北方国际
NORINCO international

LICENSE PROPOSED MODIFICATION APPLICATION
FOR
100 MW NORINCO INTERNATIONAL THATTA POWER PRIVATE LIMITED WIND POWER PROJECT AT JHIMPIR, SINDH

NORINCO Intl Thatta Power
北方国际萨塔电力

21-02-2019

The Registrar
National Electric Power Regulatory Authority
NEPRA Tower
Islambad.

Subject: Licensee Proposed Modification Application for 100MW Norinco International Thatta Power Private Limited

Dear Sir,

I, Fahad Usman, being the duly authorized representative of 100 MW Norinco International Thatta Power Private Limited by virtue of Board Resolution dated 23rd -01-2019 hereby apply to the National Electric Power Regulatory Authority for the modification of Generation License No. WPGL/36/2016 dated 4th February, 2016 AND Generation License No. WPGL/51/2017 dated 27th November2017, pursuant to section to Regulation 10(2) of the National Electric Power Regulatory Authority (Application and Modification Procedure) Regulations, 1999 (the "AMPR").

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 Licensing (Application and Modification Procedure) 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 in belief.

A BANK DRAFT in sum of Rs. 409,800/- being the non-refundable modification of Generation license fee calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

The application is filed in triplicate with all annexure appended with each set of the application.

Thank & Regards

Fahad Usman
Asst. Executive Engineer

NITPPL

NORINCO International Thatta Power (PVT.) Limited 北方国际萨塔电力有限公司
Suite No. 101, 1st Floor, Horizon Vista, Block 4, Clifton, Karachi, Pakistan
UAN: +92-21-111-111-275 PABX: +92-21-35371833-34 +92-21-35171835-36 Email: norinco-power@qq.com

NORINCO Intl Thatta Power
北方国际萨塔电力

21 February 2019

Registrar
National Electric Power Regulatory Authority (NEPRA)
NEPRA Tower,
Islamabad

Subject: Cancellation Generation License No. WPGL/ 51/ 2017of Norinco International Thatta Power (PVT) Ltd (NORINCO-2),

Dear Sir,

With reference to the subject, we were applied for two wind power projects of NITPPL i.e. Norinco-I 50 MW and Norinco-II 50 MW separately and got approved both generation license. (Copy enclosed for your ready reference)

Now we have merged our project into 100MW and soon we will apply for license proposed modification in the authority to move forward.

We request you to please cancel our Generation License No. WPGL/ 51/ 2017 dated incorporate under section - 32 of the company ordinance 1984.

Feel free to contact me for any further clarifications.

Thank & Regards

Zhang Yong
Company Secretary

Received
Seal
Date 22/02/19
Signature

NORINCO International Thatta Power (PVT.) Limited 北方国际萨塔电力有限公司
Suite No. 101, 1st Floor, Horizon Vista, Block 4, Clifton, Karachi, Pakistan
Email: norinco-power@qq.com

National Electric Power Regulatory Authority
(NEPRA)
Islamabad – Pakistan

GENERATION LICENCE

No. WPGL/51/2017

In exercise of the Powers conferred under Section-15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997, the Authority hereby grants the Generation Licence to:

NORINCO INTERNATIONAL THATTA POWER (PVT.) LIMITED

Incorporated Under Section-32 of the Companies Ordinance 1984 (XLVII of 1984) Having Corporate Universal Identification No. 0097671, dated February 04, 2016

for its Generation Facility/Wind Farm/Wind Power Plant Located at Deh Kohistan, 7/1 Tapo Jhimpir,Taluka & District Thatta in the Province of Sindh

(Total Installed Capacity: 50.00 MW Gross ISO)

to engage in generation business subject to and in accordance with the Articles of this Licence.

Given under my hand this on 27th day of November Two Thousand & Seventeen and expires on 29th day of June Two Thousand & Forty-Four.

27/11/17

Registrar

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY * NEPRA * REGISTRAR

National Electric Power Regulatory Authority
(NEPRA)
Islamabad – Pakistan

GENERATION LICENCE

No. WPGL/36/2016

In exercise of the Powers conferred upon the National Electric Power Regulatory Authority (NEPRA) under Section-15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997, the Authority hereby grants a Generation Licence to:

NORINCO INTERNATIONAL THATTA POWER (PVT.) LIMITED

Incorporated under the Companies Ordinance, 1984
Corporate Universal Identification No. 0097671, dated February 04, 2016,

for its Generation Facility/Wind Power Plant Located at Deh Kohistan 7/1 Tapo Jhimpir, District Thatta, in the Province of Sindh

(Installed Capacity: 50.00 MW Gross ISO)

to engage in generation business subject to and in accordance with the Articles of this Licence.

Given under my hand on 10th day of November Two Thousand & Sixteen and expires on 30th day of December Two Thousand & Thirty Nine.

10.11.16

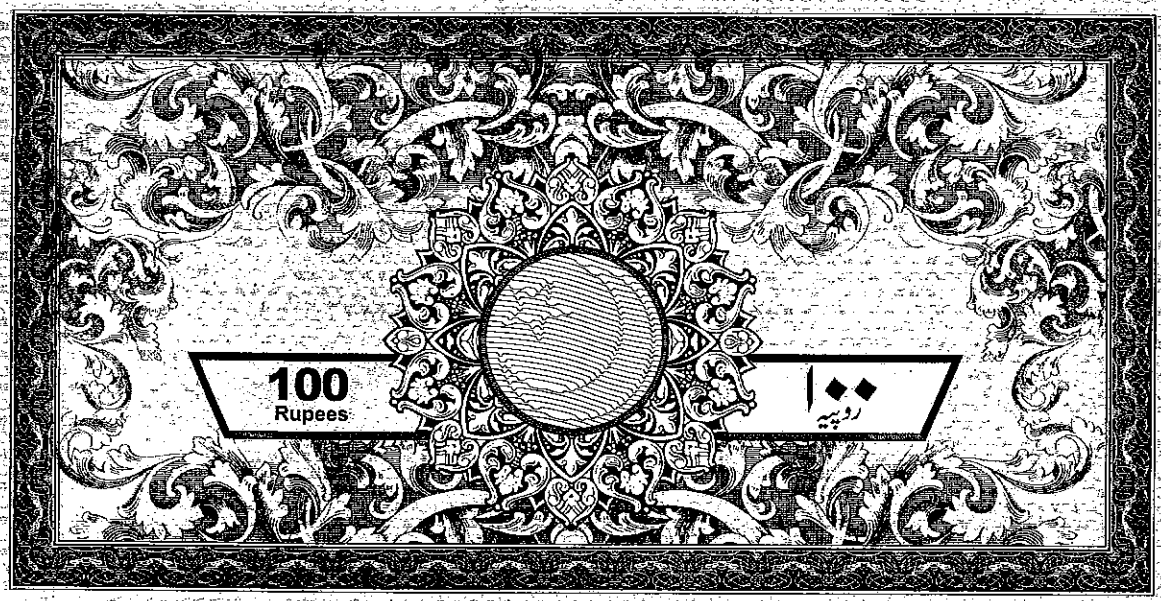
Registrar

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
REGISTRAR
* NEPRA *

ANNEXURE 2

AFFIDIVIT

P197008



KASHIF RAZA STAMP VENDOR
Licence No. 02 G-14, Spanish Homes
Phase-1, D.H.A., Karachi.
S.no 8180 Date MUHAMMAD SABIR
Issued ...h Address.....
Through ...h Address.....
Purpose.....
Value Rs.....Attached.....
Stamp Vendor's Signature.....
(NOT USE FOR FREE WILL & DIVORCE PURPOSE)

15 JAN 2019

(RUPEES ONE HUNDRED ONLY)

AFFIDAVIT

I, Fahad Usman, CNIC 34603-4696787-9, Asst Executive Engineer, Norinco International Thatta Power Private Limited, Suit No. 101, 1st Floor, Horizon Vista, Block 4, Clifton, Karachi, Pakistan, do hereby solemnly affirm and declare that:

The License Proposed Modification Application for 100 MW, Norinco International Thatta Power Private Limited has been filed before the National Electric Power

The contents of the accompanying application for license Proposed Modification for, Norinco International Thatta Power Private Limited 100 MW Wind power project at Jhimpir, Distt Thatta, Sindh, Pakistan Including all supporting documents are true and correct to the best of my knowledge and belief, and nothing material or relevant thereto has been concealed or withheld therefrom.

I also affirm that all further documentation and information to be provided by me is connection with the aforesaid request shall be true and correct to the best of my knowledge and belief.

Deponent
Fahad Usman,
CNIC 34603-4696787-9,
Asst Executive Engineer,
Norinco International Thatta Power Private Limited

ANNEXURE 3

BOARD OF RESOLUTION

NORINCO Intl Thatta Power
北方国际萨塔电力

EXTRACTS OF THE MEETING OF THE BOARD OF DIRECTORS OF NORINCO INTERNATIONAL THATTA POWER (PRIVATE) LIMITED (THE "COMPANY") HELD ON JANURARY 23rd, 2019

Ref: NOR-THA-BPARD-09

It is RESOLVED THAT Mr. Fahad Usman, AEE of the Company, is Hereby appointed as Authorized person to apply to National Electric Power Regulatory Authority (NEPRA) for the Modification of Generation License of Norinco International Thatta Power (Private) Limited and to undertake the following steps on behalf of the Company:

(a) To file/sign all the required documents,
(b) To comply with any of the NEPRA objections / instructions in this regard, and
(c) To make necessary changes/modifications to the documents submitted for Generation License to ensure compliance with NEPRA requirements as per related Rule/regulations.

Certified that the abovementioned is a true and valid extract from the meeting of the Board of Directors of NORINCO INTERNATIONAL THATTA POWER (PRIVATE) LIMITED held on 23rd, January 2019.

Zhang Yong
Company Secretary

NITPPL

NORINCO INTL THATTA
POWER PVT LTD

COMPANY SECRETARY

ANNEXURE 4

BANK DRAFT FOR APPLICATION FEE

Account Payee Only

ICBC

ICBC Karachi Branch (0100)

P.O. No. C0000014393

Stationery/Ref No: 00012748

0	9	0	2	1	9

Pay to NEPRA or Order

Rupees FOUR HUNDRED NINE THOUSAND EIGHT HUNDRED ONLY

PKR 409,800.00

PAYABLE AT ANY BRANCH IN PAKISTAN

Signatory
PA/Attorney No

Signatory
PA/Attorney No

Please do not write below this line.

⑈000127⑆0880100⑈ ⑈020⑈

ANNEXURE 5

TEXT OF THE PROPOSED MODIFICATION

TEXT OF THE PROPOSED MODIFICATION

Norinco International Thatta Power Private Limited (the "Company") has selected Model Goldwin GW121-2.5 MW each with hub height of 90m for its 100 MW Wind Power Plant located in Jhimpir, Distt Thatta, and Sindh. The Company has finalized the equipment for the Project. The Company desires to modify its Generation License by changing the followings:-

After Merging Net Power Output of Wind Power Plant from one sub- station is 100 MW.

After Merging Number of WTGs and Power Rating from 20 x 2500 kW to 40 x 2500 kW.

The company intense to merger its two generation facility for which the authority Nepra has granted Generation License No. WPGL/36/2016 dated 4th February, 2016 AND Generation License No. WPGL/51/2017 dated 27th November2017.After merger they accumulative the total install capacity will be 100MW.

- The Letter of Intent (copy enclosed for your reference)
- LOI's has been merged from 2x50 MW into 100 MW (copy enclosed for your reference)
- Extension in the LOI till to date (copy enclosed for your reference)

Ph: 021-99206449

NO. DAE/Wind/77-A/2015
GOVERNMENT OF SINDH
Directorate of Alternative Energy
ENERGY DEPARTMENT
Karachi, dated 20th April, 2015

Mr. Wang YueTao,
President ,
Norinco International Cooperation Ltd.
C/O Mr. Asad Alam Khan
101,Horizon Vista, Plot # Commercial -10
Block-4 scheme 5, Clifton Karachi.

Subject: **LETTER OF INTENT (LOI) FOR FOR50 MW THATTA WIND FARM-I PROJECT**

Reference: your letter/proposal dated nil.

In pursuance of the Policy for Development of Renewable Energy for Power Generation 2006 ("Policy"), implemented by Govt. of Sindh under clause 32 of schedule II, Sindh Govt. Rules of Business 1986, the Directorate of Alternative Energy, Energy Department Govt. of Sindh, (DAE, GoS) hereby confirm its interest in your proposal for establishing an approximately 50MW Wind Power Generation Project in wind corridor Thatta. The sponsors may approach the Land Utilization (LU) Department, through Energy Department Government of Sindh for acquisition of land. DAE GoS shall facilitate the sponsors for acquisition of land for project development. DAE GoS acknowledges receipt of Bank Guarantee **NO. LG288011500100** issued on dated 17th April,2015, in the sum of USD25,000/(USD Twenty Five thousand only) from Industrial Commercial Bank of China, Karachi, Branch for the issuance of Letter of Intent ("LOI") **NO.DAE/Wind/77-A/2015/10**.

2. The Sponsor(s) is required to complete the feasibility study and achieve the milestones listed at the Annex-I to this LOI ("LOI Milestones") for the subject project, at no risk and at no cost to, and without any obligation on the part of the DAE Energy Department Government of Sindh or any other Provincial (Sindh) agency, within a period of 18 Months from the date of issuance of this LOI.

3. The Sponsor(s) is required to carry out and complete the feasibility study in accordance with internationally acceptable standards and in accordance with the terms and conditions stipulated in the Policy and this LOI. The feasibility study must include, inter alia, micro-siting details, detailed power production estimates based on wind speed benchmarks set by DAE GoS/GoP , soil tests reports, technical details pertaining to wind turbines to be used in the wind farm, electrical studies (including but not limited to short-circuit study, power quality study, load flow study and stability study), environmental study, project costing, financing plan, carbon credits, financing terms, tariff calculations and assumptions for financial calculations including economic/financial analysis. The Sponsor is also advised to liaise with Panel of Expert (POE), constituted by DAE,GoS. and the power purchaser while determining the site, project layout, sub-station design and layout, the transmission line, interconnection arrangements and other related matters.

4. The validity of this LOI is Eighteen (18) calendar months from the date of its issue, where after it will automatically lapse immediately (unless extended

Verified
NORINCO INT. THATTA POWER (PVT) LTD.

pursuant to clause 5 or 6), being the **19th October,2016** (the **"Expiry Date"**). Issuance of this LOI or the lapsing of its validity, or your conducting a feasibility study there under, cannot form the basis of any claim for compensation or damages by the Sponsor(s) or the project company or any party claiming through or under them against the Government of Sindh or any of its allied department, employees or consultants on any grounds whatsoever, during or after the expiry of the validity of the LOI.

5. The Sponsor(s) is therefore required to complete the feasibility study and achieve the LOI Milestones for the subject project within the validity of this LOI. The Sponsor(s) is also required to submit quarterly progress reports to be reviewed by Panel of Experts (POE). Provided the Sponsor(s) meets the LOI Milestones on the stated dates, the expiry date of this LOI shall be extended on a day-to-day basis for the number of days of delay by which the approval or review by the relevant public sector entity listed in the LOI Milestones is delayed beyond the corresponding period stated in the LOI Milestones. In case there is a delay in completion of the feasibility study within the validity of this LOI for reasons not attributable to a public sector entity, a one-time extension may be granted up to a maximum period of 180 days, provided that DAE GoS is satisfied that the feasibility study is being conducted in a satisfactory manner and is likely to be completed shortly, and provided the Sponsor(s) enhance the amount of the bank guarantee to twice its original amount and extend its validity for a period six (6) months beyond the extended date of the LOI. Furthermore, if the said feasibility study is technically approved by the Panel of Experts and later the tariff awarded by NEPRA is not agreed by the Sponsor(s) (such decision to be made within 30 days of the award of the tariff, and in any event within the validity of the LOI), the bank guarantee less 10% deduction for administrative and ancillary charges, would be returned to the Sponsor(s).

6. The Sponsor(s) shall apply to NEPRA for award of tariff within the period of validity of this LOI. Upon tariff being given, the Sponsor(s) shall forthwith submit a new Performance Guarantee in the sum of **USD125,000/** (One Hundred Twenty Five thousand US dollars) (subject to revision from time to time) and obtain the Letter of Support (Tripartite i.e. AEDB for GoP, Energy Department for GoS and Project Company) from DAE GoS within the validity period of this LOI, provided, if the award of the tariff is delayed beyond the initial validity of the LOI, the Sponsor(s) shall extend the bank guarantee for a further period of six (6) months (or such period as may be determined by DAE GoS in the circumstances) and the validity of this LOI shall be extended *ipso facto* for a further period of six (6) months, and the Sponsor(s) shall obtain the Letter of Support and submit the Performance Guarantee within the extended period afore-said. For avoidance of doubt, the afore-said extension process may be repeated if the tariff is not announced (including any review petition filed by the Sponsor(s), such review (if any) to be filed within the period prescribed in the NEPRA (Tariff Procedures and Standards) Rules up to fifteen (15) days before the then prevailing Expiry Date.

7. In case the Sponsor(s) fails to meet the LOI Milestones or perform any other obligations set forth in the Policy and this LOI, including the extension of the date of expiry of bank guarantee as provided herein, DAE GoS will terminate this LOI and encash the bank guarantee.

8. (A) Pending the nomination of the Main Sponsor per sub-clause (B), the **M/S Norinco International Cooperation Ltd.** *(being the individual or group holding at least 20% equity or participatory interest in the IPP project)* is liable for all

Verified
NORINCO INT. THATTA P...

obligations and liabilities of and on behalf of all other shareholders/ Sponsor(s) (without relieving the other shareholders/Sponsor(s) of their obligations and liabilities under this LOI). It is emphasized that the financial and other relevant credentials of **M/S Norinco International Cooperation Ltd.** were a fundamental consideration for exercise of its shareholding (or other participatory interest, if the project company is not formed by the date of issue of the LOI) in the project or the project company without the prior written approval of DAE, Energy Department GoS, which approval may be declined by DAE, Energy Department GoS in its discretion if the proposed transferee's financial and other relevant credentials are found unsatisfactory.

(B) The Sponsor(s) is advised to nominate the Main Sponsor (being the individual or group holding at least 20% equity or participatory interest in the IPP project) no later than the Expiry Date of the LOI. In default of nomination as aforesaid, the **M/S Norinco International Cooperation Ltd** will be deemed the Main Sponsor for all intents and purposes. The Main Sponsor together with other initial project shareholders/Sponsor(s) (which shall, subject in each case to sub-clause (A) above, by firmly settled and announced to DAE GoS by the Expiry Date of the LOI), must hold 51% of the project equity for a period up to the project's Commercial Operations Date (COD).

(C) Any actual or purported transfer or assignment of the shares or other participatory interests by the Sponsor(s) / shareholders in contravention of the foregoing restrictions without prior written consent of the DAE GoS shall render this LOI void and the bank guarantee will be encashed in such case by DAE GoS.

9. This LOI is not assignable and non-transferable. This LOI shall be void upon any actual or purported assignment or transfer hereof without the prior written consent of DAE GoS.

10. This LOI is issued in duplicate on the date hereof, and it shall come into effect when one copy is received by DAE, Energy Department GoS, after being duly countersigned by you. Nevertheless, this LOI shall lapse if the countersigned copy is not received at DAE within 15 days of its issuance.

Agreed & Accepted for and on behalf
M/S Norinco International Cooperation Ltd

20-04-2015

Engr. Mehfooz Ahmed Qazi)
Director Alternative Energy
DAE, Energy Department
Government of Sindh

Directorate of Alternative Energy
Energy Department, Govt. of Sindh

Verified
NORINCO INT. THATTA POWER (P)

Ph: 021-99206449

NO. DAE/Wind/77/2015
GOVERNMENT OF SINDH
Directorate of Alternative Energy
ENERGY DEPARTMENT
Karachi, dated February 22, 2016
SAY NO TO CORRUPTION

To,

Mr. Wang YueTao,
President ,
Norinco International Cooperation Ltd.
C/O Mr. Asad Alam Khan
101,Horizon Vista, Plot # Commercial -10
Block-4 scheme 5, Clifton Karachi.

Subject: **MERGER OF 2X50MW WIND POWER PROJECTS INTO 100MW BY M/S NORINCO INTERNATIONAL COOPERATION LTD.**

I am directed to refer your letter No. nil dated September 9, 2015, on the subject cited above.

2. The Directorate of Alternative Energy, Energy Department, Govt. of Sindh acknowledges the receipt of bank guarantee NO. LG28801B600048 amounting USD50,000/(USD Fifty Thousand only) issued on February 18, 2016 submitted by M/s Norinco International in view of request of merger of 2x50MW LOIs.

3. The Lol No. DAE/Wind/77-B/2015/11 dated April 20, 2015 for 50MW wind power generation is merged into Lol No. DAE/Wind/77-A/2015/10 dated April 20, 2015 and the capacity of the Lol No. DAE/Wind/77-B/2015/10 dated April 20, 2015 is upgraded from 50MW to 100MW.

4. it is informed that the capacity of the project stated in the Lol No. DAE/Wind/77-A/2015/10 dated April 20, 2015 issued to "M/s Norinco International" for the development of 50MW wind power project will now read as 100MW. All the other terms and conditions of LOI shall remain the same.

(ENGR. MEHFOOZ A. QAZI)
Director, Alternative Energy

Copy for information:

- Secretary Land utilization Department, Govt of Sindh Karachi
- CEO, AEDB, Islamabad.
- CEO, CPPA (G), Islamabad.
- CEO, NTDC WAPDA House, Lahore.
- Registrar, NEPRA, Islamabad.
- PS to Secretary, Energy Department, Govt. of Sindh.

Verified
NORINCO INT. THATTA POWER (PVT) LTD.

ANNEXURE 5

STATEMENTS OF REASONS IN SUPPORT OF MODIFICATIONS

STATEMENTS OF REASONS IN SUPPORT OF MODIFICATIONS

Wind can provide low cost electricity generation from wind turbine when speeds are favourable.The tariff will be lower by doing the merger of both the Generation License No. WPGL/36/2016 dated 4th February, 2016 AND Generation License No. WPGL/51/2017 dated 27th November, 2017 from 50 MW to 100 MW which is the good for the end consumers as well as the project costs will be lower because every power plant has construction, maintenance, and operating costs. After the modifications it's helpful for the end consumer.

ANNEXURE 6

IMPACT OF THE PROPOSED MODIFICATION

IMPACT OF THE PROPOSED MODIFICATION

Impact on Tariff:
As energy yield or capacity factor of Wind Power Plant shall remain the same and there will be reduction in EPC price or O&M price, so there will be no impact on Tariff due to proposed modification.

Impact on Quality of Service:
The Company certifies that the quality of service and the performance by the Company under the Generation License shall not be affected on acceptance by NEPRA of this Application. The Company has been fully diligent and dedicated in the performance of its services and aspires to cater to the energy crisis currently being faced by Pakistan.

Impact on the obligations of the Company under the License:
The proposed modification would facilitate the Company in fulfilling its obligations under the License and the generation of electric power in national interest. Furthermore, the quality of service and the performance by the Licensee of its obligations under the Generation License shall not be affected with the proposed amendment.

ANNEXURE-8

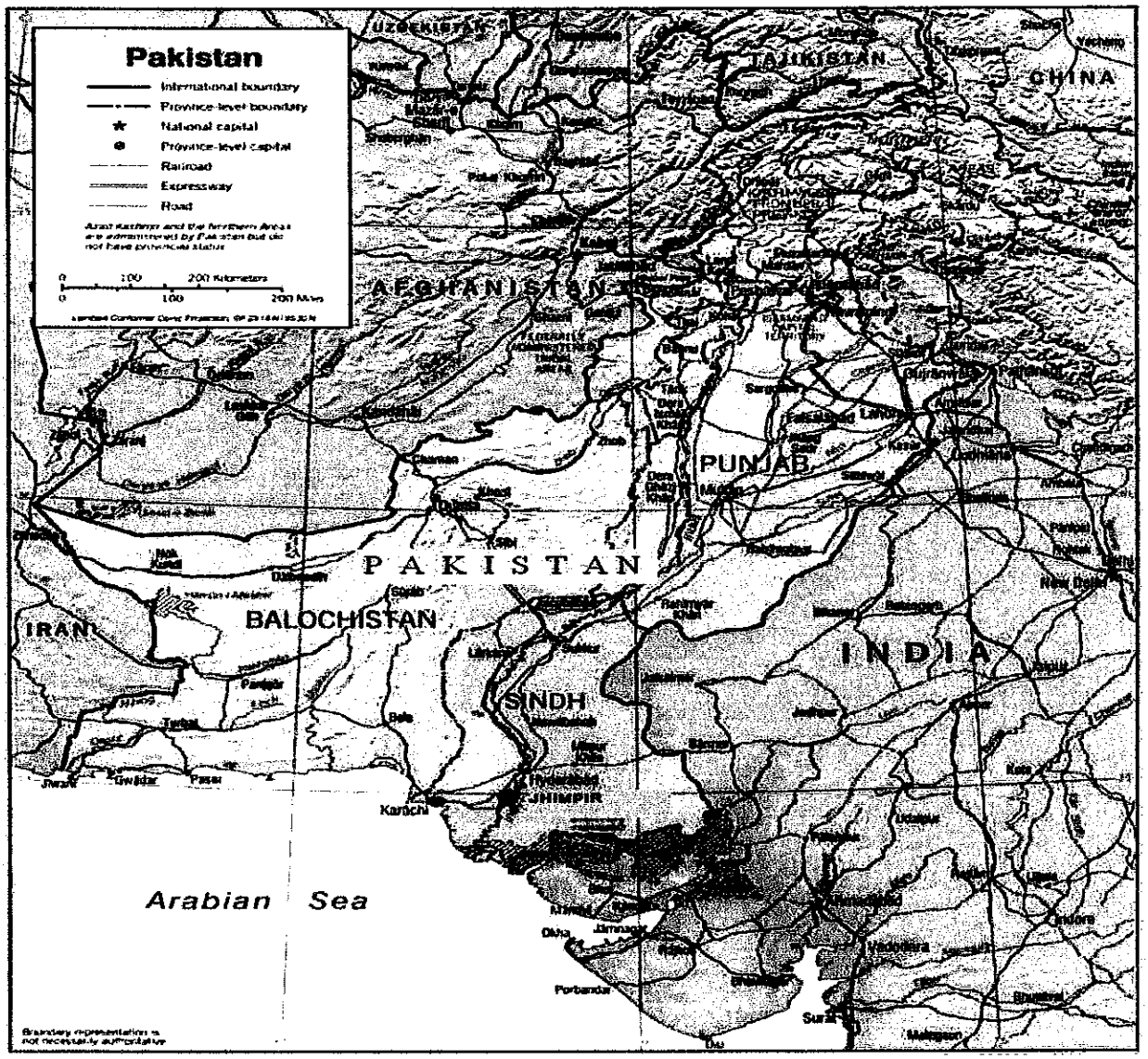
GEL SCHEDULE-I OF LPM

SCHEDULE-I
The Location, Size (i.e. Capacity in MW),
Type of Technology,
Interconnection Arrangements,
Technical Limits,
Technical/Functional
Specifications and other details specific to the Generation Facilities ofthe Licensee are described in this Schedule.

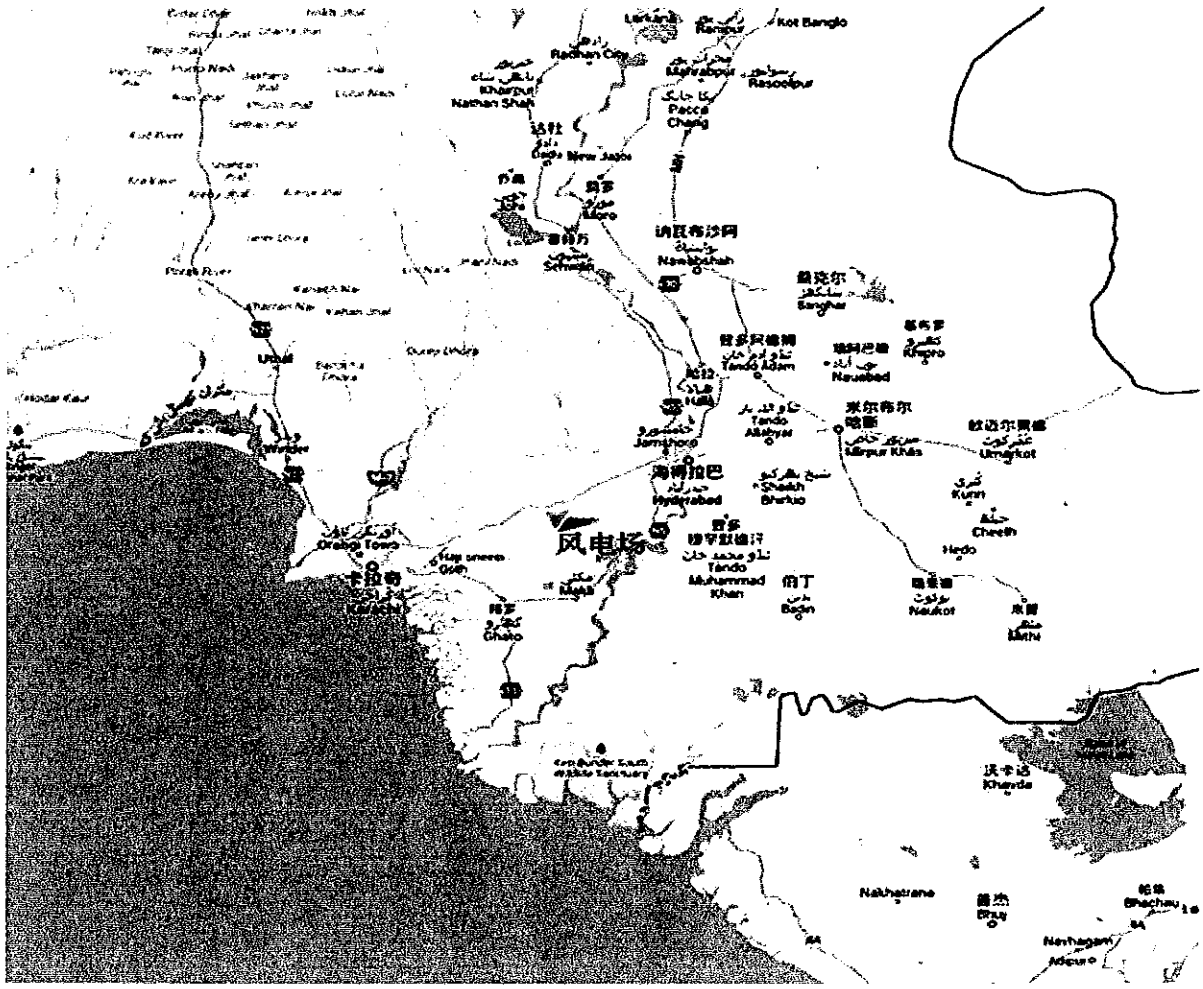
Actual drawings pertaining to Wind Farm Location Map, Wind Farm Lay Out, Wind Farm Micro-Sitting, Single Line Diagram (Electrical System of the Wind Farm),

Location of Generation Facility/ Wind Farm

Norinco International Thatta Power Private Limited Pakistan (NITPPLT) has acquired land around 2500 acres for the Project Company's Norinco International 100MW Wind Power Project, located at Jhimpir in Sindh Province of Pakistan, about 110km northeast away from Karachi and 80km northeast away from Port Qasim, with geographical coordinates of 68°0′4"~68°3′55" E and 25°5′23"~25°8′4" N. The project area stretches in nearly northwest-southeast direction, with a length of about 6.7km and a width of 1.6km. The elevation of the project area is 40m~60m. The site was selected after going through various technical studies of terrain and assessment of wind. The geographical location of the project is shown in figure below.


Pakistan
International boundary
Province-level boundary
National capital
Province-level capital
Railroad
Expressway
Road
0 100 200 Kilometers
0 100 200 Miles
UZBEKISTAN
TAJIKISTAN
CHINA
AFGHANISTAN
PUNJAB
PAKISTAN
BALOCHISTAN
IRAN
INDIA
SINDH
JHIMPIR
Karachi
Arabian Sea
New Delhi
Porbandar
Surat

The Project Site has flat terrain with sparse vegetation, consisting of small shrubby bushes. The map is given in Figure below:



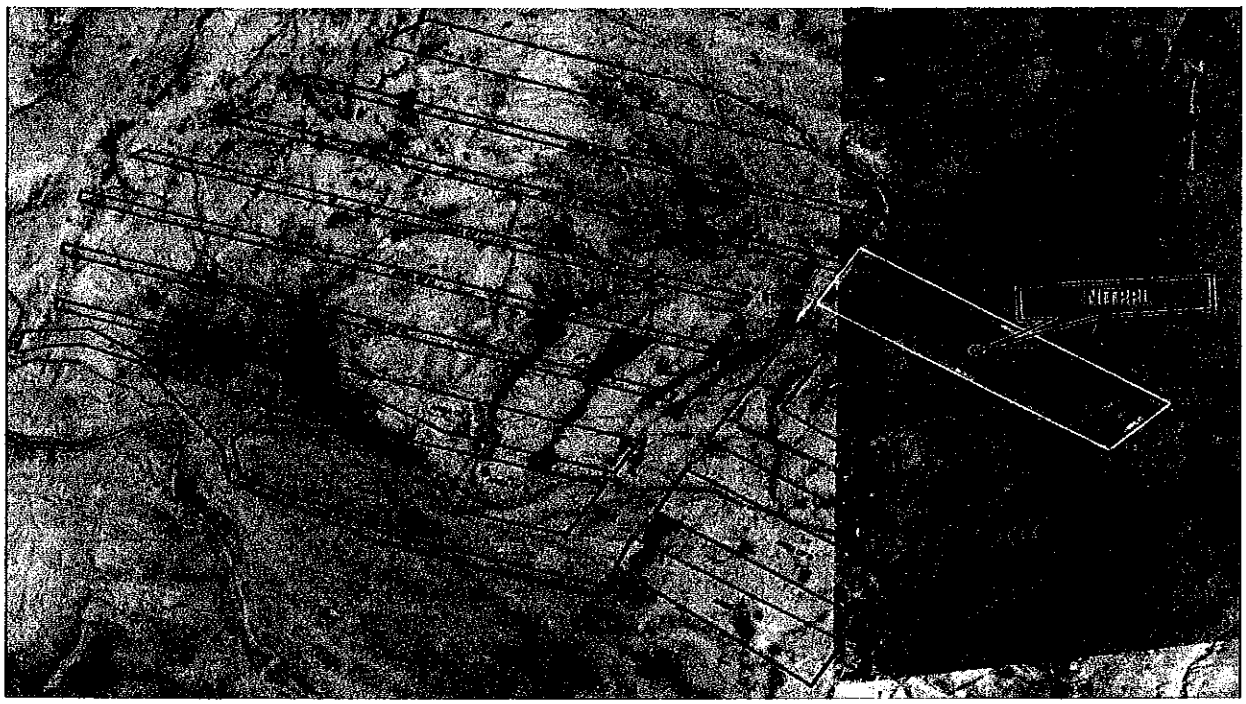
Project Size

The Project shall have an installed capacity of 100 MW rated power. The number of WTGs is 40 with capacity of 2.5 MW each.

Layout of Generation Facility/ Wind Farm

As the wind direction in Norinco International Thatta Power Private Limited Pakistan (NITPPL) area is relatively constant and stable, west-southwest (WSW) wind has maximum speed and energy as well as highest frequency; the prevailing wind direction is stable and the availability of wind energy is high. According to the prevailing wind direction and topography condition of this wind farm, the arrangement of wind turbines should take advantage of locations with high wind energy index and greater exploitation value.

Norinco International Thatta Power Private Limited Pakistan (NITPPL) site takes on a long strip about 6.5km long and 1.6km wide. Taking into account the characteristics of the site area, for optimal utilization of the available ground area, it is proposed to arrange those WTGs of the recommended models perpendicular to the prevailing wind direction in the pattern of 2.5D × 12D. The layout fashions for WTGs of each capacity of 2.5MW are shown in Fig



Land Coordinates of Generation Facility/Wind Farm

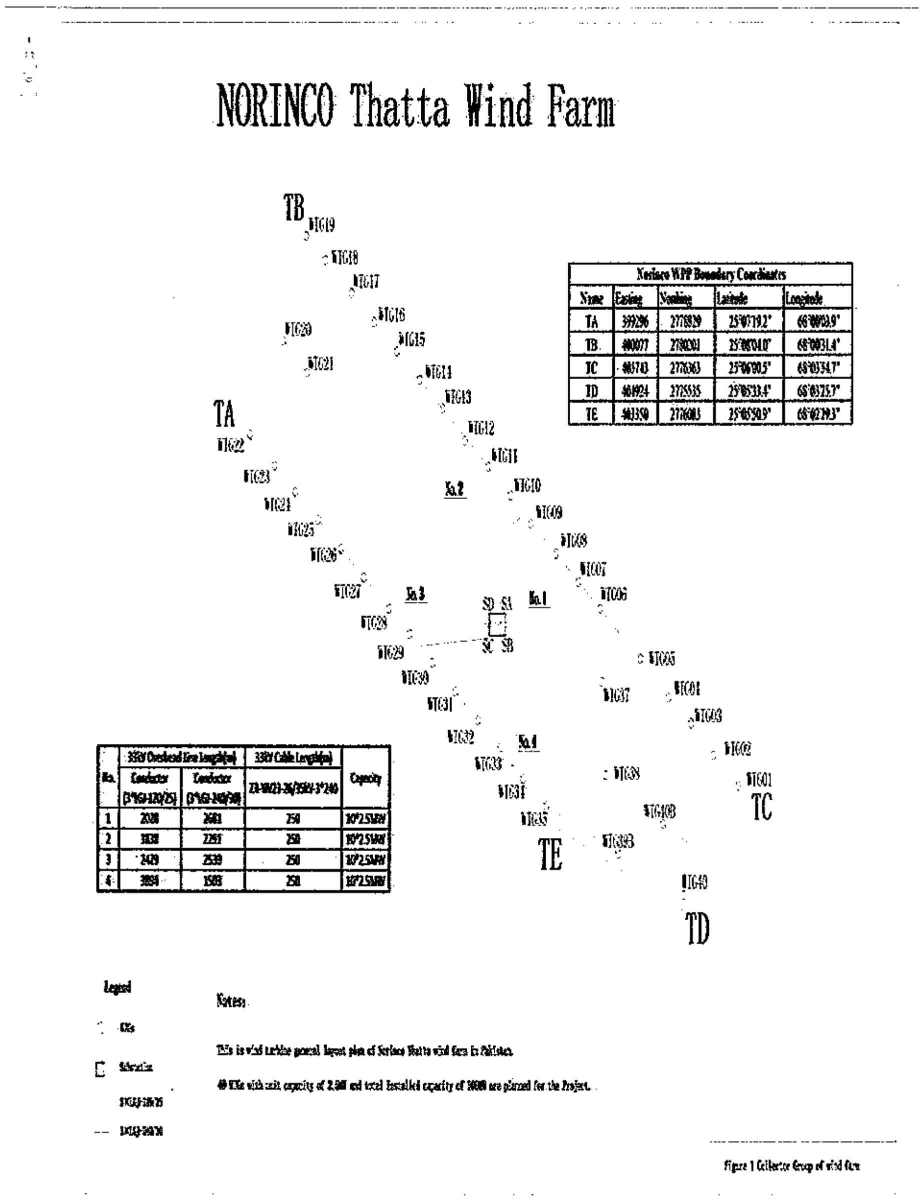
Location: Jhimpir—Sindh, Pakistan
The Site coordinates are given in Table below.

Total Land Area: 2500 Acres

Boundary Coordinates

Name	Easting	Northing	Latitude	Longitude
TA	399295.80	2778828.54	25°07'19.2"	68°00'03.9"
TB	400076.64	2780201.28	25°08'04.0"	68°00'31.4"
TC	405742.67	2776363.49	25°06'00.5"	68°03'54.7"
TD	404924.03	2775534.51	25°05'33.4"	68°03'25.7"
TE	403349.76	2776083.25	25°05'50.9"	68°02'29.3"

Norinco International Thatta Power Private Limited Pakistan



Electrical System Single Line Diagram of Generation

Facility/Wind Farm

The project will install 40 WTGs (Goldwin G121-2.5). There shall be Three (03) WTG collector group.

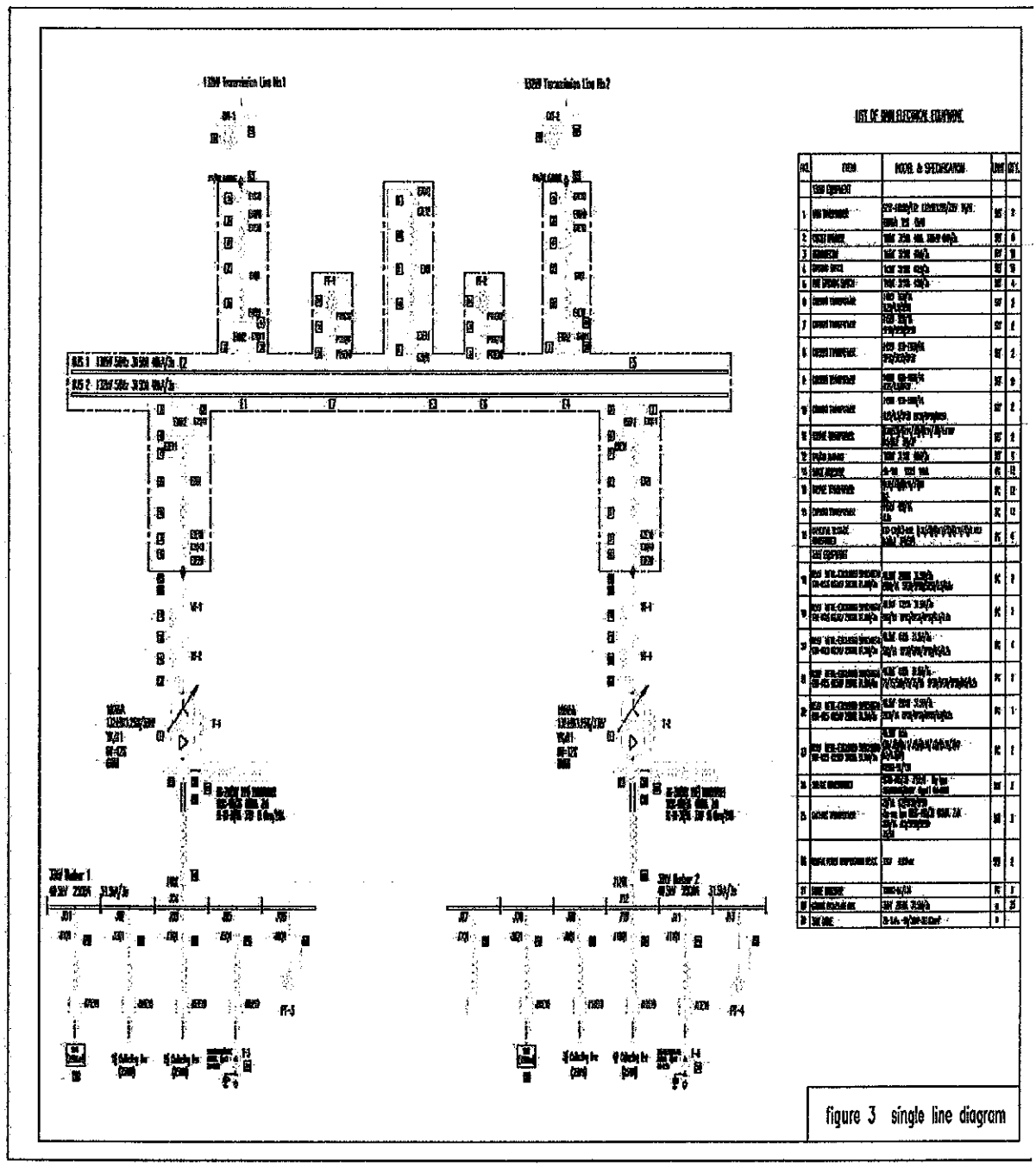
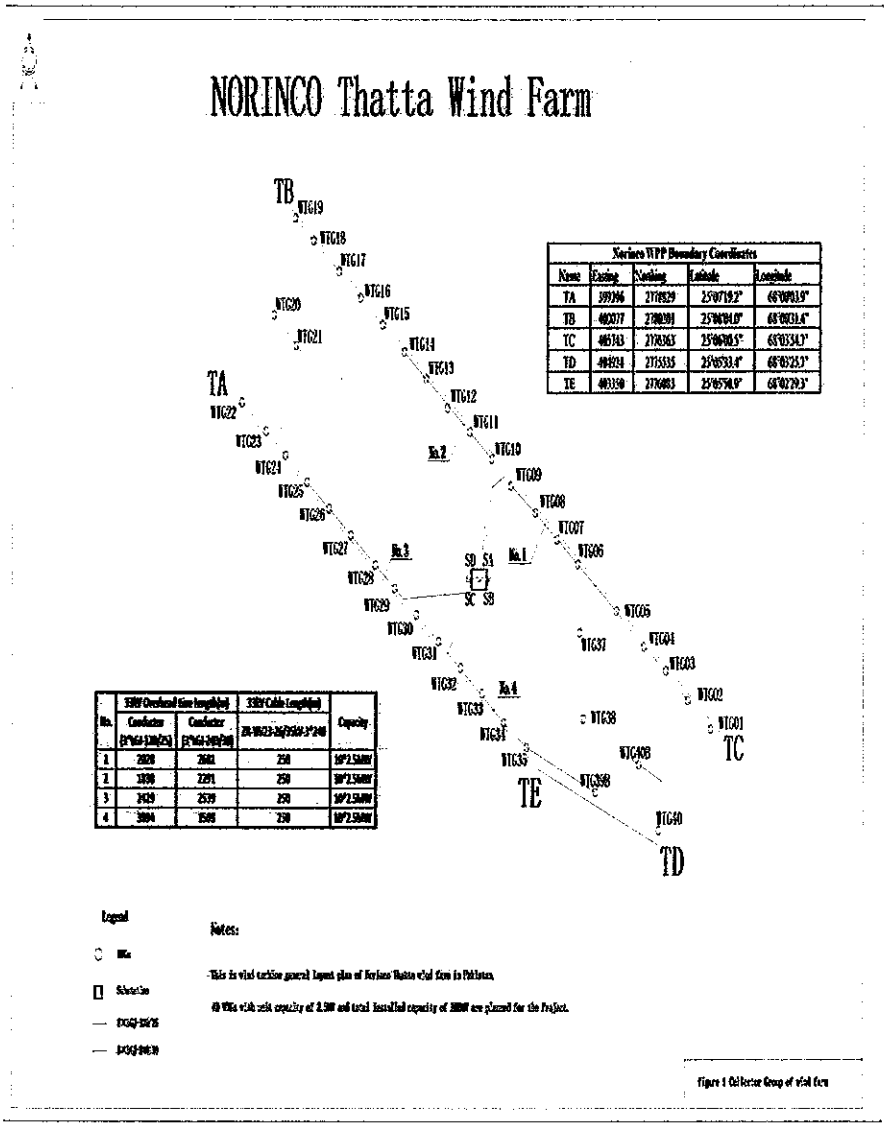


figure 3 single line diagram

Micro-Sitting of Generation Facility/Wind Farm

The micro-sitting of Wind Farm with 40 WTGs is given in figure below;



The coordinates are WTGs are given in table below.

LIST OF WTGs COORDINATES

Substation Coordinates		
Name	Latitude	Longitude
SA	25°06'38.8"	68°02'4.1"
SB	25°06'33.9"	68°02'4.1"
SC	25°06'33.8"	68°01'57.0"
SD	25°06'38.7"	68°01'56.9"
WTGs Coordinates		
Name	Latitude	Longitude
WTG01	25°06'01.1"	68°03'50.5"
WTG02	25°06'07.9"	68°03'39.4"
WTG03	25°06'15.0"	68°03'29.2"
WTG04	25°06'20.6"	68°03'18.7"
WTG05	25°06'29.0"	68°03'05.6"
WTG06	25°06'40.1"	68°02'47.2"
WTG07	25°06'46.0"	68°02'37.2"
WTG08	25°06'52.4"	68°02'26.8"
WTG09	25°06'58.8"	68°02'15.3"
WTG10	25°07'05.1"	68°02'06.1"
WTG11	25°07'11.4"	68°01'55.7"
WTG12	25°07'17.1"	68°01'45.3"
WTG13	25°07'24.1"	68°01'35.0"
WTG14	25°07'30.4"	68°01'24.6"
WTG15	25°07'36.8"	68°01'14.2"
WTG16	25°07'43.1"	68°01'03.9"
WTG17	25°07'49.5"	68°00'53.5"
WTG18	25°07'56.8"	68°00'41.6"
WTG19	25°08'02.2"	68°00'32.8"
WTG20	25°07'38.8"	68°00'22.7"
WTG21	25°07'31.7"	68°00'33.5"
WTG22	25°07'17.8"	68°00'07.8"
WTG23	25°07'11.0"	68°00'19.2"
WTG24	25°07'05.3"	68°00'28.6"
WTG25	25°06'59.0"	68°00'39.1"
WTG26	25°06'52.7"	68°00'49.5"
WTG27	25°06'46.4"	68°00'59.9"
WTG28	25°06'39.5"	68°01'11.5"
WTG29	25°06'33.9"	68°01'20.8"
WTG30	25°06'27.6"	68°01'31.2"
WTG31	25°06'21.3"	68°01'41.6"
WTG32	25°06'15.1"	68°01'52.0"
WTG33	25°06'09.0"	68°02'02.3"
WTG34	25°06'02.0"	68°02'12.6"
WTG35	25°05'56.2"	68°02'23.3"
WTG37	25°06'23.8"	68°02'48.2"
WTG38	25°06'03.2"	68°02'50.2"
WTG39B	25°05'45.7"	68°02'56.2"
WTG40B	25°05'52.5"	68°03'16.7"
WTG40	25°05'36.8"	68°03'26.3"

Detail of Generation Facility/Power Plant/ Wind Farm

General Information

(i).	Name of Applicant/Company	Norinco International Thatta Power Pvt Ltd
(ii)	Registered Office	Suit No.101, 1st Floor, Horizon Vista, Block 4,Clifton ,Karachi, Pakistan
(iii).	Business Office	Suit No.101, 1st Floor, Horizon Vista, Block 4,Clifton ,Karachi, Pakistan Ph. 92 21 35371833-34/03115144575
(iv).	Plant Location	Jhimpir, District Thatta, Sindh
(v).	Type of Generation Facility	Wind Power

Wind Farm Capacity & Configuration

(i).	Wind Turbine Type, Make & Model	Goldwin GW121-2.5 MW
(ii).	Installed Capacity of Wind Farm (MW)	100MW
(iii).	Number of Wind Turbine Units/Size of each Unit (kW)	40 x 2500 Kw

Wind Turbine Details

Rotor		
	Rated Power	2.5 MW
	Number of Blades	3 Each
	Rotor Speed	7~15.2 rpm

	Rotor Diameter	121 m
	Swept Area	11595 m^2
	Power Regulation	Variable speed and variable pitch
	Rated power at	9.3 m/s(static, air density = 1.225 kg/m^3)
	Cut-in Wind Speed	3.0 m/s
	Cut-out Wind Speed	22 m/s
	Survival Wind Speed	37.5m/s (10mins average) 52.5m/s (3 seconds average)
	Hub Height	90 m
	Pitch Regulation	Independent Electrical Pitch control system, belt transmission, one for each blade.
Blades		
	Number of Blades	3 Each
	Blade Length	59.5 m
	Material	Glass Fiber reinforced resin
	Weight	14200kg (per piece)
Generator		
	Power	2500 KW
	Voltage	690 V
	Type	PMDD Synchronous Generator
	Speed	Range:7-15.5rpm; Speed at rated power:13.5 rpm
	Enclosure Class	IP 54
	Coupling	No coupling
	Efficiency	92.7%
	Weight	55400 Kg

	Power Factor	±0.9 (Leading to Lagging)
Yaw System		
	Yaw Bearing	Fixed system : outer slew bearing ring Rotating system :inner ring of the slew bearing
	Brake	7 pairs of braking pads Fixed system : static brake disc Rotating system :hydraulic brakes
	Yaw Drive	4 induction drive motors
	Speed	0.316 degrees/Sec
Control System		
	Type	Microprocessor Controlled, DFÜ (SCADA)
	Grid Connection	Full power converter automatically synchronization
	Scope of Monitoring	Central monitoring and remote monitoring system
	Recording	The SCADA system is integrated into the turbine through the main controller. Normal operation, safety protection, fault inspection and handling, operation parameters setting and data recording
Brake		
	Design	3 Aerodynamic brakes for each blade
	Operational Brake	Aerodynamic brake
	Secondary Brake	Hydraulic brake (only for maintenance)
Tower		
	Type	4 section tubular steel tower
	Hub Heights	90m

Other Details

(I)	Project Cost	USD 149.365 Million
(II)	Debt/Equity	70%/30%
(III)	Project Commissioning Date (Anticipated)	End of 2020
(IV)	Expected Life of the Project from Commercial Operation Date (COD)	25 Years

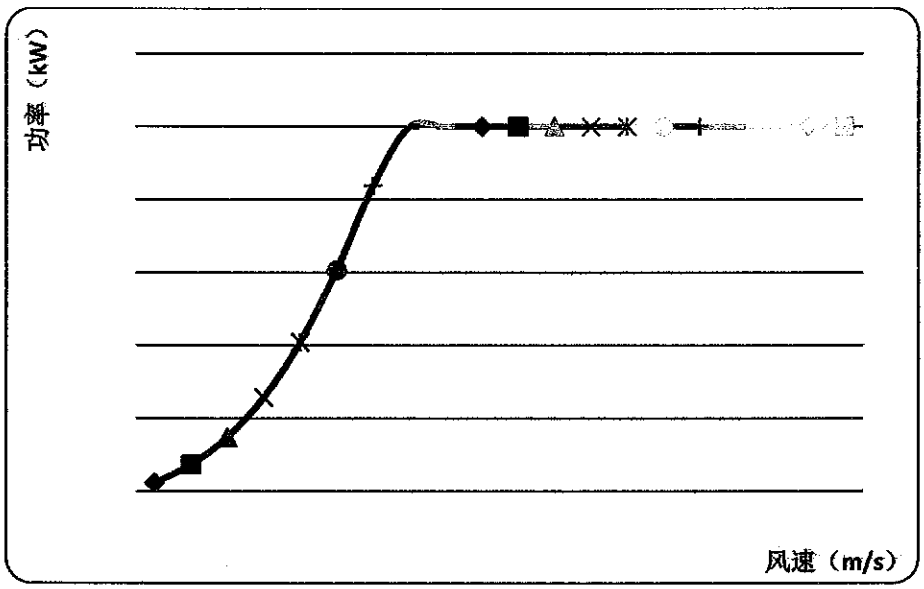
Power Curve of Goldwin GW121-2.5MW Wind Turbine Generator

The tabular and graphical values of Power curve are shown below:

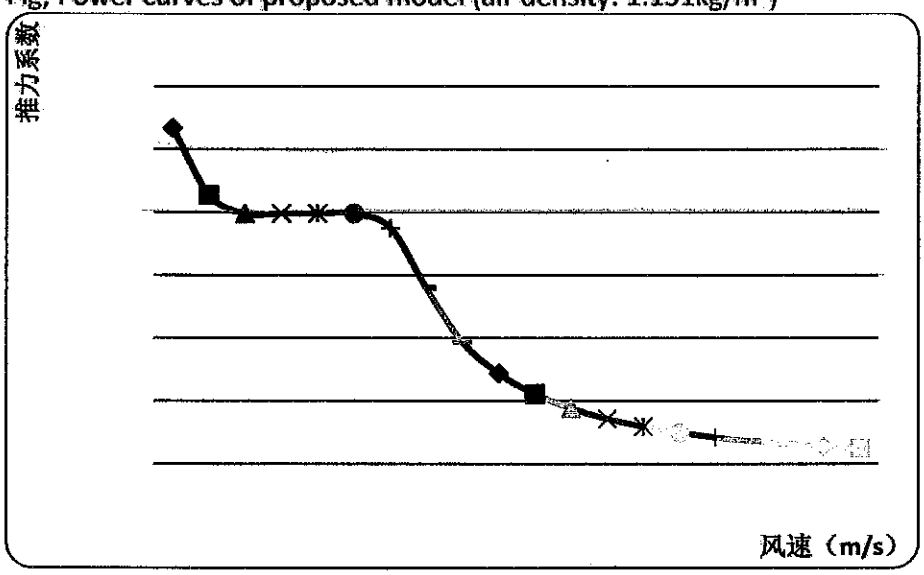
Power curve and thrust coefficient curve of proposed model under Local air density (1.131 kg/m^3)

Wind speed (m/s)	Power (kW)	Thrust coefficient
3	59	1.068
4	185	0.855
5	372	0.797
6	645	0.797
7	1024	0.797
8	1516	0.797
9	2096	0.750
10	2500	0.560
11	2500	0.387
12	2500	0.288
13	2500	0.223
14	2500	0.177
15	2500	0.144
16	2500	0.119
17	2500	0.099
18	2500	0.084
19	2500	0.073
20	2500	0.063
21	2500	0.055
22	2500	0.049

Notes: The above data are provided by the corresponding manufacturer of the proposed model.



Fig; Power curves of proposed model (air density: 1.131kg/m^3)



Fig; Thrust coefficient curves of proposed model (air density: 1.131kg/m^3)

ANNEXURE 8-A

GEL SCHEDULE-II OF LPM

SCHEDULE-II

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

SCHEDULE-II

(1).	Total Installed Gross ISO Capacity of the Generation Facility /Wind Farm (MW/GWh)	100.00 MW
(2).	Total Annual Full Load Hours	3307Hrs
(3).	Average Wind Turbine Generator (WTG) Availability	97.0 %
(4).	Total Gross Generation of the Generation Facility/Wind Farm (in GWh)	384.5 GWh
(5).	Array & Miscellaneous Losses GWh	30.76 GWh
(6).	Availability Losses GWh	11.535Wh
(7).	Balance of Plant Losses GWh	11.535 GWh
(8).	Annual Energy Generation (25 years equivalent Net AEP) GWh	330.67 GWh
(9).	Net Capacity Factor	37.7 %

Note

All the above figures are indicative as provided by the License/"NITPPL". The net energy available to power purchaser for dispatch will be determined through procedures contained in the energy purchase agreement.

Interconnection Arrangement for Dispersal of Power from The Generation Facility/Wind Power Plant of GEL

The scheme of interconnection of these 15 new WPPs including Norinco International Thatta Power Private Limited Pakistan (NITPPL) proposes the following reinforcements in place at Jhimpir cluster.

. • 220 kV D/C transmission line approx. 5km long on twin bundled Greeley conductor looping In/out of second circuit of existing Jamshoro – KDA-33 D/C transmission line at the proposed Jhimpir-2 220/132 kV substation

• Addition of 4th 220/132 kV transformer at the newly proposed Jhimpir-2 220/132 kV substation.

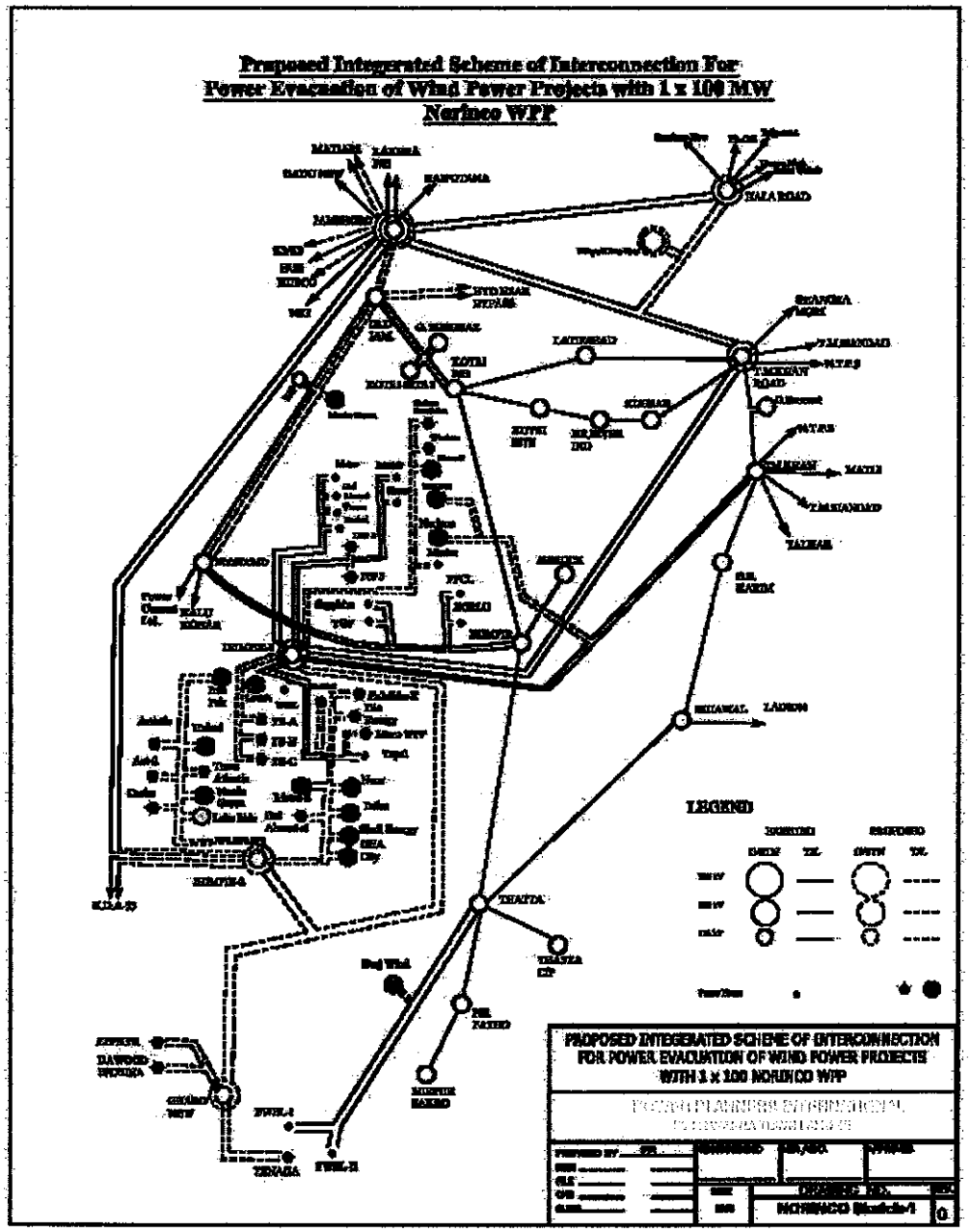
• 132kV double circuit transmission line approx. 135 km long on twin bundled Greeley conductor for connecting 8 WPPs in the first loop to Jhimpir-2 220/132 newly proposed substation.

• 132kV double circuit transmission line approx. 168 km long on twin bundled Greeley conductor for connecting 8 WPPs in the second loop to Jhimpir-2 220/132 newly proposed substation.

• In this Integrated study, the newly proposed scheme interconnection of Norinco International Thatta Power Private Limited Pakistan(NITPPL) WPP includes 132 kV D/C transmission line approx. 1 km long, on Greeley conductor for looping in/out on the 132 kV single circuit from Tricom WPP to Jhimpir-1 Grid Station.

The existing grid system of HESCO and NTDC in the vicinity of Norinco International Thatta Power Private Limited Pakistan (NITPPL) has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Norinco International Thatta Power Private Limited Pakistan (NITPPLT) and no bottlenecks or constraints have been found in the grid system.

Schematic Diagram for Interconnection
Arrangement/Transmission Facilities for Dispersal of Power from
Norinco International Thatta Power Private Limited Pakistan



APPROVAL OF GRID INTERCONNECTION STUDY REPORT OF 1×100MW

NORINCO INTERNATIONAL THATTA POWER (PVT). LTD.

NATIONAL TRANSMISSION & DESPATCH CO. LTD

General Manager Power System Planning, NTDC

No. GMPSP/CETP/TRP-380/1079-1084 Dated: 11-02-2019

Chief Technical Officer CPPA(G) Ltd.
Shaheen Plaza, Plot No, 73-West,
Fazal-e-Haq Road, Blue Area
Islamabad.
Fax # 051-9213617

Sub: Approval of Grid Interconnection Study Report of 1x100 MW Wind Power Project (WPP) with Revised Interconnection Arrangement by M/s Norinco International Thatta Power (Pvt) Limited

Ref: (i) CPPA(G) letter No. CPPAG/CTO/DGMT-RENEWABLE/MT-B&W/NITPPL/30419-21 dated 07-11-2018.
(ii) Minutes of Meeting issued by Govt. of Sindh (Energy Department) vide letter No. DAE/wind/77/2015-vol-II/51 dated 19-09-2018.

This office received the final grid interconnection study (GIS) report of the subject 1x100 MW Wind Power Project (WPP) with revised interconnection arrangement vide reference (i). It is specifically mentioned that GIS report of the subject Norinco WPP was already approved by our office for two separate 50 MW WPPs namely; 50 MW Norinco-I and 50 MW Norinco-II. However, due to the proposed swapping/merger arrangement of 2x50 MW Norinco-I & II WPPs with 50 MW Sinowell, GIS report of the subject Norinco WPP has been re-submitted in view of the revision in their interconnection line arrangements. After review of the GIS report of the subject Norinco WPP, it was found that some corrections in the studies were needed which were communicated to the study consultant, i.e. M/s PPI during a meeting held in this office in 3rd week of January 2019. Afterwards, M/s PPI re-submitted the said report by incorporating our comments on 04-02-2019. Therefore, the grid interconnection study report of 1x100 MW WPP by M/s Norinco International Thatta Power (Pvt.) Limited is approved at NTDC end as per assumptions, study results and recommendations presented in the report. The comments of HESCO should also be obtained on the subject report.

It is intimated that the subject report has been approved only for the interconnectivity aspects of the subject power plant. The consent of power evacuation arrangement for the subject WPP cannot be given at this stage. Any commitment regarding induction of the subject 1x100 MW Norinco WPP and/or for any other purpose should be discussed with/decided by CPPA-G and relevant stakeholders.

It is added that during EPA, if there is any major change in the parameters of the subject WPP as used in the interconnection study and/or any change in the upcoming generation/transmission plan in the vicinity of the subject power plant, then the relevant studies will have to be revised. Moreover, if there is any increase in length of 132 kV transmission line relating to both 1x100 MW Norinco WPP

Verified
NORINCO INT. THATTA POWER (PVT) LTD.

and 50 MW Sinowell WPP during commissioning of project due to swapping of Sinowell WPP and Norinco WPP, the cost of increased length of transmission line will be borne by M/s Norinco International Thatta Power (Pvt.) Limited as already agreed by them in the meeting held on 30th August 2018 (Reference No. ii) and also mentioned in the study report.

11/2/2019

(Engr. Dr. Khawaja Riffat Hassan)
General Manager Power System Planning

Cc:

- Deputy Managing Director (AD&M), WAPDA House Lahore.
- Deputy Managing Director (P&E), NPCC Islamabad.
- P.S. to Managing Director (NTDC), WAPDA House Lahore.
- M/s Norinco International Thatta Power (Pvt) Limited, Suite No. 101, 1st floor, Horizon Vista, block-4 Clifton, Karachi.
- M/s PPI, 95-H/2, WAPDA Town, Lahore, Pakistan.
- Master File

Verified
NORINCO INT. THATTA POWER (PVT) LTD.

ELECTRICAL GRID STUDIES

For The merger of 2x50 MW Wind Power Plant into 1x100 MW by Norinco International Thatta Power (Pvt.) Limited, Jhimpir Sindh

Power Planners International (Pvt.) Ltd.

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Version	Date	Authors	Checked By	Comments
1	07/11/2018	Fatima Muhammad	Umair Bilal	14/01/2019
2	01//02/2019	Hassan Mushtaq	Umair Bilal	

Executive Summary

- A study of 15 Wind Power Plants was carried out by the individual consultants and got approved from NTDCL planning department in 2017. This study was carried out for 15 new WPPs in integration with the already planned WPPs and other upcoming WPPs in its vicinity.
- Grid interconnection studies were carried out for two wind power projects of Norinco International Thatta Power (Pvt.) Limited (NITPPL) i.e. Norinco-I 50 MW and Norinco-II 50 MW separately and got approved from NTDC. The study for Norinco-I WPP was carried out by NTDC and they proposed it to be connected with Jhimpir 220/132 kV substation. The study for Norinco-II WPP was carried out by M/s PPI and its proposed interconnection scheme was with the Jhimpir – T.M Khan 132 kV Transmission Line. NITPPL intends to merge the two 50 MW wind power projects into one 100 MW project with one substation considering the close proximity of these two projects.
- The problem with the merger is that both plants are connected in different loops and either of the loop does not have enough transmission capacity to accommodate the additional 50 MW. The only solution available is the swapping of one 50 MW Norinco power project with any other 50 MW wind power project in the same loop.
- Grid interconnection study for 50 MW Sino Well WPP was also carried out by M/s PPI as a part of the integrated study for evacuation of power from wind power plants in Jhimpir area. Sino Well WPP was proposed to be interconnected next to Norinco-II WPP with the Jhimpir – T.M Khan 132 kV Transmission Line. Considering the location, it seems feasible to swap Norinco-I WPP with Sino Well WPP and interconnect Sino Well WPP with the recently constructed Jhimpir 220/132 kV grid station.
- For this purpose, NITPPL has requested to the management of Sinowell and both the parties have agreed for the swap. This study is being carried out for Norinco WPP for the purpose to make sure that there are no technical constraints while swapping the interconnection of both the projects.
- The study objective, approach and methodology have been described and the plant's data has been used as received from the sponsor Norinco International Thatta Power (Pvt.) Limited.

- The wind project by Norinco International Thatta Power (Pvt.) Limited, referred to as Norinco WPP in the remainder of the report, is expected to start commercial operation by the end of 2020. Therefore, the scenario of summer 2021 has been selected to carry out the study as it will help determine the maximum impact of the project.
- Norinco WPP which is the plant under study, has been placed in the loop at 220/132 kV Jhimpir-1 grid station. Norinco Wind Power Plant would be connected by a double circuit of 132 kV by looping in-out configuration of the one circuit of Jhimpir-1 – T.M. Khan along with Tricom WPP. It should be noted that the length of circuits used for the simulations are confirmed from site visit and agreed with NTDC officials. They may change slightly during the implementation of the project. In case, if there is any increase in the length of transmission line during the implementation of the project, the additional cost of the increased length for both Sinowell and Norinco will be borne by Norinco. In addition, the connectivity of Norinco WPP with neighboring wind power plants may change, depending upon the COD of the project.
- The newly proposed scheme of interconnection of Norinco WPP includes 132 kV D/C transmission line approx. 1 km long, on Greeley conductor for looping in/out on the 132 kV single circuit from Tricom WPP to Jhimpir-1 grid station.
- To meet the power factor of 0.95 at the point of common coupling as per grid code criteria, SVCs of 2 x ±20 MVAR is proposed at the 33 kV (MV) bus bar.
- The existing and planned grid system of HESCO and NTDC in the vicinity of Norinco WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Norinco WPP and no bottlenecks or constraints have been found in the grid system.
- Wind Farm of Norinco has been modeled considering Type-4 WTGs. The terminal voltage is 0.69 kV. The medium voltage level of wind farm has been selected as 33 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132kV) at Farm substation to connect to the Jhimpir-1 220/132 kV grid station of NTDC.
- The design of scheme of 132/33 kV substation of Norinco Wind Farm has been provided by the Sponsor and is attached in Appendix – 2.
- Load flow analysis has been carried out for peak and Off Peak scenarios of summer 2021 considering the expected COD of end of 2020 targeted by Norinco WPP and a future scenario of 2023, for the dispersal of power from Norinco WPP into NTDC system using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme has been evolved

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

- The load flow results for Peak and Off-Peak scenarios establish that the proposed scheme of interconnection of Norinco 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 Norinco WPP under normal as well as the contingency conditions.
- Maximum and minimum short circuit levels for three-phase faults and single-phase faults have been evaluated. The maximum SC levels have been evaluated for the year 2023 and minimum short circuit level for the year 2021 for the most stringent conditions. The maximum fault levels of Norinco 132 kV are 8.05 kA and 7.11 kA for 3-phase and 1-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Norinco Farm Substation as per NTDC requirements for 132 kV. The fault levels for Norinco MV 33 kV are 17.41 kA and 19.51 kA for 3-phase and 1-phase faults respectively for year 2023.

  Therefore, the short circuit rating for 33 kV switchgear is recommended as 25 kA. It has been found that the proposed scheme provides maximum SC strength for the evacuation of Norinco WPP power to the grid.

  The switchgear ratings for Norinco WPP substation are as follows:

  132 kV:

  Short circuit rating = 40 kA (3 sec.)

  Continuous rating = 2500 A

  33 kV:

  Short circuit rating = 25 kA (3 sec.)

  Continuous rating = 2000 A

- Transient Stability analysis has been carried out for Norinco WPP based on their selection of Type-4 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 Norinco WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Norinco WPP side did not cause any stress on the main grid or the power plants nearby and in the HESCO area such that the whole system remained stable under all events.

- The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault clearing due to stuck-breaker (breaker failure) reason. The simulations have proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.
- The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and unbalance are within the permissible limits of IEC and other International Standards.
- There are no technical constraints whatsoever in the way of bringing in the 100 MW of Norinco 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.

TABLE OF CONTENTS

1. Introduction

1.1. Background

A study of 15 Wind Power Plants was carried out by the individual consultants and got approved from NTDCL planning department in 2017. This study was carried out for 15 new WPPs in integration with the already planned WPPs and other upcoming WPPs in its vicinity. Grid interconnection studies were carried out for two wind power projects of Norinco International Thatta Power (Pvt.) Limited (NITPPL) i.e. Norinco-I 50 MW and Norinco-II 50 MW separately and got approved from NTDC. The study for Norinco-I WPP was carried out by NTDC and they proposed it to be connected with Jhimpir 220/132 kV substation. The study for Norinco-II WPP was carried out by M/s PPI and its proposed interconnection scheme was with the Jhimpir – T.M Khan 132 kV Transmission Line. NITPPL intends to merge the two 50 MW wind power projects into one 100 MW project with one substation considering the close proximity of these two projects.

The problem with the merger is that both plants are connected in different loops and either of the loop does not have enough transmission capacity to accommodate the additional 50 MW. The only solution available is the swapping of one 50 MW Norinco power project with any other 50 MW wind power project in the same loop.

Grid interconnection study for 50 MW Sino Well PP was also carried out by M/s PPI as a part of the integrated study for evacuation of power from wind power plants in Jhimpir area. Sino Well WPP was proposed to be interconnected next to Norinco-II WPP with the Jhimpir – T.M Khan 132 kV Transmission Line. Considering the location, it seems feasible to swap Norinco-I WPP with Sino Well WPP and interconnect Sino Well WPP with the recently constructed Jhimpir 220/132 kV grid station.

For this purpose, NITPPL has requested to the management of Sinowell and both the parties have agreed for the swap. This study is being carried out for Norinco WPP for the purpose to make sure that there are no technical constraints while swapping the interconnection of both the projects.

1.2. Objectives

The overall objectives of this study are:

1. Impact of Norinco Wind Power Plant on the System
2. Impact of the System on Norinco Wind Power Plant

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

The impacts are required to be studied for steady state as well as the dynamic and disturbed conditions of the system. The specific objectives are:

1. To develop a feasible scheme of interconnections of Norinco 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 Norinco Wind Farm to regulate the voltage under steady state and contingency conditions to fulfill the Grid Code criteria of ± 0.95 Power Factor at the point of common coupling (interface point) interconnecting Wind Farm and the Grid i.e. 132 kV gantries of outgoing circuits.
5. To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations at 220 kV and 132 kV voltage levels to be within the rating of equipment of these substations, and also determine the short circuit ratings of the proposed equipment of the Medium Voltage substation of collector system of Norinco Wind Farm and the NTDC/HESCO substations of 132 kV connecting with the Norinco Wind Farm.
6. To check the minimum short circuit strength of the system to handle large variation of generation of wind turbine
7. To check if the interconnection with the grid withstands transient stability criteria of post fault recovery with good damping satisfying the NEPRA Grid Code.

8. Transient stability to see the dynamic performance of Norinco WPP in response to Grid disturbances and vice versa the dynamic impact of disturbances in Norinco WPP on the Grid.
9. To check the ability of the wind turbine generators of Norinco 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	+8%, -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 40 kA

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

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

1. Total normal fault clearing time from the instant of initiation of fault current to the complete interruption of current, including the relay time and breaker interruption time to isolate the faulted element, is equal to 100 ms (5 cycles) for the systems of 132 kV and above.
2. In case of failure of primary protection (stuck breaker case), the total fault clearing time from the instant of initiation of fault current to the complete interruption of current to isolate the faulted element, including the primary protection plus the backup protection to operate and isolate the fault, is equal to 180 ms (9 cycles) for 132 kV and higher voltage levels.

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

Reactive Power and Power factor:

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

Power Quality Requirements:

As per IEC61400-21standards

1.4. Operating Criteria

The operating requirements to be fulfilled by the proposed Norinco 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 latest load forecast and the generation expansion plan of NTDC has been used as shown in Appendix 2.

The input data regarding Norinco Wind Farm has been provided by the client who has indicated to use 2.5 MW Goldwind Science & Technology Co., Ltd. Type-4 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 required to absorb constant variations of MW, MVAR and hence rapid deviation in voltage and frequency from the system's normal operating set point.

An abundance of coal power plants are present in the Southern grid such as Thal Nova, Thar Energy, Engro, HUBCO, Port Qasim etc. Apparently, this amount of generation in Southern grid seems strong enough to absorb the penetration of wind power. But there are other variables that necessitate detailed studies like strengths of nodes of connectivity, loading capacity of the transmission lines to evacuate power from Wind Farm area and dynamic response of wind turbine generators and neighboring conventional synchronous generators.

The dynamic studies will determine how they respond to dynamic behavior of Norinco 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 Norinco Wind Energy is considering using 2.5 MW Goldwind Science & Technology Co., Ltd. Type-4 WTGs.

2.2. Approach to the Problem

We will apply the following approaches to the problem:

- According to the expected COD of Norinco WPP i.e. end of 2020 as provided by the Sponsor Norinco International Thatta Power (Pvt.) Limited, we have decided to perform our analysis for the scenario of summer 2021 to judge the maximum impact of the plant after the COD of the plant when the 220/132 kV Substation of Jhimpir-2 is commissioned.
- The base case for the year 2021 comprising all 500 kV, 220 kV and 132 kV, and 66 kV system would be prepared envisaging the load forecast, the generation additions and transmission expansions for each year particularly in the Southern parts of the country. The case would include all the proposed and existing Wind Power Plants which have been developed or are going to be developed on a fast track basis and are expected to be commissioned by 2021 as per the latest schedule of AEDB.
- Interconnection scheme without any physical constraints, like right of way or availability of space in the terminal substations, would be identified.
- Perform technical system studies for peak load conditions of high wind seasons' power dispatches, to confirm technical feasibility of the interconnections.
- The proposed interconnection scheme will be subjected to steady state analysis (load flow), short circuit and transient stability to test the robustness of the scheme under normal and contingency conditions by checking steady state and transient/dynamic behavior under all events.
- Determine the relevant equipment for the proposed technically feasible scheme of interconnection
- Perform sensitivity studies considering adjacent wind farms to check their impact on HESCO/NTDC Grid. This sensitivity check can be performed for the ultimate planned number of Wind Power Plants in the neighborhood of Norinco Wind Power Plant.

3. Analysis of the Network Prior to Norinco WPP Interconnection

3.1. Description of the Network

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

In this sketch, all the existing and proposed WPPs in the Jhimpir and Gharo clusters are modeled. The existing 132 kV substation of Jhimpir 220/132 kV and newly proposed 220/132 kV substation of Jhimpir-2 is shown with their complete existing and planned connectivity.

We have carried out the studies of the case "without" Norinco WPP but including all the other planned and existing WPPs which have expected COD by the end of 2020 to ascertain if there are any constraints in the system prior to Norinco WPP's commissioning.

3.1.1. Load Forecast

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

3.1.2. Generation and Transmission Expansion Plan

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

3.2. Load Flow Analysis

Load flow analysis has been carried out for the NTDC / HESCO network including all the existing and planned wind power plants at Jhimpir and Gharo clusters but without including Norinco 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 summer 2021. The month has been selected so that the Jhimpir-2 220/132 kV substation is completed before the commissioning of the said WPPs. In order to ensure proper economic dispatch in the southern area for this High Wind High Water Season, it was essential to have a reasonable energy mix with contributions from both thermal and wind power plants. We kept the dispatch of the nearby power plants such as Thatta, Nooriabad and Kotri-Site at its maximum. Kotri GTPS was operated at 50% capacity.

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

The N-1 contingency check has also been applied and the results are attached in Appendix-3 as below:

Exhibit 3.1	Jhimpir-1 to Tricom 132 kV Single Circuit Out
Exhibit 3.2	Tricom to T.M. Khan 132 kV Single Circuit Out
Exhibit 3.3	Jhimpir-1 to T.M. Khan 132 kV Single Circuit Out
Exhibit 3.4	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 3.5	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 3.6	Jhimpir-1 to TM Khan Road 220 kV Single Circuit Out
Exhibit 3.7	T.M. Khan Road to Jamshoro 220 kV Single Circuit Out
Exhibit 3.8	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.9	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 3.10	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 3.11	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 3.12	Jamshoro 500/220 kV Single Transformer Out

The load flow results of the network in the close vicinity of Norinco WPP shown plotted in Exhibits 3.1 to 3.12 indicate that all the power flows on the lines are within the rated limits of this network.

Therefore, it is established with Load flow results that the network existing before Norinco WPP in the same vicinity in Jhimpir cluster including the Jhimpir-1 220/132 kV collector substation is enough to absorb their power and has no limitations in terms of power transfer capacity under normal as well as N-1 contingency, prior to connection of Norinco WPP. We will check the adequacy of network after adding Norinco WPP in Chapter 6.

4. Development of Interconnection Scheme

4.1. Interconnection of Norinco 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 Norinco WPP, the nearest substation is the collector substation of Jhimpir-1 220/132 kV for evacuation of power from said power plant.

4.2. Proposed Interconnection Scheme

The scheme of interconnection of Norinco WPP includes 132 kV D/C transmission line approx. 1 km long, on Greeley conductor for looping in/out on the 132 kV single circuit from Tricom WPP to Jhimpir-1 grid station. It must be noted that with merger of 2x50 MW of Norinco into 1x100 MW will also requires only single connection from NTDC and apparently NTDC will save about 3 km of the transmission line cost.

The connection scheme of Norinco WPP for the scenario of summer 2021 as shown in Appendix - 4 is by interconnecting Norinco in the double circuit going from Tricom WPP to Jhimpir-1. They may change slightly during the implementation of the project. In case, if there is any increase in the length of transmission line during the implementation of the project, the additional cost of the increased length for both Sinowell and Norinco will be borne by Norinco. In addition, the connectivity of Norinco WPP with neighboring wind power plants may change, depending upon the COD of the project.

5. Modeling of Norinco Wind Farm

5.1. Electrical Layout of Wind Farm

5.1.1. Norinco WPP Turbine Selection

Norinco has selected 2.5 MW Goldwind GW121/2500 Type-4 WTG which they are considering to install on their Wind Farm. Each WTG would step up from its terminal LV voltage of 0.69 kV to a medium voltage (MV) that will be 33 kV.

5.1.2. Electrical Layout

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

Line – 1	WTGs 1-10	(10 x 2.5 = 25 MW)
Line – 2	WTGs 11-20	(10 x 2.5 = 25 MW)
Line – 3	WTGs 21-30	(10 x 2.5 = 25 MW)
Line – 4	WTGs 31-40	(10 x 2.5 = 25 MW)

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

The Farm Substation has been assumed to be located somewhere in the middle of the Farm. The three collector circuits of 33 kV would thus be laid as shown in Sketch-3 and explained as follows;

Collector Line-1	from WTG-1 to Farm Substation
Collector Line-2	from WTG-11 to Farm Substation
Collector Line-3	from WTG-21 to Farm Substation
Collector Line-4	from WTG-31 to Farm Substation

Since each collector would carry a max of approximately 25 MW at normal rating, the 33 kV collector circuits loading capacity should be in the range of 30 MVA each, giving some margin for reactive power at 0.95 Power Factor and some losses in the circuits with certain overload capacity as well.

5.1.3. 33 kV Collector Circuits

The MV voltage level selected by Norinco for interconnection of collector groups of WTGs in the Farm is 33 kV. Underground cables will be used with length of approx. 5 km, 4.4 km, 5.22 km and 5.65 km for four different collector Cables as shown in sketch-3 of Appendix - 5. Further details regarding the type of cable is provided in Appendix - 2.

5.2. Wind Farm Substation 132/33 kV

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

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

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

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

5.2.1. Conceptual Design of 33 kV

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

- Two single bus-sections of 33 kV with a bus sectionalizer
- Four breaker bays to connect four collector double circuits of WTG Lines 1-4
- Two breaker bays to connect two transformers of 132/33 kV
- Two breaker bays for connecting two auxiliary transformers of 33/0.4 kV
- Two breaker bays to connect SVCs

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

= 2000A for Bus Sectionalizer and Power TF

5.2.2. Conceptual Design of 132 kV

The single line diagram named Sketch–2 (Appendix–5) shows 132 kV bus bars of the Farm substation, which would comprise as follows:

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

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity	= 40 kA
Normal continuous current	= 1250 A for line and TF breakers
	= 2500 A for Bus Sectionalizer

The other equipment of the substation consists of:

- Two 132/33 kV, 100 MVA OLTC transformers, 132±8×1.25%/33 kV, to fulfill N-1 criteria of Grid Code
- Two station auxiliary transformers 33/0.4 kV
- Two SVCs each of the size of ±20 MVAR with contactors and PLC (Programmable Logic Controller).
- Energy meters would be installed on HV side (132 kV) of the 132/33 kV transformers.

6. Load Flow Analysis

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

6.1. Modeling of Wind Farm in Load Flow

Representation of all the individual machines in a large Wind Farm is inappropriate in most grid impact studies [1]. There is a provision in the model structure of PSS/E to allow single equivalent WTG machine model to represent multiple WTGs. However, there are limitations. Disturbances within the local collector grid cannot be analyzed, and there is some potentially significant variation in the equivalent impedance for the connection to each machine. A single machine equivalent requires the approximation that the power output of all the machines will be the same at a given instant of time. For grid system impact studies, simulations are typically performed with the initial wind of sufficient speed to produce the rated output on all the machines. Under this condition, the assumption that all the machines are initially at the same (rated) output is not an approximation [2]. Otherwise this assumption presumes that the geographic dispersion is small enough that the wind over the farm is uniform. Though simulations of bulk system dynamics using a single machine equivalent are adequate for most planning studies, we have adopted a rather more detailed level of modeling by using an equivalent machine just for one group of WTGs connected to one collector feeder. Since we have four collector feeders connecting to four groups of WTGs, therefore there are four equivalent WTGs assumed for each collector group in this study report.

The Farm Substation is represented by two bus bars as Norinco medium voltage bus named Norinco -MV 33 kV and Norinco 132 kV, with two inter-bus transformers of 100 MVA each. These transformers have an additional capacity of 100 MVA 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. 100 MVA.

6.2. Reactive Power Requirements

Norinco is considering using 2.5 MW Goldwind GW121/2500 Type-4 WTG, in their WPP. Its power factor is 0.9 lagging (capacitive/generating) and 0.9 leading (inductive/absorbing). The maximum reactive power output that can be available at the 0.69 kV terminal is 1.21 MVAR for each WTG. Part of this reactive power will be consumed by the 0.69/33 kV step-up (GSU) transformer and the rest may be consumed in the MV collector cables of the wind farm. However, some reactive power might reach the MV bus bar of Farm substation. That means

each WTG is self sufficient to meet VAR absorption requirement of its step-up transformer with some contribution of VARs to the Farm MV network.

The Grid Code Addendum No.1 requires to meet the criteria of ± 0.95 power factor at the point of interconnection with the NTDC/HESCO grid at 132 kV (point of common coupling). Therefore, a Farm of 100 MW generating capacity is required to pump 32.8 MVAR to the grid at full output of 100 MW. The VAR generating capability of WTG at 0.9 PF will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers, collector cables and the HV/MV i.e. 132/33 kV transformers at the Farm substation. In order to meet the Grid Code criteria, we need to install SVC at 33 kV bus of the Farm substation of sufficient size capable of delivering approx. 32.8 MVAR at 132 kV bus after VAR loss across 132/33 kV transformers.

6.3. Load Flow Analysis for Peak Load Scenario of summer 2021

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

The integrated case has been studied for the system conditions of summer 2021, the time line associated with the COD of Norinco WPP and after the commissioning of the newly proposed 220/132 kV substation in the southern part of Jhimpir. In order to ensure proper economic dispatch in the southern area for this High Wind High Water Season, it was essential to have a reasonable energy mix with contributions from both thermal and wind power plants. We kept the dispatch of the nearby power plants such as Thatta, Nooriabad and Kotri-Site at its maximum. Kotri GTPS was operated at 50% capacity. Output from all the existing/ under construction/ planned Wind Plants was kept at maximum.

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

6.3.1. Normal Case

Exhibit 6.1.0 shows the normal case under the system conditions of summer 2021. All the wind farms in Jhimpir and Gharo clusters with installed capacity of 50 MW or 49.5 MW have been assumed after deducting Farm losses and given some diversity in the maximum output of all the Wind Power Plants at one time. For Norinco WPP, 95 MW is assumed to be delivered at the point of delivery to grid at 132 kV.

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

We see that all the WTGs are running at a power factor above its rated value of 0.90 not using full reactive power capability leaving enough margin to cover contingencies. The SVCs of ±40 MVAR at 33 kV bus bar is helping to maintain the power factor of 0.95 even after the VAR losses across 132/33 kV Transformer 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	Norinco 132/33 kV Single Transformer Out
Exhibit 6.1.2	Norinco to Jhimpir-1 132 kV Single Circuit Out
Exhibit 6.1.3	Norinco to Tricom 132 kV Single Circuit Out
Exhibit 6.1.4	Tricom to T.M. Khan 132 kV Single Circuit Out
Exhibit 6.1.5	Jhimpir-1 to T.M. Khan 132 kV Single Circuit Out
Exhibit 6.1.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.1.7	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 6.1.8	Jhimpir-1 to TM Khan Road 220 kV Single Circuit Out
Exhibit 6.1.9	T.M. Khan Road to Jamshoro 220 kV Single Circuit Out
Exhibit 6.1.10	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.1.11	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.1.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.1.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.1.14	Jamshoro 500/220 kV Single Transformer Out

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

6.4. Load Flow Analysis for Off-Peak Load Scenario of summer 2021

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

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

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

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

Exhibit 6.2.1	Norinco 132/33 kV Single Transformer Out
Exhibit 6.2.2	Norinco to Jhimpir-1 132 kV Single Circuit Out
Exhibit 6.2.3	Norinco to Tricom 132 kV Single Circuit Out
Exhibit 6.2.4	Tricom to T.M. Khan 132 kV Single Circuit Out
Exhibit 6.2.5	Jhimpir-1 to T.M. Khan 132 kV Single Circuit Out
Exhibit 6.2.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.2.7	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 6.2.8	Jhimpir-1 to TM Khan Road 220 kV Single Circuit Out
Exhibit 6.2.9	T.M. Khan Road to Jamshoro 220 kV Single Circuit Out
Exhibit 6.2.10	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.2.11	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.2.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.2.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.2.14	Jamshoro 500/220 kV Single Transformer Out

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

6.5. Load Flow Analysis for Future Scenario of 2023

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

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

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

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

Exhibit 6.3.1	Norinco 132/33 kV Single Transformer Out
Exhibit 6.3.2	Norinco to Jhimpir-1 132 kV Single Circuit Out
Exhibit 6.3.3	Norinco to Tricom 132 kV Single Circuit Out
Exhibit 6.3.4	Tricom to T.M. Khan 132 kV Single Circuit Out
Exhibit 6.3.5	Jhimpir-1 to T.M. Khan 132 kV Single Circuit Out
Exhibit 6.3.6	Jhimpir-2 220/132 kV Single Transformer Out
Exhibit 6.3.7	Jhimpir-1 220/132 kV Single Transformer Out
Exhibit 6.3.8	Jhimpir-1 to TM Khan Road 220 kV Single Circuit Out
Exhibit 6.3.9	T.M. Khan Road to Jamshoro 220 kV Single Circuit Out
Exhibit 6.3.10	Jhimpir-1 to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.3.11	Gharo-New to Jhimpir-2 220 kV Single Circuit Out
Exhibit 6.3.12	Jhimpir-2 to KDA-33 220 kV Single Circuit Out
Exhibit 6.3.13	Jhimpir-2 to Jamshoro 220 kV Single Circuit Out
Exhibit 6.3.14	Jamshoro 500/220 kV Single Transformer Out

The load flow results of the network in the close vicinity of Norinco WPP shown plotted in Exhibits 6.3.1 to 6.3.14 indicate that all the power flows on the lines are within the rated limits of this network.

6.6. Conclusion of Load Flow Results

For the base year of 2021 and the future year 2023, the load flow results of the proposed scheme of interconnection of Norinco 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 Norinco WPP under normal as well as the contingency conditions for all the scenarios studied.

7. Short Circuit Analysis

7.1. Methodology and Assumptions

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

7.1.1. Assumptions for maximum and minimum short circuit levels

7.1.1.1. Assumptions-Maximum short circuit levels

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

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

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

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

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

7.1.1.2. Assumptions-Minimum Short Circuit Levels

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

To assess the minimum short circuit levels, we have considered conditions of 2021 to simulate the minimum short circuit strength of southern grid. For Norinco WPP we have assumed a smaller percentage of dispatch of its capacity for the minimum short circuit calculations i.e. with partial output of approx. 33.3 MW is on bar.

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

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

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

7.2. Fault Currents Calculations

7.2.1. Maximum Short Circuit Levels for the Year 2023

The short circuit levels have been calculated and plotted on the bus bars of 500 kV, 220 kV and 132 kV of substations lying in the electrical vicinity of our area of interest i.e. Jhimpir, T.M.Khan Road, Jamshoro and Gharo area, and are shown plotted in the Exhibit 7.2 for the scenario of 2023 and attached in Appendix-7. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-7 for the 500 kV, 220 kV and 132 kV bus bars of our interest i.e. the substations connecting in the three branches of 132 kV running South of Hyderabad up to Southern Sind coast line. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 7.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations which normally are 25 kA or 31.5 kA for older substations and 40 kA for new substations; except at Jamshoro 500/220 kV in which fault current exceeds 40 kA. However, one and a half breaker scheme is installed at Jamshoro 500/220 kV substation therefore, the short circuit across individual circuit breaker will remain in limit.

The fault levels of Norinco 132 kV are 8.05 kA and 7.11 kA for 3-phase and 1-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Norinco Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Norinco 33 kV are 17.41 kA and 19.51 kA for 3-phase and 1-phase faults respectively for 2023. Therefore, the short circuit rating recommended for 33 kV switchgear is recommended as 25 kA.

Table-7.1

Maximum Short Circuit Levels with Norinco WPP – 2023

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Norinco132 kV	8.05	7.11
Norinco MV 33 kV	17.41	19.51
Tricom 132 kV	7.49	6.15
Nooriabad 132 kV	10.62	8.18
Thatta 132 kV	6.22	5.35
PAF 132 kV	7.40	5.07
Master GRN	8.53	6.56
Jamshoro Old 132 kV	23.86	17.41
Jamshoro New 132 kV	25.38	17.91
Kotri GTPS 132 kV	20.53	16.13
Hala Road 132 kV	23.31	14.77
Jhimpir 132 kV	10.33	8.72
Jhimpir-1 132 kV	29.92	23.89
Jhimpir-2 132 kV	23.47	18.21
Gharo-New 132 kV	10.21	8.59
Gharo-New 220 kV	10.02	6.62
Jhimpir-1 220 kV	23.25	14.97
Jhmipir-2 220 kV	27.36	19.14
Jamshoro 220 kV	44.10	40.36
Hala Road 220 kV	31.93	23.79
TM.KH.RD 220 kV	29.39	19.95

7.2.2. Minimum short circuit levels

The minimum fault levels have been calculated for minimum dispatch of power in the grid system. The plotted results of short circuit analysis are attached as Exhibit 7.1. Both 3-phase

and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the faulted bus bar.

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

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

Table-7.2

Minimum Short Circuit Levels with Norinco WPP 2021

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Norinco132 kV	7.52	6.90
Norinco MV 33 kV	15.62	17.66
Tricom 132 kV	7.22	6.31
Nooriabad 132 kV	9.04	7.68
Thatta 132 kV	5.33	4.86
PAF 132 kV	6.34	4.57
Master GRN	7.15	5.91
Jamshoro Old 132 kV	18.88	16.65
Jamshoro New 132 kV	19.97	18.05
Kotri GTPS 132 kV	16.33	14.06
Hala Road 132 kV	18.50	15.61
Jhimpir 132 kV	8.59	8.17
Jhimpir-1 132 kV	20.85	19.80
Jhimpir-2 132 kV	18.17	18.42
Gharo-New 132 kV	7.82	7.70
Gharo-New 220 kV	7.90	6.30
Jhimpir-1 220 kV	16.95	14.17
Jhmipir-2 220 kV	20.31	16.92
Jamshoro 220 kV	26.57	22.44
Hala Road 220 kV	21.50	17.16
TM.KH.RD 220 kV	20.44	15.98

7.3. Conclusions of Short Circuit Analysis

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

The fault levels of Norinco 132 kV are 8.05 kA and 7.11 kA for 3-phase and 1-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Norinco Farm Substation as per NTDC requirements for 132 kV.

The fault levels for Norinco 33 kV are 17.41 kA and 19.51 kA for 3-phase and 1-phase faults respectively for 2023. Therefore, the short circuit rating recommended for 33 kV switchgear is 25 kA.

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

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

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

8. Dynamic Stability Analysis

The objective of transient stability study is to see:

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

8.1. Assumptions & Methodology

Norinco is considering using Doubly Fed Induction Generator which is designated as Type-4 WTG in their Wind Power Plant. We have used the generic Type-4 wind turbine-generator model, which has been developed and has been made available by Siemens–PTI to their users of PSS/E software. Only the main parameters have been incorporated in this model, whereas other details and minute control parameters have been based on assumptions in the controllers of generic model of Siemens-PTI software PSS/E.

8.2. Dynamic Impact of System Disturbances

8.2.1

Fault Type: 3-Phase			
Fault Location: Norinco 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Norinco to Jhimpir-1 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Norinco 132 kV 2. Norinco MV 33 kV 3. Jhimpir-1 132 kV 4. Tricom 132 kV 5. T.M Khan 132 kV 6. Jhimpir-1 220 kV	The voltages of all the bus bars recover after fault clearance	8.1.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.1.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.1.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after fault clearance	8.1.4
• **MW Line Flow** • **MVAR Line Flow**	Jhmipir-1 to TM. Khan 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.1.5

• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.1.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.1.7

8.2.2

Fault Type: 1-Phase			
Fault Location: Norinco 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Norinco to Jhimpir-1 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Norinco 132 kV 2. Norinco MV 33 kV 3. Jhimpir-1 132 kV 4. Tricom 132 kV 5. T.M Khan 132 kV 6. Jhimpir-1 220 kV	The voltages of all the bus bars recover after fault clearance	8.2.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.2.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.2.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after fault clearance	8.2.4
• **MW Line Flow** • **MVAR Line Flow**	Jhmipir-1 to TM. Khan 132 kV intact single circuit	Attains steady state value after damping of oscillations	8.2.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.2.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.2.7

8.2.3

Fault Type: 3-Phase			
Fault Location: Norinco 33 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: One 132/33 kV transformer			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Norinco MV 33 kV 2. Norinco 132 kV 3. Tricom 132 kV 4. Jhimpir-1 132 kV 5. T.M Khan 132 kV 6. Jhimpir-1 220 kV	The voltages of all the bus bars recover after fault clearance	8.3.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.3.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.3.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after fault clearance	8.3.4
• **MW Line Flow** • **MVAR Line Flow**	Norinco 132/33 kV intact single transformer	Attains steady state value after damping of oscillations	8.3.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.3.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.3.7

8.2.4

Fault Type: 3-Phase			
Fault Location: Norinco 33 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: One collector group of 25 MW			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Norinco MV 33 kV 2. Norinco 132 kV 3. Tricom 132 kV	The voltages of all the bus bars	8.4.1

	4. Jhimpir-1 132 kV 5. T.M Khan 132 kV 6. Jhimpir-1 220 kV	recover after fault clearance	
Frequency	Norinco 132 kV	Recovers after fault clearance	8.4.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.4.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after fault clearance	8.4.4
• **MW Line Flow** • **MVAR Line Flow**	Norinco 132/33 kV intact single transformer	Attains steady state value after damping of oscillations	8.4.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.4.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.4.7

8.2.5

Fault Type: 3-Phase			
Fault Location: Tricom 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Tricom to TM. Khan 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Tricom 132 kV 2. Norinco 132 kV 3. Norinco-MV 33 kV 4. T.M Khan 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220 kV	The voltages of all the bus bars recover after fault clearance	8.5.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.5.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.5.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.5.4

• **MW Line Flow** • **MVAR Line Flow**	Jhimpi-1 to T.M Khan 132 kV intact Single Circuit	Attains steady state value after damping of oscillations	8.5.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.5.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.5.7

8.2.6

Fault Type: 1-Phase			
Fault Location: Tricom 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Tricom to TM. Khan 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Tricom 132 kV 2. Norinco 132 kV 3. Norinco-MV 33 kV 4. T.M Khan 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-1 220 kV	The voltages of all the bus bars recover after fault clearance	8.6.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.6.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.6.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.6.4
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M Khan 132 kV intact Single Circuit	Attains steady state value after damping of oscillations	8.6.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.6.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV	Damps down quickly and attain a steady state value	8.6.7

	5. Hubco CFPP 500 kV 6. Guddu-New (Reference)		

8.2.7

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-1 to Norinco 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 132 kV 2. Norinco 132 kV 3. Norinco MV 33 kV 4. Tricom 132 kV 5. T.M Khan 132 kV 6. Jhimpir-1 220 kV	The voltages of all the bus bars recover after fault clearance	8.7.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.7.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.7.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after fault clearance	8.7.4
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M. Khan 132 kV Single Circuit	Attains steady state value after damping of	8.7.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.7.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.7.7

8.2.8

Fault Type: 1-Phase			
Fault Location: Jhimpir-1 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-1 to Norinco 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 132 kV 2. Norinco 132 kV	The voltages of all the bus bars	8.8.1

	3. Norinco MV 33 kV 4. Tricom 132 kV 5. T.M Khan 132 kV 6. Jhimpir-1 220 kV	recover after fault clearance	
Frequency	Norinco 132 kV	Recovers after fault clearance	8.8.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.8.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after fault clearance	8.8.4
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M. Khan 132 kV Single Circuit	Attains steady state value after damping of	8.8.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Recovers after damping down oscillations	8.8.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.8.7

8.2.9

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-1 to T.M. Khan 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 132 kV 2. T.M Khan 132 kV 3. Norinco 132 kV 4. Tricom 132 kV 5. Jhimpir-1 220 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.9.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.9.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.9.3

• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.9.4
• **MW Line Flow** • **MVAR Line Flow**	Norinco to Jhimpir-1 132 kV intact single circuit	Recovers after damping down oscillations	8.9.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Attains steady state value after damping of oscillations	8.9.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.9.7

8.2.10

Fault Type: 1-Phase			
Fault Location: Jhimpir-1 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-1 to T.M. Khan 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 132 kV 2. T.M Khan 132 kV 3. Norinco 132 kV 4. Tricom 132 kV 5. Jhimpir-1 220 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.10.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.10.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.10.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.10.4
• **MW Line Flow** • **MVAR Line Flow**	Norinco to Jhimpir-1 132 kV intact single circuit	Recovers after damping down oscillations	8.10.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Attains steady state value after damping of oscillations	8.10.6

Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.10.7

8.2.11

Fault Type: 3-Phase			
Fault Location: Jhimpir-1 220 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 220 kV 2. TM. Kh.RD 220 kV 3. Norinco 132 kV 4. Tricom 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.11.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.11.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.11.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.11.4
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M. Kh. Road 220 kV intact single circuit	Recovers after damping down oscillations	8.11.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Attains steady state value after damping of oscillations	8.11.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.11.7

8.2.12

Fault Type: 1-Phase			
Fault Location: Jhimpir-1 220 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Jhimpir-1 to T.M. Khan Road 220 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Jhimpir-1 220 kV 2. TM.Kh. RD 220 kV 3. Norinco 132 kV 4. Tricom 132 kV 5. Jhimpir-1 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.12.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.12.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.12.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.12.4
• **MW Line Flow** • **MVAR Line Flow**	Jhimpir-1 to T.M. Kh Road 220 kV intact single circuit	Recovers after damping down oscillations	8.12.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Attains steady state value after damping of oscillations	8.12.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.12.7

8.2.13

Fault Type: 3-Phase			
Fault Location: Norinco 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Norinco to Tricom 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Norinco 132 kV 2. Norinco MV 33 kV	The voltages of all the bus bars	8.13.1

	3. Jhimpir-1 132 kV 4. Tricom 132 kV 5. TM Khan 132 kV 6. Jhimpir-2 220 kV	recover after fault clearance	
Frequency	Norinco 132 kV	Recovers after fault clearance	8.13.2
• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.13.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.13.4
• **MW Line Flow** • **MVAR Line Flow**	Norinco to Jhimpir-1 132 kV intact single circuit	Recovers after damping down oscillations	8.13.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Attains steady state value after damping of oscillations	8.13.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.13.7

8.2.14

Fault Type: 1-Phase			
Fault Location: Norinco 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Norinco to Tricom 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Norinco 132 kV 2. Norinco MV 33 kV 3. Jhimpir-1 132 kV 4. Tricom 132 kV 5. TM Khan 132 kV 6. Jhimpir-2 220 kV	The voltages of all the bus bars recover after fault clearance	8.14.1
Frequency	Norinco 132 kV	Recovers after fault clearance	8.14.2

• **Plant MW Output** • **Plant MVAR Output**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.14.3
• **Voltage Sensor for LVACR**	Norinco Collector Group 0.69 kV	Recovers after damping down oscillations	8.14.4
• **MW Line Flow** • **MVAR Line Flow**	Norinco to Jhimpir-1 132 kV intact single circuit	Recovers after damping down oscillations	8.14.5
• **MW Output** • **MVAR Output**	Tricom 132 kV	Attains steady state value after damping of oscillations	8.14.6
Rotor Angles	1. Kotri GTPS 132 kV 2. Thatta 132 kV 3. Lakhra 132 kV 4. Nooriabad 132 kV 5. Hubco CFPP 500 kV 6. Guddu-New (Reference)	Damps down quickly and attain a steady state value	8.14.7

8.3. Conclusion of Stability Study

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

There are no constraints of connecting Norinco WPP with the NTDC grid in terms of transients or dynamic behavior of system under the disturbed conditions either on the Farm side or on the Grid side.

9. Power Quality

The issues of power quality are of particular importance to wind turbines that may cause flicker and distortions in the power supply due to harmonics and unbalance. These issues are more significant for weak systems of low short circuit strength. Therefore, we have investigated these issues for the case of minimum short circuit of 2021 for the proposed scheme of interconnection. The same case has been re-evaluated with per unit MVA values and plotted for 3-phase faults in Exhibits 7.1.1 and 7.1.2 in Appendix-7

9.1. Flicker

We have used IEC61400-21 for the calculations of flicker levels for steady-state continuous operation and for switching conditions [1].

9.1.1. Continuous Operation

The probability of 99th percentile flicker emission from a single wind turbine during continuous operation for short time $P_{st\Sigma}$ and longer time flicker levels $P_{lt\Sigma}$ are assumed same and calculated by the following formula

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

where

$c(\psi_k, v_a)$ is the flicker coefficient of the wind turbine for the given network impedance phase angle, ψ_k at the PCC, and for the given annual average wind speed, v_a at hub-height of the wind turbine at the site;

S_n is the rated apparent power of the wind turbine;

S_k is the short-circuit apparent power at the PCC.

N_{wt} is the number of wind turbines connected to the PCC.

PCC is the point of common coupling of WTGs that is MV bus of Norinco Farm substation. For minimum short circuit case we have assumed the same case as discussed in paragraph 7.1.1.2 of Chapter 7 in which output of Norinco Wind farm reduced from full rated capacity. Therefore, taking 33.3 MW as reduced value.

S_n= 2.77 MVA at 0.90 PF (For 1 WTG)

N_{WT} = 10 (Approximate)

S_k for MV bus = 890 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

$P_{St\Sigma} = P_{lt\Sigma} = 0.009870 = 0.9870\ \%$

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 Norinco Wind farm would not cause any flicker problem during steady state operation even in the weakest system conditions of minimum short circuit level.

9.1.2. Switching Operation

The most common switching operations would be as follows;

a. Wind turbine start-up at cut-in speed
b. Wind turbine start-up at rated wind speed
c. The worst case of switching between the WTGs

The flicker emission from the wind farm of many machines can be calculated by the following equation as per IEC61400-21 (Section 8.3.2)

$$P_{st\Sigma} = \frac{18}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{10,i} \cdot \left(k_{f,i}(\psi_k) \cdot S_{n,i} \right)^{3,2} \right)^{0,31}$$

$$P_{lt\Sigma} = \frac{8}{S_k} \cdot \left(\sum_{i=1}^{N_{wt}} N_{120,i} \cdot \left(k_{f,i}(\psi_k) \cdot S_{n,i} \right)^{3,2} \right)^{0,31}$$

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;

$P_{St\Sigma} = 0.20798$

$P_{lt\Sigma} = 0.199707$

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

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

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

9.2. Voltage Unbalance

9.2.1. Voltage Step-Change

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

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

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

Where

S_{WKA} = MVA rating of the WTG

S_{KE} = Short circuit MVA at connection point

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

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

S_{WKA} = 2.77 MVA for the equivalent WTG of a collector group for the minimum case

S_{KEI} for one WTG in collector group = 480 MVA (Exhibit 7.1.2)

S_{KSS} = 860 MVA (Exhibit 7.1.2)

Substituting these values, we get

$$\Delta V = 0.002557063 = 0.2557063\ \%$$

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 = 0.005208333 = 0.520833%

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

10. Conclusion and Recommendations

- The Grid Interconnection Study has been revised for the merger of 2x50 MW Norinco WPP into 1x100 MW Wind Power Plant.
- Norinco WPP has been placed in the loop at 220/132 kV Jhimpir-1 grid station. Norinco Wind Power Plant would be connected by a double circuit of 132 kV by looping in-out configuration of the one circuit of Jhimpir-1 – T.M. Khan along with Tricom WPP. It should be noted that the length of circuits used for the simulations are confirmed from site visit and agreed with NTDC official. They may change slightly during the implementation of the project. In case, if there is any increase in the length of transmission line during the implementation of the project, the additional cost of the increased length for both Sinowell and Norinco will be borne by Norinco. In addition, the connectivity of Norinco WPP with neighboring wind power plants may change, depending upon the COD of the project.
- The newly proposed scheme of interconnection of Norinco WPP includes 132 kV D/C transmission line approx. 1 km long, on Greeley conductor for looping in/out on the 132 kV single circuit from Tricom WPP to Jhimpir-1 grid station.
- To meet the power factor of 0.95 at the point of common coupling as per grid code criteria, SVCs of 2 x ±20 MVAR is proposed at the 33 kV (MV) bus bar.
- The existing and planned grid system of HESCO and NTDC in the vicinity of Norinco WPP has been studied in detail by performing load flow, short circuit and dynamic analysis for the conditions prior to commissioning of Norinco WPP and no bottlenecks or constraints have been found in the grid system.
- Wind Farm of Norinco has been modeled considering Type-4 WTGs. The terminal voltage is 0.69 kV. The medium voltage level of wind farm has been selected as 33 kV for unit step-up transformers, for collector circuits and step-up from MV to HV (132 kV) at Farm substation to connect to the Jhimpir-1 220/132 kV grid station of NTDC.
- The design of scheme of 132/33 kV substation of Norinco Wind Farm has been provided by the Client and is attached in Appendix – 2.
- Load flow analysis has been carried out for peak and Off Peak scenarios of summer 2021 considering the expected COD of end of 2020 targeted by Norinco WPP and a future scenario of 2023, for the dispersal of power from Norinco WPP into NTDC system using the latest load forecast, generation and transmission expansion plans of NTDC and HESCO. The above mentioned interconnection scheme has been evolved by performing

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

- With the proposed interconnection for the base year of 2021, the load flow results for Peak and Off-Peak scenarios establish that the proposed scheme of interconnection of Norinco 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 Norinco WPP under normal as well as the contingency conditions.
- Maximum and minimum short circuit levels for three-phase faults and single- phase faults have been evaluated. The maximum SC levels have been evaluated for the year 2023 and minimum short circuit level for the year 2021 for the most stringent conditions. The maximum fault levels of Norinco 132 kV are 8.05 kA and 7.11 kA for 3-phase and 1-phase faults respectively for 2023. This is much less than the switchgear rating of 40 kA recommended for Norinco Farm Substation as per NTDC requirements for 132 kV. The fault levels for Norinco MV 33 kV are 17.41 kA and 19.51 kA for 3-phase and 1-phase faults respectively for year 2023.

  Therefore, the short circuit rating for 33 kV switchgear is recommended as 25 kA. It has been found that the proposed scheme provides maximum SC strength for the evacuation of Norinco WPP power to the grid.

  The switchgear ratings for Norinco WPP substation are as follows:

  132 kV:

  Short circuit rating = 40 kA (3 sec.)

  Continuous rating = 2500 A

  33 kV:

  Short circuit rating = 25 kA (3 sec.)

  Continuous rating = 2000 A

- Transient Stability analysis has been carried out for Norinco WPP based on their selection of Type-4 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 Norinco WTG unit's dynamic characteristics and the grid connectivity is strong enough to maintain stability under all disturbances. In turn, any disturbance from Norinco WPP side did not cause any stress on the main grid or the power plants nearby and in the HESCO area such that the whole system remained stable under all events.

- The LVRT requirements have been tested to fulfill 100 ms (5 cycles) under normal clearing time and 180 ms (9 cycles) for contingency condition of delayed fault clearing due to stuck-breaker (breaker failure) reason. The simulations have proved that the proposed machine fulfills the LVRT criteria as required in the Grid Code for Wind IPPs.
- The issues of power quality like flicker, unbalance and harmonic resonance have been studied in detail. The results have indicated that the levels of flicker and unbalance are within the permissible limits of IEC and other International Standards.
- There are no technical constraints whatsoever in the way of bringing in the 100 MW of Norinco 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.

DECISION ON INITIAL ENVIRONMENT EXAMINATION (IEE)

Reference No: EPA/2016/02/03/IEE/11

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF SINDH
Plot # ST – 2/1, Sector 23, Korangi
Industrial Area, Karachi – 74900
Ph: 021 – 35065950, 35065621,
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epasindh@cyber.net.pk
Fax No: 021 - 35065940

Dated: 04th March 2016

SUBJECT: DECISION ON INITIAL ENVIRONMENTAL EXAMINATION (IEE)

1.	**Name & Address of Proponent:**	Mr. Asad Alam Niazi Director & COO Norinco International Thatta Power Pvt. Ltd Suite No. 201, 2nd Floor, Horizon Vista, Block -4, Clifton, Karachi
2.	**Description of Project:**	Establishment of 100 MW Wind Farm in Jhimpir
3.	**Location of Project:**	Project site is located in Jhimpir about 110 km Northeast of Karachi and 80km Northeast of PQ, with geographical coordinates: 68°0'4"~68°3'55"E and 25°5'23"~25°8'4"N.
4.	**Date of Filing of IEE:**	03-02-2016

5. After careful review and analysis of the Initial Environmental Examination (IEE) report, the Sindh Environmental Protection Agency (SEPA) accords its approval subject to the following conditions:
   i) All mitigation measures recommended in IEE report should be complied with, for achieving negligible impacts on physical, biological, environmental and socio-economic resources of the area. Sindh Environmental Quality Standards (SEQS) shall be followed in letter and spirit.
   ii) A complete code of Health, Safety and Environment (HSE) shall be developed which should include efficient parameters at specific work place. For this purpose HSE setup should be established and supervised by a designated HSE officer at the senior level with sufficient administrative and technical authority to perform the designated functions. Proponent will make sure that the operating instructions and emergency actions are made available to every worker/labor at the site. Environmental management system shall be made in place during the operation of the project needing towards third party environmental audit and for achievement of ISO14000 standards.
   iii) The proponent shall also appoint a reputable research institute or organization to conduct a detailed noise mapping/modeling study & Avian Risk Assessment and

Verified
NORINCO INT. THATTA POWER (PVT) LTD

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Management Study. The noise modeling report and Avian Risk Assessment and Management Study must be submitted to SEPA within 04 weeks from the date of issuance of this approval.

iv) The proponent shall be under obligation to compensate for any significant adverse short term, long term and irreversible impact occurred due to windfarm operations. During the project execution, safe distances of the under mentioned environmental sensitivities will be maintained:
   - 500m from communities, industries and main transport network
   - 300m from community water well
   - 500m from archaeological / cultural site / monument
   - Distance will be measured from the tip blade of turbines or / and transmission power lines associated.
   - Project activity will not be carried out within buffer zone of any projected area designated under Sindh wildlife protection act.

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

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

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

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

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

Verified
NORINCO INT THATTA

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

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

xii) The proponent shall 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.

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

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

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

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

Muhammad Imran Sabir
Deputy Director (Technical)

Verified
MORINCO INT. THATTA POWER (PVT) LTD