An Incremental Distribution Network for Wind Power Consumption Nearby

Tianliang Yao and Qiao Liu

ABSTRACT

In view of the fact that the wind power generation rate is high and the national incremental power distribution business is rapidly advancing, an incremental distribution network for in-situ wind power consumption using load and regulation power supplies with high load capacity characteristic is proposed. In order to eliminate the wind power's incremental distribution network, it will fundamentally solve the problem of reducing the electricity cost of the incremental power supply load, reducing the abandonment rate and improving the efficiency of the power sales companies and power generation companies.\(^1\)

KEYWORDS

Incremental Distribution Network; Wind Power; Construction Method.

INTRODUCTION

As of the end of 2017, China's renewable energy power generation capacity reached 650 million kilowatts (including grid-connected wind power installed capacity of 164 million kilowatts, grid-connected photovoltaic installed capacity of 130 million kilowatts), renewable energy power generation installed capacity accounted for 36.6% of all power installed capacity, Renewable energy generation accounts for about 26.4% of all power generation.

However, with the continuous surge of grid-connected wind power and photovoltaic installed capacity, the problem of abandoned wind, abandoned light

\(^1\)Tianliang Yai, Qiao Liu. CEEC Gansu Electric Power Design Institute, China
and power cut has become the new normal. In 2017, the area with a wind curtail rate of more than 10% included Gansu (33%, abandoned wind power of 9.2 billion kWh), Xinjiang (29%, abandoned wind power of 13.3 billion kWh), and Jilin (21%, abandoned wind power of 2.3 billion kWh). Inner Mongolia (15%, abandoned wind power 9.5 billion kWh), Heilongjiang (14%, abandoned wind power 1.8 billion kWh). It can be seen that due to the unbalanced spatial distribution of regional resources and the inconsistency of the source-network-load in the power system, the power consumption of the power grid is insufficient. The power-restriction problem of renewable energy has become the new normal, and the problem of cracking the nearest consumption has become a long-term “outlet” for the industry.

At the same time, the CPC Central Committee and the State Council’s "Several Opinions on Further Deepening the Reform of the Power System" and related supporting documents have opened a new round of power reform [1]. From 2016 to 2018, the National Development and Reform Commission and the National Energy Administration standardized the pilot reform of incremental power distribution business, and identified the first batch of 105, the second batch in 89, and the third batch in 97. incremental power distribution business reform pilot project [2].

Based on the above background analysis, a batch of new power sales companies' incremental power distribution business pilots provide the possibility to reduce the cost of electricity for users and promote the near-reduction of renewable energy. How to use the incremental distribution network to promote the local consumption of wind power, and then crack the “disease” of wind power consumption has become the focus of the renewable energy industry.

PRINCIPLE OF THE CONSTRUCTION METHOD

Research and design an incremental distribution network that utilizes incremental power load and regulating power supply to absorb wind power in situ. The specific principles of the technical achievements are as follows:

1. In the vicinity of large-scale wind farms, an incremental load with intermittent and high load-carrying characteristics is arranged, and a wind power company is established to build a power sales company to carry out incremental distribution network business, with intermittent and high load capacity characteristics. The increment is powered by an electrical load and the wind power is consumed locally. The location distribution of wind power bases, high-energy industrial parks and the relationship with power sales companies are shown in Figure 1.
Figure 1. Schematic diagram of location distribution.

1—wind power centralized Internet line, 2—wind farm booster station, 3—gas power plant, 4—energy storage device, 5—photothermal power station, 6—regulating power supply line, 7—intermittent and high load capacity Incremental electrical load of the characteristic, 8—increment distribution network distribution line.

Figure 2. Incremental distribution network system structure.

1—High-voltage busbar of wind farm booster station, 2—first-stage step-up transformer, 3—second step-up transformer, 4—wind farm low-voltage busbar, 5—wind farm booster station added medium-voltage busbar, 6—Regulating power supply line, 7—increment distribution network distribution line.

Figure 3. Schematic diagram of the improvement of the electrical structure of the wind farm booster station.
2. Planning and construction of regulating power sources such as gas power stations, solar thermal power stations and energy storage devices in the incremental distribution network, as a wind power peaking power supply. The structure diagram of the incremental distribution network system is shown in Figure 2.

3. The wind farm booster station adopts a two-stage boosting method to increase the structure of the incremental distribution network by adding an intermediate voltage level, provide power for the incremental distribution network load, and provide a grid access point for the adjustable power supply. The schematic diagram of the improvement of the electrical structure of the wind farm booster station is shown in Figure 3.

4. The original large-scale wind farms with centralized Internet access will be changed to priority self-use and internal balance with the incremental distribution network load. The wind power output will be greater than the load when the load is online, and the power generation revenue will be increased.

Through the improvement and innovation of the above contents, the technical achievements are aimed at the problem of infra-red distribution network planning for wind power consumption, taking into account the power generation revenue of wind power enterprises and the profit model of power sales companies, and innovating the construction method of incremental distribution networks.

**EFFECTDESCRIPTION**

The use of large-scale wind farms for incremental load supply is in line with the new power reform policy. The wind farm booster station and the regulated power supply are invested and built by the power generation enterprise. The incremental distribution network distribution line and power supply line are invested and constructed by the power sales company, the expansion of distribution network business to nearly eliminate wind power.

According to the conventional practice, the conventional wind farm booster station only has a high voltage bus and a low voltage bus, and never sets a medium voltage bus, nor does it undertake the task of connecting the peaking power supply and the load power supply line. This achievement adds a medium-voltage busbar and connects to the regulating power supply line and the incremental distribution network distribution line, which serves as a hub substation to expand the structure of the incremental distribution network. Keep the line connected to the public network to ensure the safe and stable operation of the incremental distribution network in the event of an accident.

The gas-fired power plants, energy storage devices, and photo thermal power plants planned and constructed in the incremental distribution network are invested and constructed by the power sales companies. As wind power peaking power supplies, they compensate for the inherent instability and unreliability of wind power generation, and together with wind power Coordinated operation of multiple power supply systems to achieve continuous and smooth power supply.
The power generation will give priority to the internal balance of the incremental distribution network load, and priority will be given to ensuring clean energy generation and reducing wind power. Take 1000MW wind power as an example, increase the annual utilization hours of 800 hours, power generation capacity of 800 million kWh, 10 million hours of on-grid electricity can get local and state subsidies of about 0.72 yuan, increase power generation revenue of about 576 million yuan.

The promotion and application of this technical achievement only need to meet the following conditions: First, the power generation enterprise has connected to the large-scale wind farm and booster station, and there is a surplus of abandoned wind power to be sold; Second, there is a high-energy capacity in the vicinity of the wind farm that needs to be adapted to the industrial transfer. Industrial parks have incremental load power requirements; third, the government, wind power companies and social capital have the desire to develop incremental power grids.

CONCLUSIONS

(1) It is proposed that the government, power generation enterprises, and industrial parks use electricity companies to form a sales company model.

(2) Make full use of existing wind farm booster stations and Internet access resources, and build an incremental distribution network simply and quickly to achieve near-radiation power supply and reduce wind power nearby.

(3) Rational use of resources to develop adjustable power sources such as solar thermal power generation, gas power generation, and energy storage to meet the peaking demand of multiple power systems and achieve continuous and stable power supply.

REFERENCES