BEFORE THE HON'BLE CENTRAL ELECTRICITY REGULATORY COMMISSION

Case No. 420/MP/2014

IN THE MATTER OF: **PETITION FOR ENDANGERING GRID SECURITY DUE TO NON-IMPLEMENTATION OF CONTINGENCY DEMAND DISCONNECTION SCHEME FOR SUDDEN LOSS OF WIND GENERATION AS PER CERC ORDER DATED 22.02.2014, NON-AVAILABILITY OF LVRT PROTECTION, NON-SCHEDULING OF WIND GENERATION AS PER CERC (INDIAN ELECTRICITY GRID CODE) REGULATIONS, 2010 (IEGC) 6.5.23(I), LACK OF NECESSARY DEMAND ESTIMATION AS PER IEGC REGULATIONS 5.3 AND NOT PROVIDING REAL-TIME SCADA DATA TO LDC.**

AND IN THE MATTER OF:

SOUTHERN REGIONAL LOAD DESPATCH CENTRE ….PETITIONER

VERSUS

TAMIL NADU STATE LOAD DEPATCH CENTRE & ORS ....RESPONDENTS

WRITTEN SUBMISSIONS ON BEHALF OF INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION

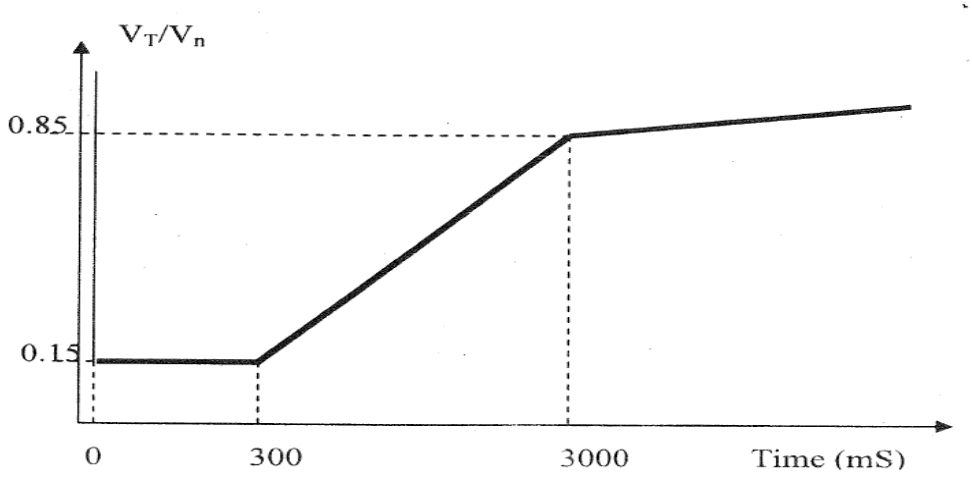
MOST RESPECTFULLY SHOWETH:

Indian Wind Turbine Manufacturers Association being one of the stake holders in the above mentioned case respectfully submits as under for the kind consideration of this Hon'ble Commission:

A. Legal Aspect

1. The Central Electricity Authority (CEA) notified its CEA (Technical Standards for Connectivity to the Grid) Amendment Regulations, 2012 on October 15, 2013 ***(****hereinafter referred to as* ***"CEA Regulations")***. It is submitted that amongst other technical standards, the CEA Regulations also specified certain conditions for connectivity for wind generating plants. The specific technical standard is reproduced below for reference:

> "*B Connectivity Standards for wind generating stations and stations and generating stations using invertors*
>
> *.....*
>
> *B2. For stations getting connected on or after completion of 6 months from the date of publication of these regulations in the official gazette.*
>
> *.....*
>
> *(3). Wind generating stations connected at voltage level of 66 kV and above shall remain connected to the grid when voltage at the interconnection point on any or all phases dips upto the levels depicted by the thick lines in the following curve:*



Where

V_T/V_N is the ration of the actual voltage to the nominal system voltage at the interconnection point

Provided that during the voltage dip, the generating units in the generating station shall generate active power in proportion to the retained voltage;

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Thus, from the above it is clear that the technical requirement related to the LVRT on wind generating stations is applicable for the stations getting connected with the grid on or after April 15, 2014 i.e. after 6 months of the notification of the CEA Regulations.

2. Further, for the wind generating stations which were connected prior to this date, the regulation specifically mentions the following:

*"**B3. For generating units which are connected before and upto 6 months after the date of publication of these Regulations, in the Official Gazette***

*The generating company and the licensee of the electricity system to which the generating station is connected shall **mutually discuss and agree** on the measures which can be taken to meet the standards specified in (B1) and B(2) subject to technical feasibility;"*

This makes it clear that for the generating stations which were connected prior to and also upto six months of the CEA Regulations coming into force the measures which can be taken to meet the standards are to be mutually discussed between the generating company and the licensee to which the generating unit is connected. The standards were to be met subject to technical feasibility. Thus, a special dispensation was consciously provided in the CEA Regualtions for such generating units.

B. Technical Aspect

1. It is submitted that the petiton and the techincal aspect of the matter have to be considered with the above legal background. The submissions on the technical aspect are as under:

   (a) It has been stated in the Petition that there is a loss of wind generation during Grid Incidents (GI) and Gird Disturbances (GD) due to cascading tripping of wind mills that do not have the Low

Voltage Ride Through (LVRT) protection and nature of instances poses threat to the gird security.

Response:

It is submitted at the outset that LVRT function would definitely help the wind generation to be available in the event of transient faults when the recovery of voltage starts after 300 milli sec. An attempt is made to analyse some of the reasons for the loss of wind generation during those incidents mentioned under Para 6 of the Petition, with the limited information available on the official websites of the central sector.

It is submitted that before a detailed analysis of the incidents cited in the petition and the other technical submissions made by the petitioner it is relevant to trace the background of the evolution of the transmission system for wind power evacuation in Tamilnadu.

Back ground:

- Under item No. 9 of the MoM (Minutes of Meeting) of Southern Region Power system planning Committee meeting held on January 22, 2007, (MoM issued on February 22, 2007) attached as **Annexure-1)**, a comprehensive power evacuation scheme for the wind power with 400 kV substations and lines in Tamil Nadu was proposed by TNEB (Tamil Nadu Electricity Board) and the same was approved. However, the process of implementation was actually started 5 years later. As a result of this, the wind

power installations were connected mostly at 110 kV and some at 220 kV levels. As the 400 kV substations catering to the evacuation of wind power have not come up, while the growth of wind power installations has increased considerably, lot of tappings on 110 kV systems were permitted to accommodate the addition of wind power. Due to these arrangements, there were issues of low voltage during high wind generation, in spite of adequate support of reactive power from the wind turbines.

- As the voltages were generally low during the high wind generation period, the un-cleared bus faults, or other system faults were cleared by several EHV lines from far end /back up protection. Therefore, the faults might have cleared after zone-2 time of distance relays on the EHV lines or beyond, which could be beyond 300 milliseconds. In such events, the substantial loss of generation from wind, connected/nearer to those buses (where fault has occurred) was not preventable even if LVRT was provided in those wind turbines. Some of the grid incidents and the loss of wind generation are discussed here. Most of the occurrences appear to fall into the above mentioned category.

- <u>Grid incidents of June 7, 2013 and June 2, 2014:</u>

  Both these incidents were very similar - A 110kV bus fault at Kayathar substation could not be cleared because of lack of availability of bus bar protection at Kayathar 110 kV bus.

Therefore, all the incoming 230 kV feeders tripped and thus there was no supply to 110 kV bus. About **440 MW** of wind generators are connected at Kayathar 110 kV bus. In such a situation, the wind generation at Kayathar 110 kV is destined to be disconnected , irrespective of the fact that LVRT is provided or not on all of the wind turbine generators.

- Grid incidents of May 28, 2013, June 5, 2014 and July 1, 2014:

  In all these incidents, the common factor is that the triggering point is a voltage dip in the system due to a fault in an adjacent corridor and mostly delayed clearance of faults.

- The voltages at many places in 110 kV system of Tamil Nadu are near 0.9pu due to lack of reactive compensation at the various grid substations, during high wind season, mainly because of not having the 400kV system in place, which was planned and approved exclusively for wind power evacuation in 2007. As the voltages were generally low, in the vicinity of 0.9 PU, during high wind generation, due to a fault on any of the transmission lines in the other corridor, the overall system voltages would go down and cause trips of all the turbines, whose trip setting is set at 0.85PU. **These trips alone can be attributed to lack of LVRT protection, albeit with a caution.**

- It should be appreciated that in many of the above incidents, the clearance of the fault was delayed, which indicates that the faults persisted for longer time. If faults have persisted beyond 0.3 sec and the voltage has remained less than 0.15 PU for more than 0.3 sec, at the wind generating unit, even if LVRT has been installed, it would not have saved the wind generation from tripping. Specific comments could not be given, since the outputs of disturbance recorder or the detailed occurrence reports were not available in public domain for these incidents. The slope of recovery of voltage at the wind turbines (as per the characteristics at B2 (3) of the CEA regulations) determines whether they could hold on to the grid or pull out, even with LVRT features. Disturbance recorders at the pooling substations are essential to capture these excursions of voltage.

- Further, it is submitted that in developed and well operated and maintained grids like Gujarat, the loss of wind generation due to un-cleared faults in EHV substation are not experienced. It is submitted that, the Bus Bar protections are to be installed and commissioned and in operation all the time to clear the Bus faults in “instantaneous time” and is not allowed to be cleared by far end lines, which could entail loss of more wind generation, even with LVRT.

- By 2012, TANTRANSCO (Tamil Nadu Transmission Company) has undertaken the setting up of the 400 kV network for power evacuation schemes at Kayathar, Thappagundu, Annaikadavu and Rasiyapalayam in a serious manner. When these are commissioned, better voltage profile and constraint-free power evacuation for wind generation is expected in the coming years. Out of these, Kayathar SS was commissioned in September and October 2014.

- Thus, there is no denying the fact that LVRT is a desirable feature subject to:

    a. ***efficacy of primary protection***
    b. ***grid operational discipline viz***
        i. ***automatic load shedding***
        ii. ***proper reactive compensation***
        iii. ***control of voltage profile to be in acceptable limits***
    c. ***Augmentation of the power evacuation system as per planning,***
    d. ***Adhering to time schedules in transmission project completion***

    The above specified points are essential for a trouble free system operation.

- Further, as submitted under para 9 of the petition, the lack of automatic load disconnection scheme commensurate with the loss of wind generation has also contributed to the sudden rush of power flow in the inter-regional link viz. 765 kV Raichur-Sholapur line causing power oscillations.

- Further, in the MoM of 25th SRPC meeting (held on July 26, 2014) attached as **Annexure-2**), it was recognized that the underlying transmission systems that were to be commissioned (delayed due to ROW issues) along with the above 765 kV lines were not commissioned and as and when they are commissioned, issues like oscillations and operational constraints would be resolved.

3. In the context of submissions made under Para 13 of the petition on Data Availability, it may not be out of context that there are instances wherein the wind developer has approached Tamil Nadu authorities as far as back in 2008, to allow them to connect ABT meters at various substations to understand the voltage profile and the power flow pattern and as a precursor to engage in the activity of forecast. The copy of the letter issued by the answering respondent dated December 23, 2008 is attached as **Annexure-3.** In the said letter, the Respondent had requested for provision of Disturbance Recorders in EHV pooling substations. It is also worthwhile to mention that both of the above requests were not entertained by TNEB.

Based on the above analysis of the submissions by the petitioner, it is imperative that:

- Prime focus should be on establishing 400kV system and its underlying EHV and HV systems for wind power evacuation as soon as possible.
- Reactive power compensation and voltage profile need to be made optimal at all nodes of the power system.
- Protection system should ensure line faults and bus faults are cleared in instantaneous time.
- Special protection systems to take care of sudden ramps.
- Free governor mode of operation has been mandated since the first grid code in 1999-2000. But it is yet to be implemented. In case of sudden variations in generation/load the FGMO would help to ensure frequency is not upset. Since, this feature is already covered under fixed cost of the generator, the generators have to be disciplined if they are not participating in FGMO by way of appropriate penalty.
- With all above measures in place the provisions of LVRT on wind turbines would provide necessary grid security.

4. The petitioner has also prayed that provision of LVRT should be mandated on old wind generating units commissioned before April 15, 2014 i.e. before effective date for implementation of the regulation. It is amply clear from the regulation that such implementation would have to be ***done through mutual discussion and agreement*** only. IWTMA

appreciates the concern of the petitioner and grid operators about the grid security and need for providing LVRT on all wind turbines, however, would like to humbly submit to this Hon'ble Commission that all the practical, technical and commercial aspects needs to be considered before giving any directions.

5. It is submitted that there are following constraints which need to be addressed before mandating LVRT on old wind turbines:

   a. Technical constraint
   b. Implementation of LVRT
   c. Commercial implications

   a. **<u>Technical Constraint</u>**:

      As submitted earlier that some of the old wind turbines of capacities up to 700 kW and with stall regulation the provision of putting add on LVRT is technically not possible. There are about 11,510 such turbines are installed in India till April 2014. It is submitted to the Hon'ble Commission that Central Electricity Authority may undertake a study on this aspect and come out with suggestions.

      For the other turbines, with capacity more than 700kW and with pitch regulation, the provision of LVRT as retrofit is possible. However, it is submitted that it is not possible to purchase such equipment off the shelf; the LVRT needs to be designed for each of

the turbine type/model and then it can be mass produced and retrofitted on these turbines. Further, in some turbine models the retrofitting of LVRT would also require modifications in the turbine structure for additional strength to absorb the mechanical stress of the LVRT, which would cause in the fault situation. For old turbines which were not originally designed for LVRT, in such turbines, adding the LVRT feature by way of retro-fitting would result in increased loads on the turbine especially in its drive train and related components. The present drive train and related components can only take this additional load, if there was a higher margin considered while designing. If not it would not be possible to technically add the LVRT even as a retro-fit, as practically one will need complete drive train re-designing and replacement.

Further, such turbines were manufactured as per the existing regulations, hence, do not have LVRT and thus the certificate also do not include the LVRT. For those turbines in which the design margins permit for adding the LVRT by way of retrofit, the Type Certification of such turbines will no longer remain valid. This could potentially affect the insurance of the turbine in case of major damage occurring to the turbine for any reason.

In case of retrofitting of LVRT, if utilities insist on the wind turbine type certification of the entire type certification process which:

- is time consuming and

- ❖ Involves substantial cost approximately Rs. 3.00 Crore per certification.

Hence, it is suggested that provision of LVRT may be certified from a competent authority and inclusion of the same in turbine test certification may not be insisted upon and in addition to this sufficient time will need to be provided for implementation of LVRT on old turbines.

b. <u>Implementation of LVRT</u>

The implementation of LVRT on turbines connected before April 2014 will pose a challenge of scales as there are about 25807 wind turbines connected prior to April 2014. Out of these there would be about 14346 Turbines which are of the capacity of more than 750 kW on which LVRT will need to be implemented. Details of the breakup of such turbines in terms of year of commissioning and capacity are attached in **Annexure -4**.

These turbines have been manufactured by about 48 different manufacturers out of these there are about 28 manufacturers who have manufactured the turbines of capacity of more than 750 kW. It is submitted that out of these 28 manufacturers only 14 are still in the business of wind turbine manufacturing. Further there are about 2000 owners (Approx.) of such turbines who will have to invest and

provide LVRT. For the existing manufacturers we have compiled that data from members which is attached as **Annexure -5**.

As per the information available with the answering Respondent, at present there are no suppliers of LVRT, which is understandable as the LVRT needs to be designed, in case of retrofitting, for each model/type of turbine. In case of new turbines which are LVRT compliant the LVRT feature is part of turbine design, hence, it is not procured from suppliers and added to the turbines. This limitation of designing and suppliers of LVRT and need to implement on large number of turbines needs to be considered while considering time frame for implementation of LVRT on existing turbines.

c. <u>Commercial Implications</u>

The retrofitting of LVRT would require additional investment by the wind generators. The Respondent would also like to submit that unlike the project cost the financial institutions would not give finance for putting LVRT on turbine. As per the estimates the cost of LVRT would be in the range of 25-50L/turbine, irrespective of turbine capacity. This would put a lot of financial burden on the generators. A typical 1MW turbine will generate about 2.1 million units in a year (assuming 24% CUF). Assuming a tariff of Rs. 4.5/unit this results in the revenue of 94.5L. The investment required for LVRT thus is in the range of 25-50% of the annual revenue from the turbine. If the total population of about 13500

turbines is considered to be mandated for adding LVRT the total fund requirement works out to be in excess of Rs. 3000 Crore.

It is thus imperative that a financing mechanism would definitely required for retrofitting of LVRT on existing turbines for successful implementation.

Further, even after financing of LVRT, the generators needs to be required compensated for the additional capital expenditure. In case of wind power projects there are three models for off-take of power, which are as follows:

- Sale to Discom: - In this case the tariffs are levelised tariffs based on capital cost assumed at the beginning of the tariff period and fixed for the tariff period. For recovery of capital expenditure the tariff will need to be increased by respective state commissions. Only after such tariff revision retrofitting of LVRT on old turbines can be successfully implemented.

- Sale of power though Open Access: the additional cost incurred due to retrospective implementation of regulation would result in loss to the generator as the purchaser of power may or may not agree to pay the additional cost. A solution for such scenario is essential as such projects may prove to be impediment to the implementation.

- ❖ Captive consumption of power: as above the additional retrofitting cost would result in effective loss and needs to be addressed.

Hence, the Respondent thus humbly submitted that:

1. Providing LVRT on wind turbines would help in grid management, however it alone cannot guarantee it. There are other measures, which should be implemented simultaneously if not at priority as mentioned in the para 3 of this submission.

2. In case of implementation of LVRT on turbines connected prior to April 15, 2014 the same needs to undertaken with mutual agreement. The implementation plan for such turbines must be devised based on the
    a. Technical constraints
    b. Implementation limitations due to high number of turbines and
    c. Compensation to generators for retrofitting of LVRT on old turbines

    In view of the above, it is suggested that a time frame of 3 years would be required with adequate funding arrangement along with cost recovery to implement LVRT on wind turbines.

INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION (IWTMA)

THROUGH

VISHAL GUPTA
ADVOCATE FOR IWTMA

DATE: 31.08.2015