

National Development and Reform Commission of PRC

Notes on the Issue of China Wind Power Generation Reduction

Recently some reviews of Chinese wind farm CDM projects have been requested by the Executive Board (EB) due to the difference between the net grid power supply and the theoretical annual power generation designed in the feasibility study reports. To address this issue, the Climate Change Department of NDRC (hereafter referred to as **the Department**) invited relevant entities, enterprises, DOEs, and research institutes to a seminar to discuss this issue in details. In addition, **the Department** entrusted the Hydropower and Water Resources Planning and Design General Institute (hereinafter referred to as HWPDI) to provide authoritative technical explanations and clarifications. HWPDI is the designated technical management entity for the preliminary work of China wind farm construction projects and the exclusive technical authority of verifying the feasibility study reports of wind farms in China. Please refer to the Appendix for its profile. Now, according to the conclusions of the seminar and the materials provided by the HWPDI, **the Department** explains the issue of China Wind Power Generation Reduction as follows, as a reference for validations by DOEs and reviews by the EB.

1. Terms and Definitions

The theoretical Gross Energy Output of Wind Farms (GEO) refers to the electricity energy output calculated in an ideal condition in accordance with the on-site measurement data and evaluation of local wind resources. When calculating the GEO of a wind farm, several factors are not taken into consideration, i.e., the wake effect of wind turbine generator systems (WTGS), the on-site air density; the instability of wind speed and directions, and climate; the availability of (WTGS), electric equipments and grid availability; and the wind farm electricity consumptions and line losses.

The Loss of Energy Output of Wind Farms (LEO) means the reduction of wind electricity generation by considering the impacts of the loss factors to the real output of wind farms. The loss factors include but not limited to the followings: the wake effect of WTGS; air density; the climate impacts such as low temperature; the control and turbulence; the availability of WTGS; the guaranteed power curve of WTGS; the wind farm electricity consumption and line losses.

The Net Energy Output Supplied to Grid (NEO) means the sellable electricity output by wind farms measured at the electricity measurement point of grid, which is calculated by the deducting the LEO from the GEO.

2. Calculation Basis

China has clear technical specifications for the analysis and methods of power generation reduction which forms part of the pre-feasibility study and feasibility study reports of wind farm projects. The related regulations are referred to in the following documents: *The Procedures for Developing Feasibility Study Report for Wind Farm Power Generation Projects* (DL/T5067-1996), *The Methods for Developing Pre-feasibility Study Report for Wind Farm Projects*(NDRC Energy [2003] No.403), and *The Methods for Developing Feasibility Study Report for Wind Farm Projects*

(NDRC Energy [2005] No.899).

3. The Classification of Wind Power Generation Energy Output Loss Factors and Typical Value Ranges

Wake Effect:

It means the energy output losses caused by the impacts of wind turbine clusters, which reflects the efficiency of wind turbine layout. The wake loss is calculated by the professional software of evaluating wind resources.

Air Density Adjustment:

It means the energy output losses caused by the differences between the on-site air density and the power curve corresponding air density cited in the calculation of the energy output. It is calculated on a case-by-case basis.

Control and Turbulence Loss:

It means the energy output losses caused by the wind regime, such as wind turbulence, on wind farms. The typical value of loss factor is around 5%.

Blade Contamination Loss:

It means the energy output losses caused by the contamination of blades, which affects the wind power capture capacity of turbines. The typical value of loss factor is within 6%.

Loss due to Availability of WTGS

It means the energy output losses caused by the quality of WTGS, which reduces the energy output due to the reduction of operating hours. The availability of WTGS generally falls short of the design value because the domestic manufacturers of WTGS are less experienced in turbine operation; their technical maturity is low; the manufacture technique is poor; and the after service is insufficient. The typical value of loss factor due to the availability of WTGS is 5-10%.

Loss due to Power Curve Guarantee of WTGS:

The energy output is reduced because the operating power curve falls short of the design value. The guaranteed power curve provided by the turbine manufacturers is generally 95% of the design value. The typical value of loss factor due to guaranteed power curve is 5%.

Wind Farm Electricity Consumption and Line Losses:

It means the electricity losses consumed by wind farm operations and wasted through transmission lines and transformers. It can be estimated in accordance with the design of wind farms. The typical value of loss factor due to the consumption and line losses is generally 3-10%, which is also determined on a case-by-case basis.

Climate Impacts:

It means the energy output losses caused by shutting down turbines in special weathers, such as low temperature, icing and frost, and extreme wind regime. The typical value of loss factor is 3-7%

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generally, which is also determined on a case-by-case basis.

Loss of Error in Software Calculation:

The adaptability of software is not quite compatible to complex terrain, therefore the GEO could be over-estimated and should be corrected accordingly. The typical value of loss factor due to the error of software calculation is 5-10% generally.

Frequency Fluctuation Effect and Access Restriction of Grid

The electricity access of grid will be temporarily restricted for the grid operation safety because of the frequency fluctuation of grid. The energy output of wind farms supplied to grid will be reduced by this access restriction. The typical value of loss factor due to frequency fluctuation and access restriction of grid is 3-5% generally.

Wake Effect of Large Scale Wind Farms

The wind regime in a small region is affected by the development of large scale wind farms. The energy output of wind farms will be decreased because the wind power around can not be resumed betimes. The analyzing methods and specific value of this loss is under research domestically and internationally.

Furthermore, China has a large territory and the natural conditions vary across the territory, so the above loss factors can be adjusted on a case-by-case basis of wind farms.

4. Conclusions

In conclusion, the actual operation conditions of wind farms projects in China is comparatively complex and differs a lot from region to region, therefore project owners can only cite the electricity supplied to grid into the financial analyses after the GEO has been adjusted in accordance with the related loss factors. Based on our investigation and statistic, the range of power generation energy output loss factor of the wind farms projects in China is around 20-45%, which is consistent with the situations in China and falls into the range allowed by national policies.

Appendix: Profile of the Hydropower and Water Resources Planning and Design General Institute

Signature of Mr. Su Wei, Director General of Department of Climate Change
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Profile of the Hydropower and Water Resources Planning and Design General Institute

The Hydropower and Water Resources Planning and Design General Institute (hereinafter referred to as HWPDI), with complete professional infrastructure and abundant technical force, has been undertaking the whole survey and design process of wind farms for long time and is the first entity engaged in the planning, survey, design, review and assessment of wind farms. It has undertaken the design, review and assessment of a majority of wind farms around China and has collected rich experience on wind farm construction. During the 10 years before the electric utility system reform, it was always the key functional department of the government, responsible for the industry management on the behalf of the former Ministry of Electricity Power (the former National Electricity Power Company), and its business covered from wind farm development & planning, project review, development of regulations, codes and technical standards to the survey, design, consultation, supervision, scientific research, acceptance check, etc., therefore certain authority and advantages on talent, technology and information were formed.

Since the deepening reform of the electric utility system in 2002, the Hydropower and Water Resources Planning and Design General Institute (hereinafter referred to as HWPDI), as the designated technical management entity entrusted by the National Development and Reform Commission for the preliminary work of Chinese wind farm construction projects, is responsible for the technical management, supervision and inspection and production acceptance check of China wind power construction projects. According to the unified deployment and arrangement of the National Development and Reform Commission and the National Energy Bureau, HWPDI is responsible for several key jobs, i.e. (1) organization and development of related technical standards and regulations on wind farm projects to promote the establishment of wind farm technical standard systems; (2) organization and implementation of the census of national wind energy resources and wind power planning; (3) establishment and management of the national wind power information management centre which collects statistics of Chinese wind power development under the preliminary and construction stages, and organizes the development and operation of a China Wind Farm Engineering Database and a China Wind Power Information Website; (4) organization of review, assessment and acceptance check of the preliminary work (design reports) of wind farm projects; (5) organization of the development of the wind power software, scientific research project and case study work. Furthermore, consigned by the National Safety Production, Supervision, and Management Administration, HWPDI is also responsible for the safety acceptance check for the completion of wind farm projects. With excellent wind power engineering construction technologies and talents, HWPDI has been providing prominent services for the construction and development of the Chinese wind power sector.