- Guddu-Dadu 2nd circuit 500 kV In-Out at Shikarpur New 2014-15
- Jamshoro-Moro 500 kV S/C 2016-17
- Moro-R.Y. Khan 500 kV S/C 2016-17
- Dadu-Moro 500 kV S/C 2016-17

220 kV

- Rohri New – Shikarpur 220 kV D/C 2012-13
- Dadu-Khuzdar 220 kV D/C 2013-14
- Uch-1-Shikarpur S/C in-out at Uch-2 Power Plant 220 kV 2013-14
- Uch-Guddu S/C In-Out at D. M. Jamali 2013-14
- Uch-2 Power Plant – Sibbi 220 kV D/C 2014-15

- Uch-1-Guddu S/C in-out at Shikarpur New 220 kV \ 2014-15
- Hala Road – T. M. Khan Road 220 kV S/C 2015-16
- Hala Road–T. M. Khan Road 220kV S/C In-Out at MirpurKhas New2015-16
- Jhimpir-T. M. Khan Rd. 220 kV D/C 2015-16
- Gharo-Jhimpir 220 kV D/C 2015-16

3.2 Load Flow Analysis

Load flow analysis has been carried out for the NTDC / HESCO network including the connections provided to new wind power plants FFC, Zorlu, TGF, Sapphire, Yunus, Sachal, UEPL, Metro, Fina, Tapal, Gul Ahmed, Hawa and Master in the Jhimpir cluster FWEL-I, FWEL-II, HYDROCHINA Dawood (HDPPL) and Tenaga in the Gharoclusterbut without including Dewan WPP to see if the network was adequate for dispersal of wind power without it. The case has been studied for the system conditions of December 2015. The month of December has been selected as NTDC, via its letter No. MD/NTDCL/PS/4403-13, has intimated that the 220 kV Collector Substations at Jhimpir and Gharo would be completed by the end of December 2015. Also the dispatch of thermal plants in South during Decemberwould be at their maximum outputs. We kept the dispatch of Kotri the nearby power plant at 132 kV at 120 MW and other Captive Power plants such as Thatta, Nooriabad and Kotri-Site therefore we can see the maximum distributed generation on 132 kV network prior to commissioning of Dewan WPP. With this dispatch, the power flow conditions on 132 kV network around Jhimpir, Thatta and Nooriabad area would be almost same irrespective of High or Low Water dispatch conditions on the primary network of NTDC. The results are shown plotted in Exhibit 3.0 in Appendix-3 which indicates that no circuit is loaded more than its rated power carrying capacity and the voltage profile at all the bus bars of 132 kV, 220 kV and 500 kV is within the permissible range. All power plants are running at lagging power factor within their rated range.

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

Exhibit-3.1	Hawa to Jhimpir-New 132 kV Single Circuit Out
Exhibit-3.2	Zorlu to Jhimpir 132 kV Single Circuit Out
Exhibit-3.3	Jhimpir to Nooriabad 132 kV Single Circuit Out
Exhibit-3.4	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit-3.5	Thatta to Jhimpir 132 kV Single Circuit Out
Exhibit-3.6	Jhimpir-New to T.M.Khan 132 kV Single Circuit Out
Exhibit-3.7	HDPPL to Gharo-New 132 kV Single Circuit Out
Exhibit-3.8	Jhimpir-New to T.M.Khan Road 220 kV Single Circuit Out
Exhibit-3.9	Gharo-New to Jhimpir-New 220 kV Single Circuit Out

The load flow results of the network in the close vicinity of DewanWPPshown plotted in Exhibits 3.1 to 3.9indicate that all the power flows on the lines are within the rated limits of this network.

The load flow results show that the network existing before Dewan WPP in the same vicinity in Jhimpir cluster including the Jhimpir-New 220/132 kV collector substation is enough to absorb their power, and has no limitations in terms of power transfer capacity under normal as well as N-1 contingency, prior to connection of Dewan WPP. We will check the adequacy of network after adding Dewan WPP in Chapter 6.

3.3 Short Circuit Analysis

In order to assess the short circuit strength of the network of 132 kV without Dewan WPP for the grid of Southern HESCO especially in the vicinity of the site of this Wind Farm, fault currents have been calculated for balanced three-phase and unbalanced single-phase short circuit conditions. The fault levels also include the contributions from other Wind Farms such as FFC, Zorlu, TGF and others in the Jhimpir Cluster and FWEL-I, FWEL-II, HDPPL and Tenaga in the Gharo cluster, as mentioned earlier, which are expected to be in operation before Dewan WPP as per AEDB'slatestgeneration schedule.

The results of this analysis will not only give us the idea of the fault levels without Dewan WPP but also it will, by comparison, let us know as to how much the contribution of fault current from Dewan WPP may add to the existing fault levels. From this analysis we also get a feel of the probable nodes to connect the Wind Farm

depending on their relative short circuit strength. The calculations have been made for maximum and minimum short circuit levels considering maximum and minimum generation dispatch conditions of the system in high water and low water seasons.

3.3.1 Maximum Fault Levels

A case for the year 2015-16 has been developed in which all the hydel and thermal generating plants have been dispatched to cover the highest possible fault current contributions.

PSS/E software provides an option of calculating the fault currents using the IEC 909 criteria, and we have used this option for all the fault calculations for this study. For maximum fault currents we have applied the following assumptions under IEC 909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence
- Desired voltage magnitude at bus bars set equal to 1.1 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition.

The short circuit levels have been plotted on the bus bars of 132 kV of substations lying in the electrical vicinity of our area of interest i.e. Jhimpir area, and are shown plotted in the Exhibit 3.10 attached in Appendix-3.

Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-3 for the 132 kV bus bars of our interest i.e. the substations connecting in the three branches of 132 kV running South of Hyderabad up to Southern Sind coast line. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 3.1.We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations

which normally are 25 kA or 31.5 kA for older substations and 40 kA for new substations.

Table 3.1
Maximum Short Circuit Levels Without DEL-WPP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Gharo-New 220 kV	6.57	4.16
Jhimpir-New 220 kV	12.02	8.73
T.M.Khan Road 220 kV	26.02	20.53
Jamshoro 220 kV	34.29	29.89
Hala Road 220 kV	26.84	21.66
Jamshoro Old 132 kV	26.93	22.19
Nooriabad 132 kV	9.17	7.88
Kotri GTPS 132 kV	29.41	26.49
Jhimpir-New 132 kV	16.11	12.93
Hawa 132 kV	10.66	7.74
HYD-TMRD 132 kV	27.54	23.03
T.M.Khan 132 kV	14.79	10.82
Jhimpir 132 kV	11.07	9.46
Thatta 132 kV	6.04	4.88
Gharo-New 132 kV	7.06	5.24

3.3.2 Minimum Fault Levels

For minimum fault levels minimum generation dispatches are assumed which in practice may correspond to minimum load conditions. We normally have minimum thermal power dispatch during High Water season and it gets further minimum during off-peak hours. Especially in Southern Sind, the thermal generation would be at its minimum during minimum load conditions of high water season. Therefore we have calculated the minimum short circuit levels under High Water off-peak conditions. Also the dispatch of WTGs from other wind farms of FFC, Zorlu, TGF and others in the Jhimpir Cluster and FWEL-I, FWEL-II,Tenaga and HDPPL in the

Gharoclusterisalso assumed as minimum to have the minimum fault contributions from these Farms. The results are shown in Appendix-3.

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

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence
- Desired voltage magnitude at bus bars set equal to 0.9 P.U. i.e. 10 % lower than nominal, which is the minimum permissible voltage under contingency condition.

The plotted results of the minimum fault currents are attached in Exhibit 3.10 the same way as before focusing on the significant 132 kV bus bars of substations in the electrical vicinity of Jhimpir. The tabular output of minimum fault currents shown in Appendix-3 is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The minimum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 3.2.

Table 3.2
Minimum Short Circuit Levels without DEL-WPP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Gharo-New 220 kV	**4.20**	**2.66**
Jhimpir-New 220 kV	**6.45**	**4.74**
T.M.Khan Road 220 kV	**10.92**	**10.36**
Jamshoro 220 kV	**12.69**	**12.96**
Hala Road 220 kV	**11.16**	**10.83**
Jamshoro Old 132 kV	**12.57**	**12.33**
Nooriabad 132 kV	**5.37**	**5.46**
Kotri GTPS 132 kV	**11.57**	**11.52**
Jhimpir-New 132 kV	**8.48**	**6.64**

Hawa 132 kV	**6.47**	**4.71**
HYD-TMRD 132 kV	**13.07**	**12.86**
T.M.Khan 132 kV	**8.90**	**7.57**
Jhimpir 132 kV	**6.64**	**5.15**
Thatta 132 kV	**3.62**	**2.65**
Gharo-New 132 kV	**4.83**	**3.45**

3.3.3 Comparison of Fault Levels

Comparing the short circuit strengths, both in terms of maximum and minimum, of the existing substations of 132 kV in the vicinity of Dewan WPP *viz.* Jhimpir-New, Nooriabad, Jhimpir and Thatta, we find that Jhimpir-New, Nooriabad and Jhimpir are strong point with relatively higher short circuit levels; whereas the worst is Thatta with very poor short circuit levels. In fact Nooriabad draws strength from its direct connection with Jamshoro-old having direct connection with a very strong source of Jamshoro. Jhimpir draws its strength from its direct connection with Kotri where sits a medium size gas turbine power plant and also have connection with Jamshoro. But Thatta and the grids connected in the branches that emanate from Thatta towards Sujawal etc. are poor due to weak sources feeding these branches.

Jhimpir-New collector substation is showing good circuit strength because of the completion of its 220 kV phase, having five sub-collector groups connecting TGF, Sapphire, Yunus, Sachal, UEPL, Metro, Fina, Tapal, Gul Ahmed, Hawa and Master to the Jhimpir-New 220/132 kV Substation at 132 kV level. The other source of fault current is T. M. Khan which is 75 km away connected through a D/C of 132 kV. Together the contribution from these sources makes it a strong node of interconnection for Dewan WPP.

4. Development of Interconnection Scheme

4.1 Interconnection of DEL 50 MW WPP

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

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

In case of Dewan WPP, the nearest substation is the collector substation of Jhimpir-New 220/132 kV whose first stage of 132 kV would be completed by June 2015 and the second stage of 220 kV would be completed in December 2015 which corresponds with the COD of Dewan-WPP.

4.2 Proposed Interconnection Scheme

Given that there can be13WPPs coming in commercial operation in the Jhimpir region and 4 WPPs coming in commercial operation in the Gharo region around the time that Dewan WPP also comes into commercial operation in December 2015, the following reinforcements in the system would be pre-requisite before we connect Dewan WPP with the system as shown in Sketch-2:

- 220/132 kV Jhimpir-New substation at suitable location in Jhimpir cluster
- 70 km long double circuit from Jhimpir-New 220 kV Substation to the existing T.M. Khan Road 220 kV Substation

- A 132kV double circuit of 82 km using Greeley conductor would be constructed to connect Jhimpir-New 220/132 kV Substation with T.M. Khan in HESCO network.
- 220/132 kV Gharo-New substation at suitable location in Gharo cluster
- 75 km long 220 kV double circuit from Gharo-New 220 kV Substation to Jhimpir-New 220 kV Substation
- Five sub-collectors groups will be connected to Jhimpir 220/132 kV collector substation through 132 kV double circuits
- FFC and Zorlu looped in-out with Jhimpir-Nooriabad 132 kV circuit.
- Two WPPs in the collector system of Gharo 220/132 kV substation
- FWEL-I and FWEL-II through a 64 km long 132 kV D/C on Greeley conductor connected to Thatta
- Rehabilitation of the exiting 132 kV lines in the vicinity of WPP clusters, i.e. Jhimpir-Kotri, Jhimpir-Thatta, Thatta-Sujawal and Nooriabad-Jamshoro Old.

Of the two sub clusters developed in Jhimpir area, one sub-cluster will comprise FFC and Zorlu looped in-out on one circuit of the Jhimpir-Nooriabad 132 kV double circuit whereas the other sub-cluster would comprise the Jhimpir-New 220/132 kV Collector Substation and would connect five sub-collectors groups through 132 kV double circuits.

The connection scheme of Dewan WPP for the scenario of December 2015 in Sketches 3 is as follows:

- Dewan 50 MW Wind Power Plant would be connected by a double circuit of 132 kV looping in-out with a sub-cluster already connecting HawaWPPtoJhimpir-New collector substation.
- The grid facilities at 132 kV for the testing of individual turbines at Dewan WPP should be made available by June 2015 whereas the grid facilities for evacuating the full output of Dewan WPP should be made available by December 2015 when the 220 kV part of the Jhimpir-New 220/132 kV Substation will be commissioned

5. Modeling of Dewan Wind Farm

5.1 Electrical Layout of Wind Farm

5.1.1 Dewan Energy Selection

DewanEnergyhasselectedGE-1.6-82.5-50 Hz WTG with capacity of 1.6 MW which they are considering to install on their Wind Farm at Jhimpir. It is aDoubly Fed Induction Generator Type-3 WTGs. A total of thirty one WTGs would be required to be installed to make a total Farm output of 50MW.Each WTG would step up from its terminal LV voltage of 0.69 kV to a medium voltage (MV) that will be 22kV.

5.1.3 Electrical Layout with GE-1.6 1.6 MW WTGs

The WTGs would be connected to MV collector cables of 22 kV laid down in the Farm connecting each line (row) of the WTGs to the Farm substation. The layout is shown in **Sketch – 5** (Appendix-5), briefly described as follows;

Line – 1	WTGs 1-8	(8 x 1.6 = 12.8 MW)
Line – 2	WTGs 9-16	(8 x 1.6 = 12.8 MW)
Line – 3	WTGs 17-24	(8 x 1.6 = 12.8 MW)
Line – 4	WTGs 25-31	(7 x 1.6 = 11.2 MW)

The average length of cable between the two WTGs has to be enough to completely outdo the wake effect from the adjoining WTG based on thumb rule to leave 4xD (rotor diameter) between the WTGs to take care of wake effect. In actual micro-siting the distances between WTGs might be slightly different due to many other factors. We have taken about 300 meters distances between the WTGs.

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

The four collector circuits of 22 kV would thus be laid as shown in Sketch-4 and explained as follows;

Collector Line-1	from WTG-1to Farm Substation
Collector Line-2	from WTG-9 to Farm Substation
Collector Line-3	from WTG-17 to Farm Substation
Collector Line-4	from WTG-25 to Farm Substation

Since each collector would carry approximately 11.2 MW to 12.8 MW at normal rating, the 22 kV collector circuits loading capacity should be in the range of 15 MVA each, giving some margin for reactive power at 0.95 Power Factor and some losses in the circuits with certain overload capacity as well.

5.1.422 kV Collector Circuits

The MV voltage level selected by Dewan Energy for interconnection of collector groups of WTGs in the Farm is 22 kV. Underground cables will be used.

The collector cable ratings would be 22 kV as the rated kV level and 15 MVA as the loading capacity of collector cables.

Maximum nominal current of 22 kV cable = (15/22xsqrt (3)) x 1000= 393 A

With 10 % safety margin, maximum nominal current of 20 kV cable = 433 A

The standard cable sizes of 22 kV, nearest to our requirement, and available in the industry, using Copper and Aluminum, are shown in Table 5.1. Either of the cables mentioned below may be used.

Table 5.1

Metal	22 kV Class (Single-Core)			
	Trefoil Formation		Flat Formation	
	X-Section, mm^2	Current, Amps	X-Section, mm^2	Current, Amps
Copper	240	432	240	440
Aluminum	400	435	400	439

5.2 Wind Farm Substation 132/22 kV

A substation would be built in the middle of the Farmto collect all the power from the WTGs, spread out in the Farm, at medium voltage (MV) level of 22 kV and step-up this power to high voltage (HV) level of 132 kV so that the Farm's output may be evacuated to the main grid of HESCO/NTDC.The single line diagrams of the substation, as a conceptual design, are briefly shown in SLD-1 and SLD-2A and SLD-2B in Appendix-5 for22 kV and 132 kV respectively.

Keeping in view of the current practices in NTDC and DISCOs, the substations for power plants of the order of 50 MW, the 132 kV bus bars are double bus with a coupler i.e. double bus-single-breaker scheme. However for 132/11 kV substations,

the MV bus i.e. 11 kVa single bus with or without sectionalizers. Keeping in view the NTDC/DISCOs practice, we propose to provide good reliability to a power plant as follows:

- Single bus scheme with a sectionalizer to enable to have two bus sections at 22kV
- Double-bus single-breaker scheme with a Bus Coupler at 132 kV, if the substation is AIS
- Single-bus with a Sectionalizer to enable to have two bus sections at 132 kV, if the substation is GIS

The schemes are shown in SLD-1 and SLD-2A, SLD-2B respectively and described as follows.

5.2.1Conceptual Design of 22 kV

The single line diagram SLD–1 in Appendix-5 shows the conceptual design of 22kV (MV) bus bar of the Farm substation. It comprises of

- Two single bus-sections of 22 kV with a bus sectionalizer
- Four breaker bays to connect four collectordoublecircuits of WTG Lines 1-4
- Two breaker bays to connect two transformers of 132/22 kV
- Two breaker bays for connecting two auxiliary transformers of 22/0.4 kV
- Two breaker bays to connect switched shunt capacitor banks

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity = 25 kA

Normal continuous current = 1250 A for line breakers

= 2500A for Bus Sectionalizerand Power TF

5.2.2Conceptual Design of 132 kV

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

- Single bus with Sectionalizer if Farm substation is GIS
- Double bus bars with a Bus Coupler if Farm substation is AIS
- Two breaker bays to connect two transformers 132/22 kV
- Two breaker bays to connect two circuits of 132 kV i.e. double circuit on single tower overhead line to connect to the grid system.

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity = 40 kA

Normal continuous current = 1250 A for line and TF breakers

= 2500 A for Bus Sectionalizer

The other equipment of the substation consists of:

- Two 132/22 kV, 31.5/40/50 MVA ONAN/ONAF1/ONAF2 OLTC transformers, 132±11×1%/22kV, to fulfill N-1 criteria of Grid Code
- Two station auxiliary transformers 22/0.4 kV, 315 kVA
- Two switched shunt capacitor banks each of the size of 10 MVAR (4 x 2.5 MVAR) with contactors and PLC (Programmable Logic Controller).
- Energy meters would be installed on HV side (132 kV) of the 132/22kV transformers.

5.2.3 Protection and Telecommunication Scheme

The protection scheme would be designed in compliance of NTDC requirements intimated by Chief Engineer Protection, vide letter No.3416-19/CE/SP/MN/50MW CWE WPP Jhimpir dated 23/07/2010 (attached in Appendix-5).

The telecommunication scheme would be designed in compliance of NTDC requirements intimated by Chief Engineer Telecommunication, vide letter No. CE (Tel)/NTDC/232/4372 dated 27/08/2010 (attached in Appendix-5).

6. Load Flow Analysis

Load flow analysis has been carried out for the proposed scheme of interconnection of Dewan WPP with NTDC / HESCO grid for the base case of December 2015 as per Sketch-3 in Appendix-4.

6.1 Modeling of Wind Farm in the Load Flow

Representation of all the individual machines in a large Wind Farm is inappropriate in most grid impact studies [1]. There is a provision in the model structure of PSS/E to allow single equivalent WTG machine model to represent multiple WTGs. However there are limitations. Disturbances within the local collector grid cannot be analyzed, and there is some potentially significant variation in the equivalent impedance for the connection to each machine. A single machine equivalent requires the approximation that the power output of all the machines will be the same at a given instant of time. For grid system impact studies, simulations are typically performed with the initial wind of sufficient speed to produce the rated output on all the machines. Under this condition, the assumption that all the machines are initially at the same (rated) output is not an approximation [2]. Otherwise this assumption presumes that the geographic dispersion is small enough that the wind over the farm is uniform. Though simulations of bulk system dynamics using a single machine equivalent are adequate for most planning studies, we have adopted a rather more detailed level of modeling by using an equivalent machine just for one group of WTGs connected to one collector feeder. Since we have three collector feeders connecting to three groups of WTGs, therefore there are three equivalent WTGs assumed for each collector group in this study report.

The Farm Substation is represented by two bus bars as Dewan-MV 22 kV and Dewan 132 kV, with two inter-bus transformers of 31.5/40/50 MVA each. These transformers have an overload capacity of50 MVA for a limited time to cover N-1 contingency criteria of Grid Code i.e. in case of outage of one transformer, the other can take up the full output of Farm i.e. 50 MVA.

6.2 Reactive Power Requirements

Dewanis considering GE-1.6-82.5-50 Hz WTG with capacity of 1.6 MW. The machine is Type-3doubly fed induction generators. Its power factor is 0.90 lagging (capacitive/generating) and 0.95leading (inductive/absorbing).Themaximum reactive power output that can be available at the 0.69 kV terminal is 0.77 MVAR for each WTG.Part of this reactive power will be consumed by the 0.69/22 kV step-up (GSU) transformer and the rest may be consumed in the MV collector cables of the wind farm. However some reactive power might reach the MV bus bar of Farm substation. That means each WTG is self sufficient to meet VAR absorption requirement of its step-up transformer with some contribution of VARs to the Farm MV network.

The Grid Code Addendum No.1 requires to meet the criteria of ± 0.95 power factor at the point of interconnection with the NTDC/HESCO grid at 132 kV (point of common coupling). Therefore a Farm of 50 MW generating capacity is required to pump 16.4 MVAR to the grid at full output of 50 MW. The VAR generating capability of WTG at 0.95 PF will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers, collector cables and the HV/MV i.e. 132/22 kV transformers at the Farm substation. In order to meet the Grid Code criteria, we need to install switched shunt capacitor bank at 22 kV bus of the Farm substation of sufficient size capable of delivering 16.4 MVAR at 132 kV bus after VAR loss across 132/22 kV transformers.

6.3 Load Flow Analysis for Peak Load Case of December 2015

Load flow analysis has been carried out for the NTDC / HESCO network to see the steady state impact of adding the generation of Dewan WPP on the network including the connections provided to other wind power plants already scheduled having been connected. These are FFC, Zorlu, TGF, Sapphire, Yunus, Sachal, UEPL, Metro, Fina, Tapal, Gul Ahmed, Hawa and Master in the Jhimpir cluster FWEL-I, FWEL-II, HYDROCHINA Dawood (HDPPL) and Tenaga in the Gharo cluster as mentioned earlier. The network configuration is same for Jhimpir and Gharo clusters as indicated in Sketch-3 of Appendix-4 and discussed in Ch. 3.

As the expected COD provided by Dewan is December2015, therefore the integrated case has been studied for the system conditions of December 2015, the time line associated with the COD of Dewan WPP and of the 220 kV parts of Jhimpir and Gharo Collector Substations. We kept the dispatch of Kotri the nearby power plant at 132 kV at 120 MW, and other Captive Power plants such as Thatta, Nooriabad and Kotri-Site therefore we can see the maximum distributed generation on 132 kV network.

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

6.3.1 Normal Case

Exhibit 6.0 shows the normal case under the system conditions of December 2015. All the wind farms in Jhimpir and Gharo clusters with installed capacity of 50 MW or 49.5 MW has been assumed dispatching nearly 47.7 MW at point of delivery (132kV) to the grid after deducting Farm losses and given some diversity in the maximum output of all the Wind Power Plants at one time. ForDewan WPP we assume to deliver 49.6 MW at the point of delivery to grid at 132kV.

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

We see that all the WTGs are running at a power factor above its rated value of 0.90 not using full reactive power capability leaving enough margin to cover contingencies. The switched shunt capacitor bank of 20 MVAR at 22 kV bus bar is supplying 16.5 MVAR at (23 kV) voltage and, after VAR loss across 132/22 kV transformers, supplying about 16 MVAR (nearly 0.95 PF) at 132 kV bus i.e. fulfilling the Grid Code criteria at the point of interconnection. The voltage profile on all the bus bars of 132 kV of HESCO grid are well within the normal operating criteria of ± 5 % off the nominal.

6.3.2 Contingency cases and evolving of reliable scheme

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

Exhibit-6.1.1	Dewan 132/22 kV Single Transformer Out
Exhibit-6.1.2	Dewan to Jhimpir-New 132 kV Single Circuit Out
Exhibit-6.1.3	Zorlu to Jhimpir 132 kV Single Circuit Out
Exhibit-6.1.4	Jhimpir to Nooriabad 132 kV Single Circuit Out
Exhibit-6.1.5	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit-6.1.6	Thatta to Jhimpir 132 kV Single Circuit Out
Exhibit-6.1.7	Jhimpir-New to T.M.Khan 132 kV Single Circuit Out
Exhibit-6.1.8	HDPPL to Gharo-New 132 kV Single Circuit Out
Exhibit-6.1.9	Jhimpir-New to T.M.Khan Road 220 kV Single Circuit Out
Exhibit-6.1.10	Gharo-New to Jhimpir-New 220 kV Single Circuit Out

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

The results also show that under all events of outages the switched shunt capacitor banks at 22 kV bus regulates the voltage under all events. The reactive power being supplied by the 20 MVAR switched shunt capacitor banks connected at 22 kV bus, maintains the supply of VARS to the grid under all contingencies adjusting its output according to the system requirement. Therefore to cover the steady state, normal and outage conditions, we need switched shunt capacitor bank of 20 MVAR at 22 kV bus.

6.4 Load Flow Analysis for Peak Load Case of 2016-17

Detailed load flow studies have also been carried out to review the scenario for the spot year of 2016-17. These studies have been carried out for the peak load conditions of the year 2016-17. The objective to review the loading on the lines under peak conditions of 2016-17 to assess the impact of Dewan-WPP in the peak 2016-17scenario. In addition to the WPPs considered in the December 2015 case, Wind-Eagle-1, Wind-Eagle-2, Hartford, Sunec and Titan have been interconnected in the Jhimpir cluster and Zephyr and NBT-Zab have been interconnected in the Gharo cluster. Together, the WPPs considered in the December 2015 case and those added to the 2016-17 case constitute the maximum power that can be evacuated with the arrangement of Jhimpir-New 220/132 and Gharo-New 220/132 kV substation as

shown in Sketch-4 of Appendix-4. Any further WPP addition to either the Jhimpir or Gharo cluster would require further reinforcement of the network.

The results of Normal case are plotted in Exhibit 6.2.0 attached in Appendix-6. We find that all the power flows on the circuits of 132 kV, 220 kV and 500 kV are within the rated limits of these circuits. Also the bus voltages are within the permissible limits.

To fulfill N-1 criteria of Grid Code, one-line-out contingency studies have also been carried out. Their results are shown plotted in Appendix-6 as follows

Exhibit-6.2.1	Dewan 132/22 kV Single Transformer Out
Exhibit-6.2.2	Dewan to Jhimpir-New 132 kV Single Circuit Out
Exhibit-6.2.3	Zorlu to Jhimpir 132 kV Single Circuit Out
Exhibit-6.2.4	Jhimpir to Nooriabad 132 kV Single Circuit Out
Exhibit-6.2.5	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit-6.2.6	Thatta to Jhimpir 132 kV Single Circuit Out
Exhibit-6.2.7	Jhimpir-New to T.M.Khan 132 kV Single Circuit Out
Exhibit-6.2.8	NBT-ZAB to Gharo-New 132 kV Single Circuit Out
Exhibit-6.2.9	Jhimpir-New to T.M.Khan Road 220 kV Single Circuit Out
Exhibit-6.2.10	Gharo-New to Jhimpir-New 220 kV Single Circuit Out

The results indicate that under all contingent conditions, the power flowing on the intact circuits are within the rated limits and the bus voltages are also within the allowable limits

6.4 Load Flow Analysis for Peak Load Case of 2020

As required by NTDC in their comments, detailed load flow studies have also been carried out for an extended term spot year of 2020. The objective is to have a comprehensive total view of wind power potential expected to be commissioned by 2020 and the adequacy of respective transmission plans to evacuate overall power not

only from wind farms but also other sources going to be added in the South by that time.

In addition to the WPPs considered in the case for 2016-17 if we consider the scope identified by AEDB nearly 550 MW is still left to be evacuated from Jhimpir area. We propose a new 500/220 kV grid station at Jhimpir which would be connected as follows:

- Double circuit of 500 kV with Matiari.
- The 220 kV of this new grid station is also proposed to be interconnected with the already proposed 220/132 kV collector substation at Jhimpir through a double circuit of 220 kV.

Other expected generation additions by the year 2020 as per NTDC Generation Schedule in South are:

Generation at Imported Coal in Jamshoro = 1200 MW

Nuclear Power Plant at Karachi = 1000 MW

In addition to 3rd circuit of 500 kV Matiari-Moro-R.Y Khan as per Transmission Plan of NTDC, more circuits of 500 kV would be required as follows to cater for all the additional power in South:

- D/C 500 kV Karachi-Nuclear to Matiari
- D/C Matiari-Moro
- D/C 500 kV Moro-R. Y. Khan

Load flow studies have been carried out with all the additional thermal and wind power generation in south and the associated additional transmission schemes discussed above. Complete scheme is shown in Sketch-5 of Appendix-4.

The results of Normal case are plotted in Exhibit 6.3.0 attached in Appendix-6.We find that all the power flows on the circuits of 132 kV, 220 kV and 500 kV are within the rated limits of these circuits. Also the bus voltages are within the permissible limits.

To fulfill N-1 criteria of Grid Code, one-line-out contingency studies have also been carried out. Their results are shown plotted in Appendix-9 as follows:

Exhibit-6.3.1	Dewan 132/22 kV Single Transformer Out
Exhibit-6.3.2	Dewan to Jhimpir-New 132 kV Single Circuit Out
Exhibit-6.3.3	Zorlu to Jhimpir 132 kV Single Circuit Out
Exhibit-6.3.4	Jhimpir to Nooriabad 132 kV Single Circuit Out
Exhibit-6.3.5	Jhimpir to Kotri GTPS 132 kV Single Circuit Out
Exhibit-6.3.6	Thatta to Jhimpir 132 kV Single Circuit Out
Exhibit-6.3.7	Jhimpir-New to T.M.Khan 132 kV Single Circuit Out
Exhibit-6.3.8	NBT-ZAB to Gharo-New 132 kV Single Circuit Out
Exhibit-6.3.9	Jhimpir-New to T.M.Khan Road 220 kV Single Circuit Out
Exhibit-6.3.10	Gharo-New to Jhimpir-New 220 kV Single Circuit Out
Exhibit-6.3.11	Jhimpir-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit-6.3.12	Jhimpir-500 to Matiari 500 kV Single Circuit Out
Exhibit-6.3.13	Matiari to Moro 500 kV Single Circuit Out

The results indicate that under all contingent conditions, the power flowing on the intact circuits are within the rated limits and the bus voltages are also within the allowable limits.

6.6 Conclusion of Load Flow results

The load flow results of the proposed scheme of interconnection of Dewan WPP in December 2015 shows no bottlenecks or capacity constraints in the adjoining 220 kV and 132 kV network in terms of absorbing all the output of Dewan WPP under normal as well as the contingency conditions.

The proposed interconnection scheme would require looping in out of one circuit of a 132 kV double circuit, emanating from Jhimpir-New 132 kV substation, at farm substation of Dewan WPP. This double circuit will also include Hawa WPP. The Greeley conductor will be used with the capacity of 184 MVA per circuit. In the load flow simulation, however, the MVA capacity is assumed to be 202.4 MVA taking into account the increase in MVA capacity of the conductors at high wind speed during high wind season.

We have also considered the scenario of the peak case of 2016-17 and an extended term scenario case of 2020. The load flow results for these scenarios also establish that the proposed scheme of interconnection of Dewan WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in terms of absorbing all the output of Dewan WPP under normal as well as the contingency conditions.

References:

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

2- *Ibid.* p.3.1

7. Short Circuit Analysis

7.1 Methodology and Assumptions

The methodology of IEC 909 has been applied in all short circuit analyses in this report for which provision is available in the PSS/E software used for these studies. For calculations of maximum fault levels the bus voltage has been assumed as 1.10 PU i.e. 10 % above the nominal as per IEC909. For calculations of minimum fault levels the bus voltage has been assumed as 0.9 PU i.e. 10 below the nominal. That covers the entire ± 10 % range of the ratings of the equipments.

7.1.1 Assumptions for maximum and minimum short circuit levels

7.1.1.1 Assumptions-Maximum short circuit levels

For evaluation of maximum short circuit levels we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the year 2015-16 to assess the impact of Dewan WPP and of the year 2020 to study the short circuit levels in an extended term scenario.

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

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

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

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

7.1.1.2Assumptions-Minimum short circuit levels

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

For assess the minimum short circuit levels we have considered off-peak conditions of 2015-16 to simulate the minimum short circuit strength of southern grid. For

DewanWPP we have assumed dispatch of 25.8 % of its capacity for the minimum short circuit calculations i.e. just one collector group with partial output of12.8 MW is on bar.

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

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

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

7.2 Fault Currents Calculations

7.2.1 Maximum short circuit levels

The short circuit levels have been calculated and plotted on the bus bars of 500 kV, 220 kV and 132 kV of substations lying in the electrical vicinity of our area of interest i.e. Jhimpir, Thatta and Gharo area, and are shown plotted in the Exhibit 7.1 for the year 2015-16 and in Exhibit 7.2 for the year 2020 attached in Appendix-7.Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-7 for the 500 kV, 220 kV and 132 kV bus bars of our interest i.e. the substations connecting in the three branches of 132 kV running South of Hyderabad up to Southern Sind coast line. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 7.1 and Table 7.2 .We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV

substations which normally are 25 kA or 31.5 kA for older substations and 40 kA for new substations.

The fault levels of Dewan 132 kV are 14.09 kA and 10.25 kA for 3-phase and single phase faults respectively in the extended term scenario of 2020. This is much less than the switchgear rating of 40 kA recommended for Dewan Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Dewan22 kV are 22.68 kA and 20.89 kA for 3-phase and single-phase faults respectively in the extended term scenario of 2020. Therefore the short circuit rating recommended for22 kV switchgear is recommended as 25 kA.

Table-7.1

Maximum Short Circuit Levels with Dewan WPP 2015-16

Substation	3-Phase fault current, kA	1-Phase fault current, kA
DEL-MV 22kV	20.58	18.69
Dewan 132 kV	10.65	7.79
Hawa 132 kV	10.65	7.79
Jhimpir-New 132 kV	16.44	13.26
Kotri GTPS 132 kV	29.44	26.51
Nooriabad 132 kV	9.17	7.88
Jamshoro Old 132 kV	26.97	22.21
HYD-TMRD 132 kV	27.60	23.08
T.M.Khan 132 kV	14.85	10.85
Jhimpir 132 kV	11.07	9.46
Thatta 132 kV	6.04	4.88
Gharo-New 132 kV	7.09	5.27
Jhimpir-New 220 kV	12.15	8.87
Gharo-New 220 kV	6.61	4.19
T.M.Khan Road 220 kV	26.12	20.61
Jamshoro 220 kV	34.38	29.96
Hala Road 220 kV	26.93	21.72

Table-7.2

Maximum Short Circuit Levels with DEL-WPP 2020

Substation	3-Phase fault current, kA	1-Phase fault current, kA
DEL-MV 22kV	22.68	20.89
Dewan 132 kV	14.09	10.25
Jhimpir 500 kV	15.79	12.7
Jhimpir-2 220 kV	27.85	25.08
Gharo-New 220 kV	9.27	5.92
Jhimpir-New 220 kV	26.03	20.62
T.M.Khan Road 220 kV	32.17	25.85
Hala Road 220 kV	32.17	26.66
Jamshoro Old 132 kV	27.81	23.3
Nooriabad 132 kV	8.05	7.3
Kotri GTPS 132 kV	26.84	23.64
Jhimpir-New 132 kV	26.04	22.54
Hawa 132 kV	14.09	10.26
HYD-TMRD 132 kV	27.65	23.5
T.M.Khan 132 kV	15.87	11.04
Jhimpir 132 kV	10.55	7.62
Thatta 132 kV	6.11	4.88
Gharo-New 132 kV	9.22	7.13

7.2.2 Minimum short circuit levels

The minimum fault levels have been calculated for minimum dispatch of power in the grid system. The plotted results of short circuit analysis are attached as Exhibit 7.3. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the faulted bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-7 for the 132 kV bus bars of our interest i.e. the substations connecting in the three branches of 132 kV running South of Hyderabad up to Southern Sind coast line. The tabular output is the detailed output showing the contribution to the fault current from

the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

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

Table-7.2

Minimum Short Circuit Levels with DEL-WPP 2015-16

Substation	3-Phase fault current, kA	1-Phase fault current, kA
DEL-MV 22kV	15.19	13.33
Dewan 132 kV	6.42	4.68
Gharo-New 220 kV	4.22	2.67
Jhimpir-New 220 kV	6.49	4.79
T.M.Khan Road 220 kV	10.97	10.41
Jamshoro 220 kV	12.73	13.00
Hala Road 220 kV	11.20	10.87
Jamshoro Old 132 kV	12.60	12.36
Nooriabad 132 kV	5.38	5.46
Kotri GTPS 132 kV	11.60	11.55
Jhimpir-New 132 kV	8.57	6.74
Hawa 132 kV	6.42	4.68
HYD-TMRD 132 kV	13.12	12.90
T.M.Khan 132 kV	8.93	7.59
Jhimpir 132 kV	6.65	5.16
Thatta 132 kV	3.63	2.65
Gharo-New 132 kV	4.85	3.47

7.3 Conclusions of Short Circuit Analysis

In order to see how much the Dewan WPP has contributed to increase the fault levels of the substations in its electrical vicinity, we compare the maximum fault levels in the peak case of 2020with the fault levels of the same bus bars in Table 3.1 (Chapter-

3) evaluated without Dewan WPP but inclusive of other Wind Farms such as FFC, ZEPL, TGF, Sapphire, Hawa and others in the Jhimpir Cluster and FWEL-I, FWEL-IIHDPPL and Tenaga in the Gharo cluster in the peak case of 2015-16 to see the impact on the short circuit levels in the area in the vicinity of Dewan WPP in the extended term after the adding DewanWPP.We find that the fault levels at Jhimpir and Jhimpir-New have increased. As a whole the fault levels at all the 132 kV bus bars are well below the short circuit rating of the equipment at these substations.

The fault levels of Dewan 132 kV are 14.09 kA and 10.25 kA for 3-phase and single phase faults respectively. This is much less than the switchgear rating of 40 kA recommended for Dewan Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Dewan 22 kV are 22.68 kA and 20.89 kA for 3-phase and single-phase faults respectively. Therefore the short circuit rating recommended for 22 kV switchgear is recommended as 25 kA.

Comparing the minimum short circuit levels of the 132 kV substations of HESCO near the Wind Farms, we find that in terms of short circuit strength, the levels at Jhimpir-New and Jhimpir 132 kV get better and the short circuit strength is improved after the interconnection of Dewan WPP in December 2015. Furthermore the short circuit strength also improves in the extended term scenario of 2020. The short circuit strength is very important for Power Quality issues like flicker, harmonics and voltage unbalance. Exhibit 7.2.1 and 7.2.2 show the results of minimum fault levels in MVA to be used in Power Quality analysis carried out in Ch.9

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

8. Transient Stability Analysis

The objective of transient stability study is to see:

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

8.1 Assumptions & Methodology

8.1.1 Type-3 WTG Dynamic Model

Dewanis considering GE-1.6-82.5-50 Hz WTG with capacity of 1.6 MWas the WTG to be installed in DewanWPP.These are Type-3 Doubly Fed Induction Generator WTGs. We have used the generic Type-3 wind turbine-generator model, which has been developed for grid studies by WECC Wind Generator Modeling Group and has been made available by Siemens–PTI to their users of PSS/E software. Type-3 is classified for doubly–fed asynchronous generators (DFAG) or doubly fed induction generators (DFIG).Only the main parameters have been incorporated in this model, whereas other details and minute control parameters have been based on assumptions in the controllers of generic model of Siemens-PTI software PSS/E.

8.2 Dynamic Impact of System Disturbances

8.2.1 Three Phase Faults, Normal Clearing Time of 5 Cycles & Trip of Circuits

The system disturbances have been simulated for this model as follows;

Three- phase fault applied at Dewan 132 kV bus bar, cleared in 5 cycles as normal clearing time i.e. 100 m seconds, followed by trip of 132 kV single circuit between Dewan-WPP and Jhimpir-New, which was significantly loaded in the pre-fault normal load flow case and its outage may cause severe impact.

Fig 8.1.1 indicates the bus voltages in pre and post fault conditions at 132 kV substations in the vicinity of Dewan WPP. We find that the voltages recover smoothly and quickly to their pre-disturbance values.

The system frequency indicated in Fig. 8.1.2 shows very nominal excursions of frequency that damps down very quickly and smoothly

The MW and MVAR output of equivalent WTG get back to normal quickly after the fault clearance as shown in Fig 8.1.3.

The dynamic response of generator is shown in Figs 8.1.4 showing the recovery of speed and mechanical power. We find that the WTG is robust enough to damp down transients in the generator speed and Pmech.

Fig 8.1.5 shows that the aerodynamic torque that dips down after fault is recovered by pitch angle control which responds quickly and restores the aerodynamic torque to normal with good damping of oscillations after fault clearance.

Fig. 8.1.6 shows no impact on shaft twist angle and quick damping of transients in aerodynamic power (Paero) on the rotor blade side.

Fig. 8.1.7 indicates no impact on turbine rotor speed and quick recovery of generator speed.

Fig. 8.1.8 shows the generator rotor angle deviation that shifts from its pre-fault value to a new value very smoothly.

Fig. 8.1.9 shows the dynamic response of pitch control and pitch compensation that acts quickly to stabilize the WTG.

The outage of 132 kV single circuit between Dewan to Jhimpir-New causes the entire output of Dewan to shift to the intact circuit between DewanWPPand Hawa WPP. This flow combines with the output of Hawa WPP to cause significant loading on the Hawa to Jhimpir-New 132 kV Single Circuit. Fig. 8.1.10 shows the transients of MW and MVAR flows on Hawa WPP and Dewan 132 kV circuit which settles the transients quickly and acquire new steady state levels soon.

The response of the adjoining power plant of Hawa WPP is shown in Fig 8.1.11, where the MW outputs of the generators recover to almost their pre-fault output levels.

The angular stability of other conventional generators of the system can be seen in Fig. 8.1.12. The relative rotor angles of Kotri 132 kV,Lakhra 132 kV, Nooriabad 132 kV, Thatta 132 kV andJamshoro 220 kVare plotted w.r.t. Hub 500 kV. The results show that they remain in synchronism with the system generators and stay stable. The angular swings are also nominal and damp quickly.

8.2.2 Three Phase Faults, Clearing Time of 9 Cycles (Stuck Breaker): LVRT Test

The worst-case fault on system may be the failure of breaker (stuck-breaker) and fault clearing with backup protection in 9 cycles. It may also be termed as testing the ride

through capability (LVRT) of Wind Power Plant for clearing time of 9 cycles i.e. 180 ms which is a criterion set out in the Grid Code to be fulfilled.

Three- phase fault applied at Dewan 132 kV bus bar, cleared in 9 cycles i.e. 180 ms, followed by trip of 132 kV single circuit between Dewan-WPP and Jhimpir-New, which was significantly loaded in the pre-fault normal load flow case and its outage may cause severe impact.

The same set of variables has been monitored as of the previous normal clearing case and plotted results discussed as follows.

Fig 8.2.1 indicates the bus voltages in pre and post fault conditions at 132 kV substations in the vicinity of Dewan WPP. We find that the voltages recover smoothly and quickly to their pre-disturbance values.

The system frequency indicated in Fig. 8.2.2 shows very nominal excursions of frequency that damps down very quickly and smoothly

The MW and MVAR output of equivalent WTG get back to normal quickly after the fault clearance as shown in Fig 8.2.3.

The dynamic response of generator is shown in Figs 8.2.4 showing the recovery of speed and mechanical power. We find that the WTG is robust enough to damp down transients in the generator speed and Pmech.

Fig 8.2.5 shows that the aerodynamic torque that dips down after fault is recovered by pitch angle control which responds quickly and restores the aerodynamic torque to normal with good damping of oscillations after fault clearance.

Fig. 8.2.6 shows no impact on shaft twist angle and quick damping of transients in aerodynamic power (Paero) on the rotor blade side.

Fig. 8.2.7 indicates no impact on turbine rotor speed and quick recovery of generator speed.

Fig. 8.2.8 shows the generator rotor angle deviation that shifts from its pre-fault value to a new value very smoothly.

Fig. 8.2.9 shows the dynamic response of pitch control and pitch compensation that acts quickly to stabilize the WTG.

The outage of 132 kV single circuit between Dewan to Jhimpir-New causes the entire output of Dewan to shift to the intact circuit between Dewan WPP and Hawa WPP. This flow combines with the output of Hawa WPP to cause significant loading on the

Hawa to Jhimpir-New 132 kV Single Circuit. Fig. 8.2.10 shows the transients of MW and MVAR flows on Hawa WPP and Dewan 132 kV circuit which settles the transients quickly and acquire new steady state levels soon.

The response of the adjoining power plant of HawaWPP is shown in Fig 8.2.11, where the MW outputs of the generators recover to almost their pre-fault output levels.

The angular stability of other conventional generators of the system can be seen in Fig. 8.2.12. The relative rotor angles of Kotri 132 kV, Lakhra 132 kV, Nooriabad 132 kV, Thatta 132 kV and Jamshoro 220 kV are plotted w.r.t. Hub 500 kV. The results show that they remain in synchronism with the system generators and stay stable. The angular swings are also nominal and damp quickly.

8.3 Dynamic Impact of Wind Farm Disturbances

8.3.1 Sudden Loss of a group of WTGs

We have simulated the sudden loss of a group of WTGs, i.e. loss of one equivalent WTG of 12.8 MW representing a collector group. This happens due to 3-phase fault on the MV bus of Dewan Farm substation and cleared by tripping of a collector cable. The fault clearing at 22 kV is assumed as 10 cycles (200 ms). The following variables are monitored

Fig 8.3.1 indicates the bus voltages in pre and post fault conditions at 132 kV substations in the vicinity of DewanWPP. We find that the voltages recover smoothly and quickly to their pre-disturbance values.

The system frequency indicated in Fig. 8.3.2 shows very nominal excursions of frequency that damps down very quickly and smoothly

The MW and MVAR output of one equivalent WTG collector group get back to normal quickly after the fault clearance and outage of one collector group as shown in Fig 8.3.3.

The dynamic response of generator is shown in Figs 8.3.4 showing the recovery of speed and mechanical power. We find that the WTG is robust enough to damp down transients in the generator speed and Pmech.

Fig 8.3.5 shows that the aerodynamic torque that dips down after fault is recovered by pitch angle control which responds quickly and restores the aerodynamic torque to normal with good damping of oscillations after fault clearance.

Fig. 8.3.6 shows no impact on shaft twist angle and quick damping of transients in aerodynamic power (Paero) on the rotor blade side.

Fig. 8.3.7 indicates no impact on turbine rotor speed and quick recovery of generator speed.

Fig 8.3.8 shows the generator rotor angle deviation that shifts from its pre-fault value to a new value very smoothly.

Fig. 8.3.9 shows the dynamic response of pitch control and pitch compensation that acts quickly to stabilize the WTG.

8.3.10 shows the transients of MW and MVAR flows on Dewan WPP 132/22 kV transformer which settles the transients quickly and acquires new steady state levels soon.

The response of the adjoining power plant of HawaWPPis shown in Fig 8.3.11, where the MW outputs of the generators recover to almost their pre-fault output levels.

The angular stability of other conventional generators of the system can be seen in Fig. 8.3.12. The relative rotor angles of Kotri 132 kV, Lakhra 132 kV, Nooriabad 132 kV, Thatta 132 kV and Jamshoro 220 kV are plotted w.r.t. Hub 500 kV. The results show that they remain in synchronism with the system generators and stay stable. The angular swings are also nominal and damp quickly.

8.3.2 Sudden Loss of one of 132/22 kV Transformer in the Farm Substation

The sudden trip of 132/22 kV transformer in the Dewan Farm is caused with the clearing of 3-phase fault on MV bus of Farm substation.

Fig 8.4.1 indicates the bus voltages in pre and post fault conditions at 132 kV substations in the vicinity of Dewan WPP. We find that the voltages recover smoothly and quickly to their pre-disturbance values.

The system frequency indicated in Fig. 8.4.2 shows very nominal excursions of frequency that damps down very quickly and smoothly

The MW and MVAR output of equivalent WTG get back to normal quickly after the fault clearance as shown in Fig 8.4.3.

The dynamic response of generator is shown in Figs 8.4.4 showing the recovery of speed and mechanical power. We find that the WTG is robust enough to damp down transients in the generator speed and Pmech.

Fig 8.4.5 shows that the aerodynamic torque that dips down after fault is recovered by pitch angle control which responds quickly and restores the aerodynamic torque to normal with good damping of oscillations after fault clearance.

Fig. 8.4.6 shows no impact on shaft twist angle and quick damping of transients in aerodynamic power (Paero) on the rotor blade side.

Fig. 8.4.7 indicates no impact on turbine rotor speed and quick recovery of generator speed.

Fig 8.4.8 shows the generator rotor angle deviation that shifts from its pre-fault value to a new value very smoothly.

Fig. 8.4.9 shows the dynamic response of pitch control and pitch compensation that acts quickly to stabilize the WTG.

The loss of one 132/22 kV Transformer at Dewan-WPP Farm Substation causes the entire output of Dewan WPP to flow on the intact 132/22 kV Transformer at Dewan WPP Farm Substation. 8.4.10 shows the transients of MW and MVAR flows on the intactDewan WPP 132/22 kV transformer which settles the transients quickly and acquires new steady state levels soon.

The response of the adjoining power plant of Hawa is shown in Fig 8.4.11, where the MW outputs of the generators recover to almost their pre-fault output levels.

The angular stability of other conventional generators of the system can be seen in Fig. 8.4.12. The relative rotor angles of Kotri 132 kV, Lakhra 132 kV, Nooriabad 132 kV, Thatta 132 kV and Jamshoro 220 kV are plotted w.r.t. Hub 500 kV. The results show that they remain in synchronism with the system generators and stay stable. The angular swings are also nominal and damp quickly.

8.4 Dynamic Impact of Faults on 220 kV Primary System

8.4.1 Three Phase Faults, Normal Clearing Time of 5 Cycles & Trip of Circuit

The system disturbances have been simulated for this model as follows;

Three- phase fault applied at Jhimpir-New 220 kV bus bar, cleared in 5 cycles as normal clearing time i.e. 100 m seconds, followed by trip of 220 kV single circuit

between Jhimpir-New to T.M. Khan Road, which was significantly loaded in the pre-fault normal load flow case and its outage may cause severe impact.

Fig 8.5.1 indicates the bus voltages in pre and post fault conditions at 220 kV Substations and 132 kV in the vicinity of Jhimpir-New the impact on the 132 and 22 kV Bus Bars of Dewan WPP. We find that the voltages recover smoothly and quickly to their pre-disturbance values.

The system frequency indicated in Fig. 8.5.2 shows very nominal excursions of frequency that damps down very quickly and smoothly

The MW and MVAR output of equivalent WTG get back to normal quickly after the fault clearance as shown in Fig 8.5.3.

The dynamic response of generator is shown in Figs 8.5.4 showing the recovery of speed and mechanical power. We find that the WTG is robust enough to damp down transients in the generator speed and Pmech.

Fig 8.5.5 shows that the aerodynamic torque that dips down after fault is recovered by pitch angle control which responds quickly and restores the aerodynamic torque to normal with good damping of oscillations after fault clearance.

Fig. 8.5.6 shows no impact on shaft twist angle and quick damping of transients in aerodynamic power (Paero) on the rotor blade side.

Fig. 8.5.7 indicates no impact on turbine rotor speed and quick recovery of generator speed.

Fig 8.5.8 shows the generator rotor angle deviation that shifts from its pre-fault value to a new value very smoothly.

Fig. 8.5.9 shows the dynamic response of pitch control and pitch compensation that acts quickly to stabilize the WTG.

The outage of 220 kV single circuit between Jhimpir-New to T.M Khan Road causes the entire output of that circuit to shift to the intact 220 kV circuit between Jhimpir-New and T.M. Khan Road. Fig. 8.5.10 shows the transients of MW and MVAR flows on Jhimpir-New to T.M. Khan 220 kV circuit which settles the transients quickly and acquire new steady state levels soon.

The response of the adjoining power plant of Hawa is shown in Fig 8.5.11, where the MW outputs of the generators recover to almost their pre-fault output levels.

The angular stability of other conventional generators of the system can be seen in Fig. 8.5.12. The relative rotor angles of Kotri 132 kV, Lakhra 132 kV, Nooriabad 132 kV, Thatta 132 kV and Jamshoro 220 kV are plotted w.r.t. Hub 500 kV. The results show that they remain in synchronism with the system generators and stay stable. The angular swings are also nominal and damp quickly.

8.5 Conclusion of Stability Study

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

There are no constraints of connecting Dewan WPP with the NTDC/HESCO grid in terms of transients or dynamic behavior of system under the disturbed conditions either on the Farm side or on the Grid side.

9- Power Quality

The issues of power quality are of particular importance to wind turbines that may cause flicker and distortions in the power supply due to harmonics and unbalance. These issues are more significant for weak systems of low short circuit strength. Therefore we have investigated these issues for the case of minimum short circuit of 2015-16 for the proposed scheme of interconnection. The same case has been re-evaluated with per unit MVA values and plotted for 3-phase faults in Exhibits7.3.1 and 7.3.2 in Appendix-7

9.1 Flicker

We have used IEC61400-21 for the calculations of flicker levels for steady-state continuous operation and for switching conditions [1].

9.1.1 Continuous Operation

The probability of 99th percentile flicker emission from a single wind turbine during continuous operation for short time $P_{st\Sigma}$ and longer time flicker levels $P_{lt\Sigma}$ are assumed same and calculated by the following formula

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

where

$c(\psi_k, v_a)$ is the flicker coefficient of the wind turbine for the given network impedance phase angle, ψ_k at the PCC, and for the given annual average wind speed, v_a at hub-height of the wind turbine at the site;

S_n is the rated apparent power of the wind turbine;

S_k is the short-circuit apparent power at the PCC.

N_{wt} is the number of wind turbines connected to the PCC.

PCC is the point of common coupling of WTGs that is MV bus of DewanFarmsubstation.

For minimum short circuit case we have assumed the same case as discussed in paragraph 7.3.1 of Chapter 7in which output of DewanWind farm reduced as low as

25.8 % of its rated capacity. Therefore taking one collector group as one equivalent generator of 8x1.6 MW we have calculated as follows;

S_n= 1.828 MVA at 0.90 PF

N_{WT} = 8

$S_k$for MV bus = 580 MVA

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

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

where

S_n is the rated apparent power of the wind turbine;

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

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

Putting this data in the above Equation, we find

$$P_{St\Sigma} = P_{lt\Sigma} = 0.00891 = 0.891\ \%$$

Whereas the acceptable value is 4 % as mentioned in Ref. [2]. Therefore we are much less than the maximum permissible level and the WTGs at Dewan Wind farm would not cause any flicker problem during steady state operation even in the weakest system conditions of minimum short circuit level.

10.1.2 Switching Operation

The most common switching operations would be as follows;

a. Wind turbine start-up at cut-in speed
b. Wind turbine start-up at rated wind speed
c. The worst case of switching between the WTGs

The flicker emission from the wind farm of many machines can be calculated by the following equation as per IEC61400-21 (Section 8.3.2)

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

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

where

$N_{10,i}$ and $N_{120,i}$	are the number of switching operations of the individual wind turbine within a 10 min and 2 h period respectively;
$k_{f,i}(\psi_k)$	is the flicker step factor of the individual wind turbine;
$S_{n,i}$	is the rated power of the individual wind turbine.

The values of N_{10} and N_{120} are usually provided by the manufacturers based on field measurements, but if these are not available then IEC61400-21 proposes in section 7.6.3 to use as follows;

For switching conditions of (a) and (b)

$N_{10} = 10$

$N_{120} = 120$

For switching conditions of (c)

$N_{10} = 1$

$N_{120} = 12$

The value of flicker step factor $k_{f,i}$ (ψk) is also provided by the manufacturer after the field and factory measurements; but for the present analysis we assume it to be equal to 1.

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

$P_{St\Sigma} = 0.197$

$P_{lt\Sigma} = 0.189$

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

Engineering Recommendation P28 (Electricity Association, 1989) specifies an absolute maximum of P_{St} on a network from all sources to be 1.0 with a 2 hour P_{St} value of 0.6. However, extreme caution is advised if these limits are approached as

the risk of complaints increases when the limits are reached, therefore, an assessment method proposed in the same document is based on P_{St}not exceeding 0.5. British Standard (1995) is less stringent specifying that over a one week period P_{lt} must be less than 1 for 95 % of the time. Gardner (1996) describes P_{St} limits from a number of utilities in the range of 0.25 to 0.5 [2].

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

10.2 Voltage Unbalance

9.2.1 Voltage Step-Change

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

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

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

Where

S_{WKA} = MVA rating of the WTG

S_{KE} = Short circuit MVA at connection point

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

For the minimum short circuit case, we have calculated minimum fault levels in MVA as shown in Exhibit 7.3.2

S_{WKA} = 1.828 MVA for the equivalent WTG of a collector group for the minimum case

S_{KEI} for one WTG in collector group = 490 MVA (Exhibit 7.2.2)

S_{KSS} = 560 MVA (Exhibit 7.2.2)

Substituting these values we get

$$\Delta V = 0.000466 = 0.0466\ \%$$

Which is much less than the limit of 3 %

9.2.2 Voltage Fluctuation

For the limits of voltage fluctuation, we need to satisfy the following equation [2].

$$\sqrt{\sum} (P_{WKA} / S_{KE})^2 \leq 1/25 \text{ or } 4\ \%$$

Where

P_{WKA} = MW rating of the WTG

S_{KE} = Short circuit MVA at connection point

Punching all the numbers in this equation, we get

Voltage Fluctuation = 0.003306 = 0.331%

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

9.3 Harmonics

Regarding harmonics, IEC61400-21 states as follows [1];

"A wind turbine with induction generator directly connected to the electrical system (i.e. without a power electronic converter) is not expected to cause any significant harmonic distortion. Hence this standard does not require any further assessment of these.

"For a wind turbine with a directly connected synchronous generator (without a power electronic converter)....the wind turbine will only give a very limited emission of harmonic currents, and hence this standard does not require any further assessment of these."

Therefore we have to look into the harmonic phenomena for a wind turbine with a power electronic converter. The important thing would be to see if the resonance of harmonics generated from the WTG occurs at or near odd-harmonic frequency or not. For this purpose we carried out frequency scan by employing a state of art software PSCAD / EMTDC. The system uptoKotri, Jamshoro-old and Thatta has been modeled in detail however the system behind these nodes has been represented by an equivalent voltage source. These equivalents have been developed from the Short Circuit cases of PSS/E discussed earlier in Chapter 7.

The frequency has been scanned through a spectrum of impedance values of this equivalent circuit at the node of Dewan-WPP 22 kV, which is the medium voltage bus of the Wind Farm substation. If harmonic resonance is controlled at this node then all the emissions of harmonics are well contained within the Farm itself. The switched shunt capacitor banks installed at MV bus bar for voltage regulation would play an important role in causing or avoiding harmonic resonance. So we have carried out the frequency scan with and without the switched shunt capacitor banks at MV bus of 22 kV for a range of 0 to 2000 Hz i.e. from fundamental frequency to 40th harmonic. However, the results have been plotted in the figures for a frequency range up to 750 Hz i.e. upto 15th harmonic, because the frequencies beyond that value are of less importance, and once the resonant point occurs at some frequency up to that range, then it would normally not recur after that.

9.3.1 Without Switched Shunt Capacitor Banks

The frequency versus positive and zero sequence resistance and reactance i.e., R_+ R_0, X_+, X_0, are shown plotted in Figures 9.1.1, 9.1.2, 9.1.3 and 9.1.4.

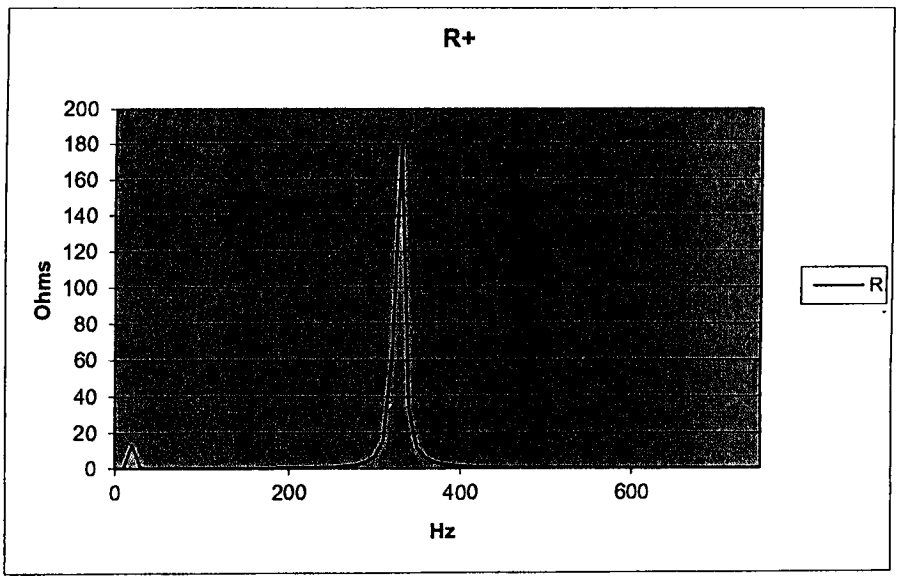


Fig 9.1.1

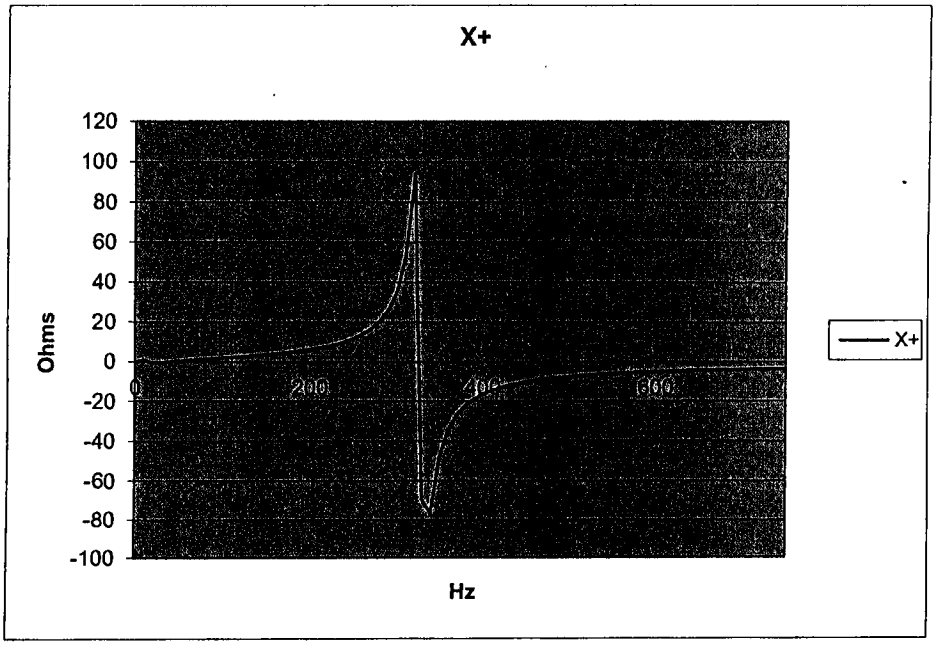


Fig 9.1.2

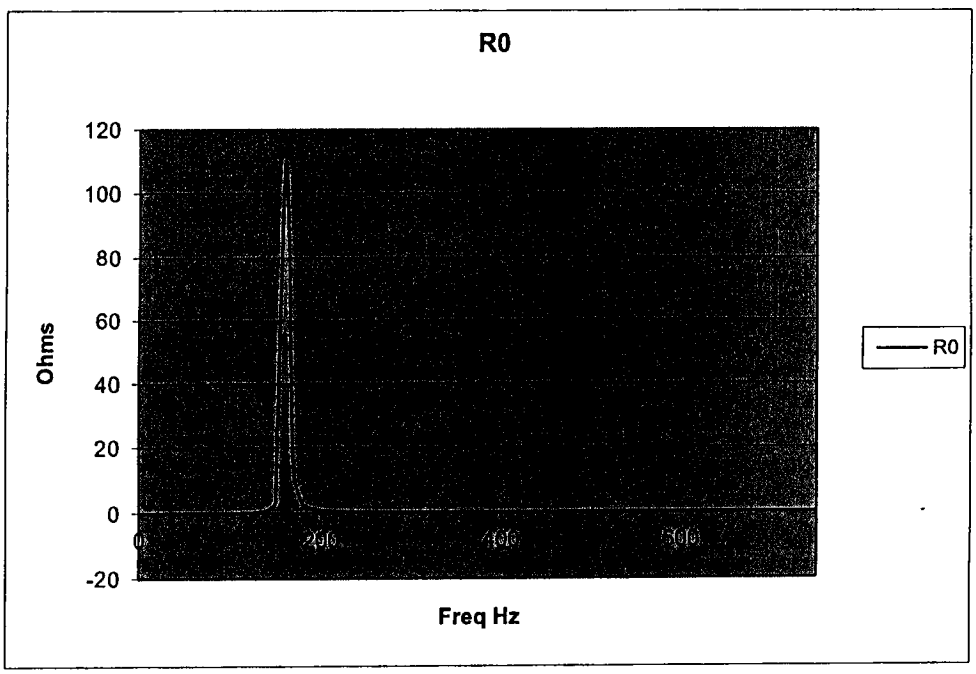


Fig 9.1.3

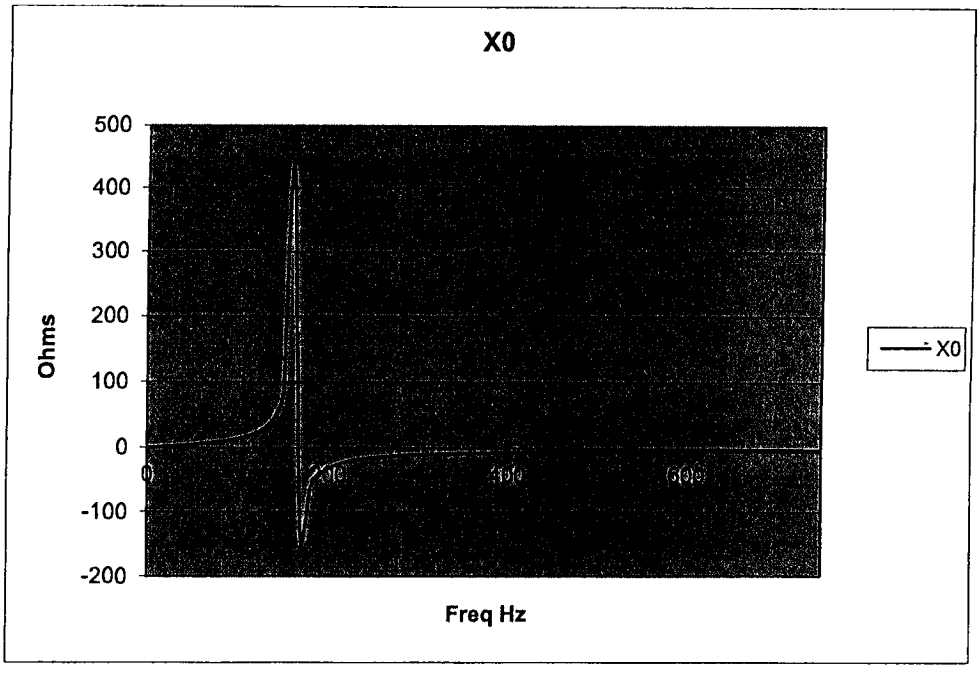


Fig 9.1.4

The curves of resistance $R_+ R_0$ show their highest value to occur at the resonance point whereas the reactance curves show the point of resonance where the curve crosses zero i.e. it changes sign from positive to negative and its value becomes zero. Resonance is a phenomenon when inductive reactance X_L and the capacitive reactance X_C becomes equal and cancels each other giving net reactance as zero. We find from the figures that the point of resonance for positive sequence occurs at 330 Hz, which is quite close to 7th harmonic i.e. 350 Hz; whereas for zero sequence the resonance occurs at 170 Hz which is close to 3rd harmonic i.e. 150 Hz. We see that both the 7th and the 3rd harmonic are odd harmonics and resonance at these points should be avoided.

9.3.2 With Switched Shunt Capacitor Banks

As we know that already we have proposed a switched shunt capacitor bank of 20 MVAR at MV bus of 22 kV for voltage regulation and reactive power compensation of the WTG consuming VARs. Therefore, we now see the impact of this capacitor bank on harmonic resonance. The PSCAD simulation has been run for frequency

scanning and the results are shown plotted in Figs 9.2.1, 9.2.2, 9.2.3 and 9.2.4 respectively for positive and zero sequence resistance and reactance.

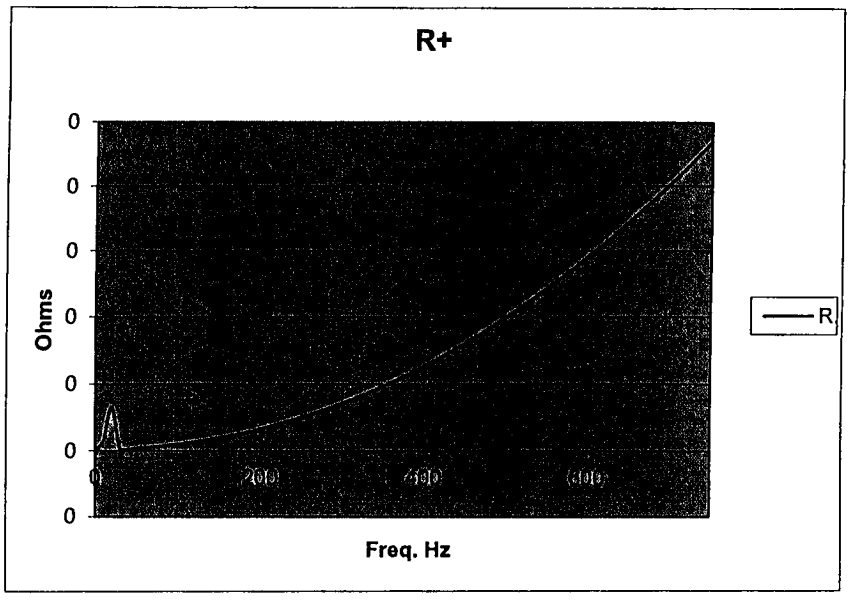


Fig 9.2.1

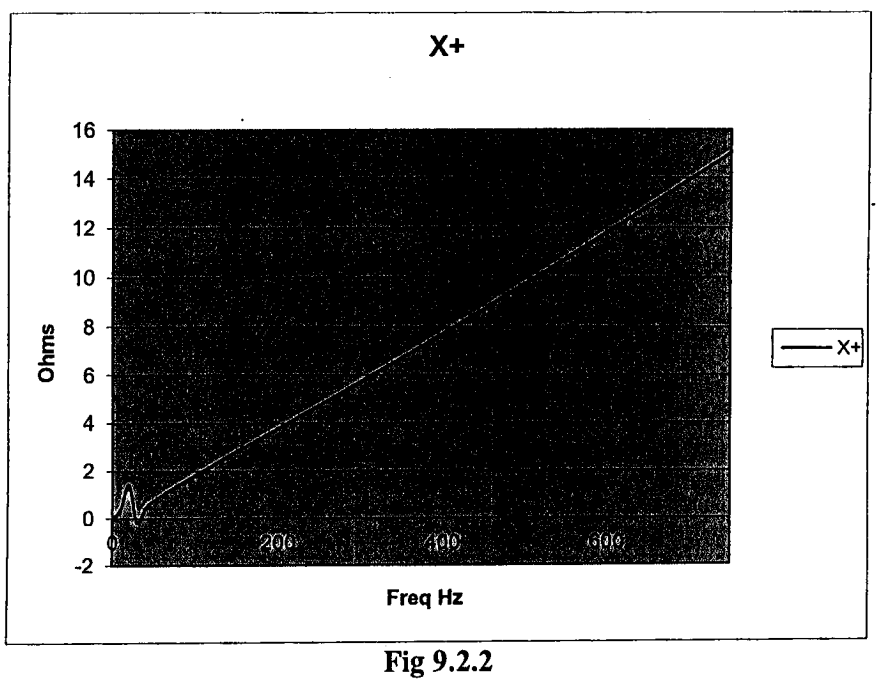


Fig 9.2.2

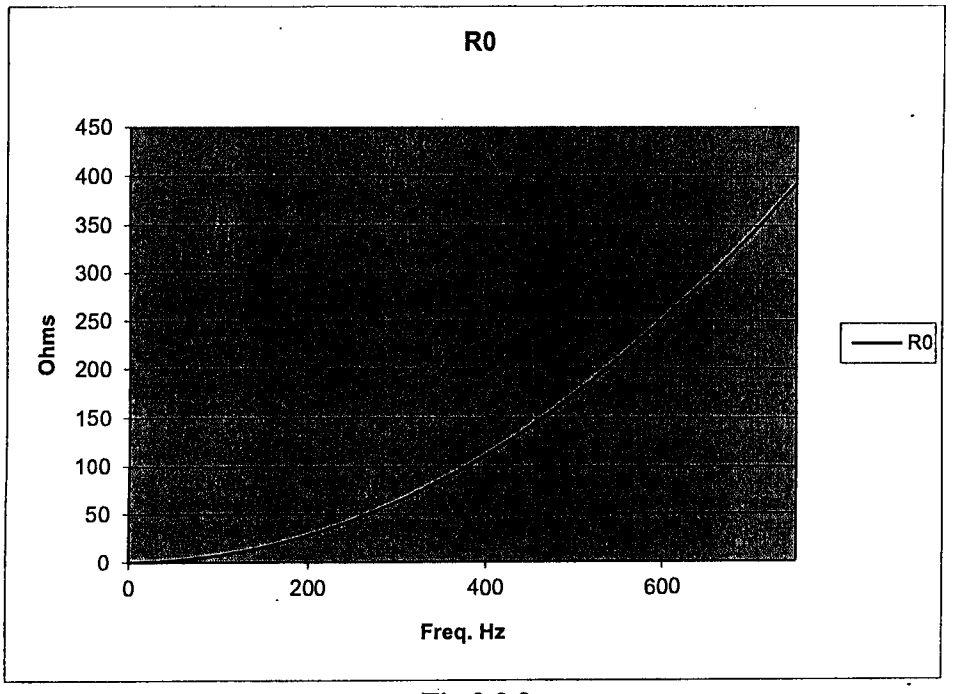


Fig 9.2.3

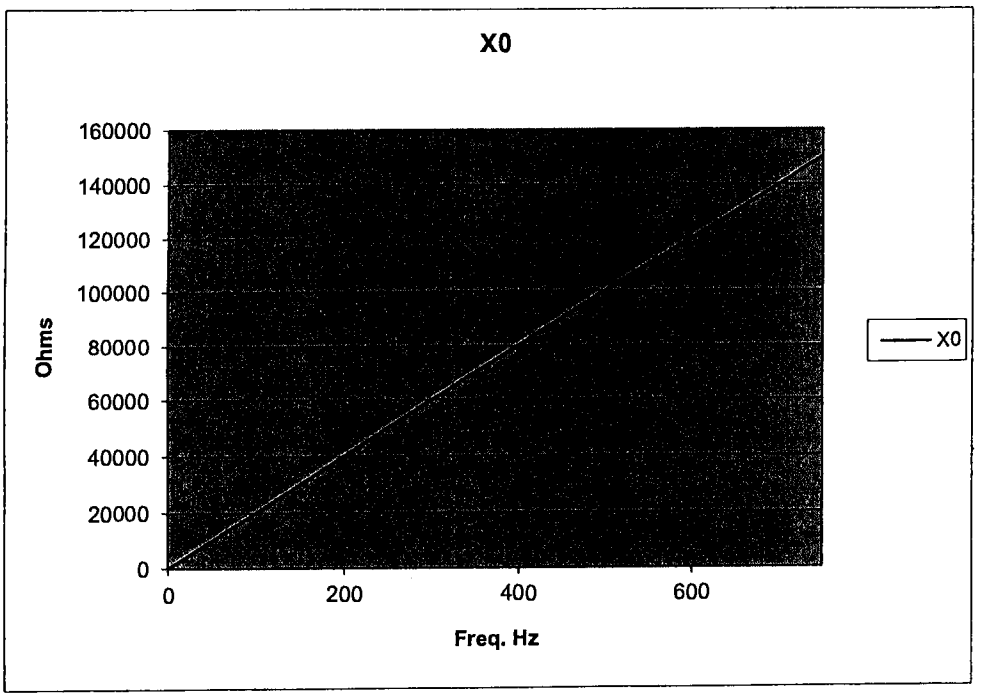


Fig 9.2.4

The results show that there is no zero crossing or change of signs of reactance or a maxima-minima of resistance showing no resonance i.e. the resonance point is detuned permanently not to occur at all. This role of capacitor banks to filter all the harmonics well within the farm field is an additional benefit of this capacitor bank.

References

1- *Wind Turbine Generator Systems*, IEC61400-21 First edition 2001-12; Part 21; Chapters 6, 7 and 8.

2- *Wind Energy Handbook*; John Wiley & Sons Ltd. 2001, Chapter 10.

10- Conclusions & Recommendations

1. DewanEnergy Wind Power Plantwould be connected by a double circuit of 132kV looping in-out with a sub cluster already connecting another 50 MW Wind Power Plant, HAWA WPP to Jhimpir-New 220/132 kV collector substation.
2. The scheme of interconnection of Dewan WPP presupposes the following reinforcement already in place in Jhimpir and Gharo clusters by December 2015:
   - 220/132 kV Jhimpir-New substation at suitable location in Jhimpir cluster
   - 70 km long double circuit from Jhimpir-New 220 kV Substation to the existing T.M. Khan Road 220 kV Substation
   - A 132kV double circuit of 82 km using Greeley conductor would be constructed to connect Jhimpir-New 220/132 kV Substation with T.M. Khan in HESCO network.
   - 220/132 kV Gharo-New substation at suitable location in Gharo cluster
   - 75 km long 220 kV double circuit from Gharo-New 220 kV Substation to Jhimpir-New 220 kV Substation
   - Five sub-collectors groups will be connected to Jhimpir 220/132 kV collector substation through 132 kV double circuits using Greeley Conductor
   - FFC and Zorlu looped in-out with Jhimpir-Nooriabad 132 kV circuit.
   - Two WPPs in the collector system of Gharo 220/132 kV substation
   - FWEL-I and FWEL-II through a 64 km long 132 kV D/C on Greeley conductor connected to Thatta
   - Rehabilitation of the exiting 132 kV lines in the vicinity of WPP clusters, i.e. Jhimpir-Kotri, Jhimpir-Thatta, Thatta-Sujawal and Nooriabad-Jamshoro Old.
3. The grid facilities at 132 kV for the testing of individual turbines at Dewan WPP should be made available by June 2015 whereas the grid facilities for evacuating the full output of Dewan WPP should be made available by December 2015

when the 220 kV part of the Jhimpir-New 220/132 kV Substation will be commissioned.

4. The existing grid system of HESCO and NTDC in the vicinity of Dewan WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Dewan WPP and no bottlenecks or constraints have been found in the grid system.
5. Wind Farm of Dewan has been modeled considering the GE-1.6-82.5-50 Hz WTG with capacity of 1.6 MW, which is a doubly fed induction generator (DFIG)Type-3 WTGs with terminal voltage of 0.69 kV. The medium voltage level of wind farm has been selected as 22 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Farm substation to connect to the HESCO/NTDC Grid.
6. A conceptual design of scheme of 132/22 kV substation of Dewan Wind Farm has been laid down as follows

   iv. For 22 kV;

      a. Two single bus-sections of22 kV with a bus sectionalizer
      b. Fourbreaker bays to connect four collector circuits from fourcollector groups of WTGs
      c. Two breaker bays to connect two 132/22 kV transformers
      d. Two breaker bays to connect two switched shunt capacitor banks of 2 x (4x2.5) MVAR, one in each bus section
      e. Two breaker bays to connect two station auxiliary transformers 22/0.4 kV, 315 kVA

   v. For 132 kV;

      f. Single bus with Sectionalizer if Farm substation is GIS
      g. Double bus bars with a Bus Coupler if Farm substation is AIS
      h. Two breaker bays to connect two 132/22 kV transformers

i. The protection scheme would be designed in compliance of NTDC requirements sent by Chief Engineer Protection, vide letter No.3416-19/CE/SP/MN/50MW CWE WPP Jhimpir dated 23/07/2010

j. The telecommunication scheme would be designed in compliance of NTDC requirements sent by Chief Engineer Telecommunication, vide letter No. CE (Tel)/NTDC/232/4372 dated 27/08/2010.

vi. Other Equipment:

a. Two 132/22 kV, 31.5/40/50 MVA ONAN/ONAF1/ONAF2 OLTC transformers, 132±11×1%/22kV, to fulfill N-1 criteria of Grid Code

b. Two station auxiliary transformers of 22/0.4 kV, 315 kVA

c. Two switched shunt capacitor banks each of the size of 10 MVAR (4 x 2.5 MVAR) to provide 20 MVAR at 22 kV with contactors and PLC (Programmable Logic Controller).

d. Energy meters would be installed on HV side (132 kV) of the 132/22kV transformers.

7. Load flow analysis has been carried out for December 2015 considering the COD targeted by Dewan, for the dispersal of load from Dewan WPP into HESCO Grid at 132 kV level using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme (item-2) has been evolved by performing the load flow studies testing the steady state performance for normal as well as N-1 contingency conditions fulfilling the Grid Code criteria of Wind Power Plants. The reactive power requirement at point of common coupling to meet PF of ± 0.95, voltage and line loading criteria are fulfilled by these studies. The grid facilities of HESCO are found adequate to absorb output power of DewanWPP. Load flow analysis was also carried out for the peak case of 2016-17 and an extended term scenario case of 2020. The load flow results for these scenarios also establish that the proposed scheme of interconnection of Dewan WPP shows no bottlenecks or capacity constraints in the adjoining 500 kV, 220 kV and 132 kV network in

terms of absorbing all the output of Dewan WPP under normal as well as the contingency conditions.

8. Maximum and minimum short circuit levels for three-phase faults and single-phase faults have been evaluated. The maximum short circuit level has been evaluated for the year 2015-16 and 2020 and the minimum short circuit level has been evaluated for 2015-16 to evaluate the most stringent conditions, and it has been found that the proposed scheme provides maximum SC strength for the evacuation of Dewan WPP power to the grid.

   The switchgear ratings for DEL WPP substation are as follows:

   132 kV:

   Short circuit rating = 40 kA (3 sec.)

   Continuous rating = 2500 A

   22 kV:

   Short circuit rating = 25 kA (3 sec.)

   Continuous rating = 2500 A

9. Transient Stability analysis has been carried out forDewan WPP based on their selection ofType-3 WTGs, with connectivity of proposed scheme. Different disturbances have been simulated to apply stresses from the system faults on the wind farm and vice versa and it was found that Dewan WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Dewan WPP side did not cause any stress on the main grid or the power plants in HESCO area viz. Kotri, Lakhra or Jamshoro such that the whole system remained stable under all events.
10. The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault clearing due to stuck- breaker (breaker failure) reason. The simulations have proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.
11. The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and

unbalance are within the permissible limits of IEC and other International Standards.

There are no technical constraints whatsoever in the way of bringing in the 50 MW of Dewan Wind Power Plant at the proposed site and scheduled time of commissioning, in any respect of steady state (load flow) or short circuit or dynamic performance (stability) or power quality issues related to this plant.

NATIONAL TRANSMISSION & DESPATCH CO. LTD.

General Manager Planning Power, NTDCL

No. GMPP/CEMP/TRP-380/WPP/DEPL/ 422-25 Dated: 29-01-2014

General Manager (CPPA)
107-WAPDA House
Lahore.
Fax #: 042-99201179

Sub: **Vetting of Interconnection Study Report for 50MW Wind Power Project (WPP) by M/s Dewan Energy (Private) Limited (DEPL) at Jhimpir, District Thatta, Sindh**

Ref: CPPA letter No. COO/GM/CPPA/CE-II/MT-IV/DEPL/148-50 dated 09-01-2014

This office has reviewed the final draft report and electronic PSS/E study files of the subject wind power project submitted by its consultant M/s PPI. In this regard, it has been found that the consultant has incorporated all the comments discussed in meeting with reference to our letter No. GMPP/CEMP/TRP-380/WPP/DEPL/4052-56 dated 12-06-2013. Moreover, the report has been updated by its consultant as per revised interconnectivity plan of Wind Power Projects with reference to MD NTDCL letter No. MD/NTDCL/PS/4403-13 dated 09-12-2013.

The results of the load flow, short circuit and transient stability analysis along with the contents of the subject report have been found appropriate in accordance with NTDC Grid Code, therefore, the subject final report of Interconnection Study of Dewan Wind Power Project is vetted.

29-01-2014

(R. S. Rehan)
General Manager Planning Power, NTDCL

cc:

i) Chief Executive Officer AEDB, House No.3, Street No.6, F-8/3 Islamabad. (Fax: 051-8358786)
ii) Engr. Saleem Siddiqui, Director Projects, M/s Dewan Energy (Pvt) Limited, 7th Floor Block 'A', Finance & Trade Centre, Shahrah-e-Faisal, Karachi. (Fax: 021-35630860)
iii) M/s Power Planner International, 66-H/2, WAPDA Town, Lahore. (Fax: 042-35183166)

- *Master File (MP)*

NATIONAL TRANSMISSION & DESPATCH CO. LTD

Chief Operating Officer /
General Manager (CPPA) NTDCL

No.COO/GM/CPPA/CE-II/MT-IV/DEPL/ 723-27 Dated: 04.02.2014

Mr. Umer Iftikhar
Project Development Manager (Technical),
M/s Dewan Energy (Pvt) Limited,
Ground Floor, OICCI Building,
I.I. Chundrigar Road,
Karachi.

Subject: **Vetting of Final Report of Electrical Grid Interconnection Study for 50 MW Wind Power Project (WPP) by M/s Dewan Energy (Private) limited (DEPL) Wind Power (Pvt) Limited at Jhimpir, District Thatta, Sindh**

General Manager Planning (Power) NTDC vide letter No. GMPP/CEMP/TRP-380/WPP/DEPL/422-25 dated 29.01.2014 **(copy enclosed)** vetted the Final Report of Electrical Grid Studies of 50 MW WPP by M/s Dewan Energy (Private) Limited (DEPL) at Jhimpir.

DA/As above

(Husnaine Zafar Hashmi)
Manager (Tech-IV)CPPA/NTDCL

CC:

i. Chief Executive Officer AEDB, 2nd Floor, OPF Building, G-5/2, Islamabad.
ii. General Manager Planning (Power) NTDC, 5th Floor, PIA Tower, Egerton Road, Lahore w.r.t his letter referred above.
iii. M/s Power Planners International (PPI), 66-H/2, WAPDA Town, Lahore
iv. PA to COO/GM (CPPA), 229-WAPDA House, Lahore.
• Master File