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Synergistic Improving Trend of Distributed Generation Technology and Smart Grid Technology

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Abstract: With the increasing development and maturity of new energy technology, distributed generation technology has made great progress in terms of power generation efficiency and economic cost of power generation, and has a tendency to gradually replace conventional primary energy. Due to the rapid development of new energy power generation equipment, the stability of power supply plays a very critical role in the power grid. The purpose of this paper is to study distributed generation technology and smart grid technology, so as to find the synergistic development trend of the two. In the experiment, taking the factory of X Automobile Co., Ltd. as the research object, the distributed generation energy storage system and the distributed generation system under the smart grid are investigated and analyzed.

1. Introduction

With the development of distributed power generation related technologies, more and more distributed power sources are distributed into the distribution network on the load side. The microgrid is composed of distributed power sources and local loads in local areas [1]. Distributed technology provides new ideas for new energy consumption. Reasonable planning of various power supply capacities of microgrids is an inevitable requirement to improve the stability and economy of microgrid planning and operation. The smart grid is a new power application mode produced with the comprehensive development of information network technology and power technology.

With the continuous improvement of distributed generation technology, its advantages in the environment, power grid and economy have become increasingly apparent.Kurt MN detects cyber-attack issues for safe operation of smart grids. Considering more powerful attacks, more powerful systems are needed to defend against various attacks. For these reasons, a robust online detection algorithm for spurious data injection is proposed, which also provides online estimation

and location estimation, and corresponding countermeasures are proposed considering that intelligent attackers can design stealth attacks to prevent detection. The proposed detection method is fast and reliable for hybrid network attacks [2]. With the advent of the smart grid, Javaid is testing opportunities for customers to integrate renewable energy and participate in demand side management. A general home energy management system is proposed to efficiently supply household loads. A building energy management system based on genetic algorithm and wind-driven genetic algorithm is proposed for scheduling. Real-time pricing is used for energy pricing, since only RTP is used, peaks can be established during peak hours. Furthermore, to manage the demands of the grid, areas are delineated and multi-knapsacks are used to solve the problem [3]. Smart grid not only has strong technical dependence, but also needs a series of social conditions to support the development of smart grid.

Based on the research status, it studies the distributed power generation technology, including wind power generation and photovoltaic power generation, and introduces the synergistic development trend of the two technologies. In the experiment, the factory of X Automobile Co., Ltd. was taken as the research object, and the distributed generation system and smart grid system were investigated and analyzed by using the calculation method of micro gas turbine.

2. Synergistic Improving Trend of Distributed Generation Technology and Smart Grid Technology

2.1. Research Status of Distributed Generation

The microgrid is powered by various types of distributed power sources, supplemented by modern communication technology and control technology for dispatching operation. The traditional distribution network planning is based on the planning under the large power grid, which mainly considers the needs of users, and does not pay much attention to the consideration of external natural factors and refined control management [4]. However, the scale, power supply and load characteristics of the microgrid, compared with the conventional grid planning, the microgrid planning will be affected by more external factors. In the planning stage, more consideration must be given to the good operation of the microgrid after completion. Planning and operation after completion are strongly coupled. A large number of scholars have invested a lot of energy in the planning and operation of microgrids.

In the aspect of microgrid planning, it mainly studies the capacity complementary configuration and access address of power supply, among which capacity planning is the focus. The type and capacity configuration of the microgrid power supply are closely related to the natural conditions of the location of the microgrid and the current state [5]. With the natural conditions and the requirements and operating characteristics of various power sources, combined with the local power load demand, the construction mode of the microgrid and the types of energy sources are determined. Distributed power configuration capacity. It makes the planning of the microgrid more in line with the actual local conditions, lays a reliable foundation for the operation of the microgrid, and enables the microgrid to operate economically and reliably in the future. Microgrid optimization involves meteorological and power operating characteristics, as well as distributed power output models, economic and technical indicators of planning, and solutions to planning schemes [6].

2.2. Distributed Generation Technology

Distributed power generation has the advantages of high reliability, little damage to the environment, and high energy utilization rate, so it is a direction of future power development. The types of distributed power generation can be divided into wind power generation and photovoltaic power generation [7].

(1) Wind power generation

As a renewable and clean energy, wind energy is being continuously connected to the power grid and become an integral part of the smart grid. Distributed wind power generation generally refers to a power generation mode that uses wind turbines as a power source, in fact, a distributed power generation system that converts wind energy into electrical energy. As a development model with excellent development prospects, wind power generation has gained more and more space for development [8].

With the continuous advancement of power electronic technology, the existing wind power generation mode generally adopts the synchronous wind power generation method, which is generally connected to the power grid through the way of alternating current to direct current, and direct current to alternating current. The advantage of this power generation mode is that the influence of different motor speed and grid frequency can be ignored.

(2) Photovoltaic power generation

Distributed photovoltaic power generation is generally built near the user's site, and its operation mode is generally the user's self-use, redundant Internet access, and a facility plan for the balance adjustment of the power distribution system is also designed [9]. Distributed photovoltaic power generation follows the principle of nearby utilization, making full use of local solar energy resources, thereby replacing and reducing the consumption of fossil energy. Generally speaking, photovoltaic power generation converts solar energy resources into electrical energy resources and then integrates them into the power grid. It is also a power generation mode with broad development space. At the same time, it can also solve the problem of energy efficiency loss caused by power transmission [10].

2.3. Smart Grid

As the traditional power grid is increasingly unable to meet the development requirements of low-carbon technologies, the concept of smart grid has emerged as the times require, and has become the development direction of the power and energy field [11-12]. Smart grid, relying on the combination of different technologies, not only relies on a series of basic grid technologies such as power transmission and energy storage technology, but also relies on high-tech intelligent science and technology such as computer technology, communication technology and power electronic control technology. Smart grid refers to the UHV power grid as the backbone, based on the coordination of power grids at all levels, supported by the platform of communication information, involving power generation, transmission and power dispatching, etc., covering all voltage levels, and reaching the power level. It is a modern power grid with the characteristics of safety, reliability and cleanliness [13-14].

2.4. Synergistic Improving Trend of Distributed Generation Technology and Smart Grid Technology

In the related theories of synergy, synergy refers to the cooperation, coordination and

synchronization of each component and each subsystem in the complex system in the process of operation and operation [15-16]. It treats all objects of study as a system of components or parts that, by exchanging matter, energy or information, can create new functions that go far beyond the sum of the functions of the original parts.

That is to say, this interaction can produce an effect of 1+1 greater than 2 [17-18]. Coordinated development, more emphasis is placed on the effect achieved by the coordination of subsystems. The coordinated improvement of them refers to achieve better results than their respective development and achieve a win-win effect of common development.

3. Investigation and Research on Distributed Generation Technology and Smart Grid Technology

3.1. Research Overview

The factory of X Automobile Co., Ltd., the 66KV substation invested and built by the municipal government of M is responsible for supplying power to the factory area. At present, after the overhead connection between the A substation and the substation of the State Grid Corporation of China is connected by T, the power supply is directly distributed to X Company all the way. There will be power generation equipment in the plan, which will be interconnected with the company's smart grid using distributed power generation technology.

3.2. Micro Gas Turbine

Micro gas turbines are generally composed of turbines, generators, inverters and other structures. The power generation principle is to preheat the compressed air in the regenerator, and then send it to the combustion chamber to burn with the fuel. Generally, micro gas turbines are direct-drive built-in tell-tale generators.In the formula, P is the output electric power of the micro-turbine, Q_{he} and Q_{co} are the waste heat and cooling capacity of the gas turbine, Q_{MT} is the exhaust heat of the micro-turbine, η_l is the heat dissipation loss coefficient of the micro-turbine, and COP_{he} and COP_{co} are the refrigerating machines, respectively. Heating and cooling coefficients. The main calculation formula of the mathematical model of the cogeneration system of the micro gas turbine is as follows:

$$Q_{MT} = \frac{P_e\left(1-\eta_e-\eta_l\right)}{\eta_e} \tag{1}$$

$$Q_{he} = Q_{MT} \times COP_{he} \tag{2}$$

$$Q_{co} = Q_{MT} \times COP_{co} \tag{3}$$

4. Analysis and Research of Distributed Generation Technology and Smart Grid Technology

4.1. Distributed Power Generation and Energy Storage System

The energy used in distributed power generation is mainly renewable energy, and renewable energy has many advantages and obvious shortcomings. The performance comparison of energy

storage without energy is shown in Table 1 and Figure 1:

Table 1. Performance comparison of different battery media

Battery types	Specific capacity	Specific power	Cycle life	Charge-discharge
Plumbic acid	52	210	1485	84
Nickel hydrogen	73	263	2365	86
Lithium ion	162	241	2458	89
Sodium sulfur	184	186	6697	87
Vanadium liquid flow	136	140	18695	90

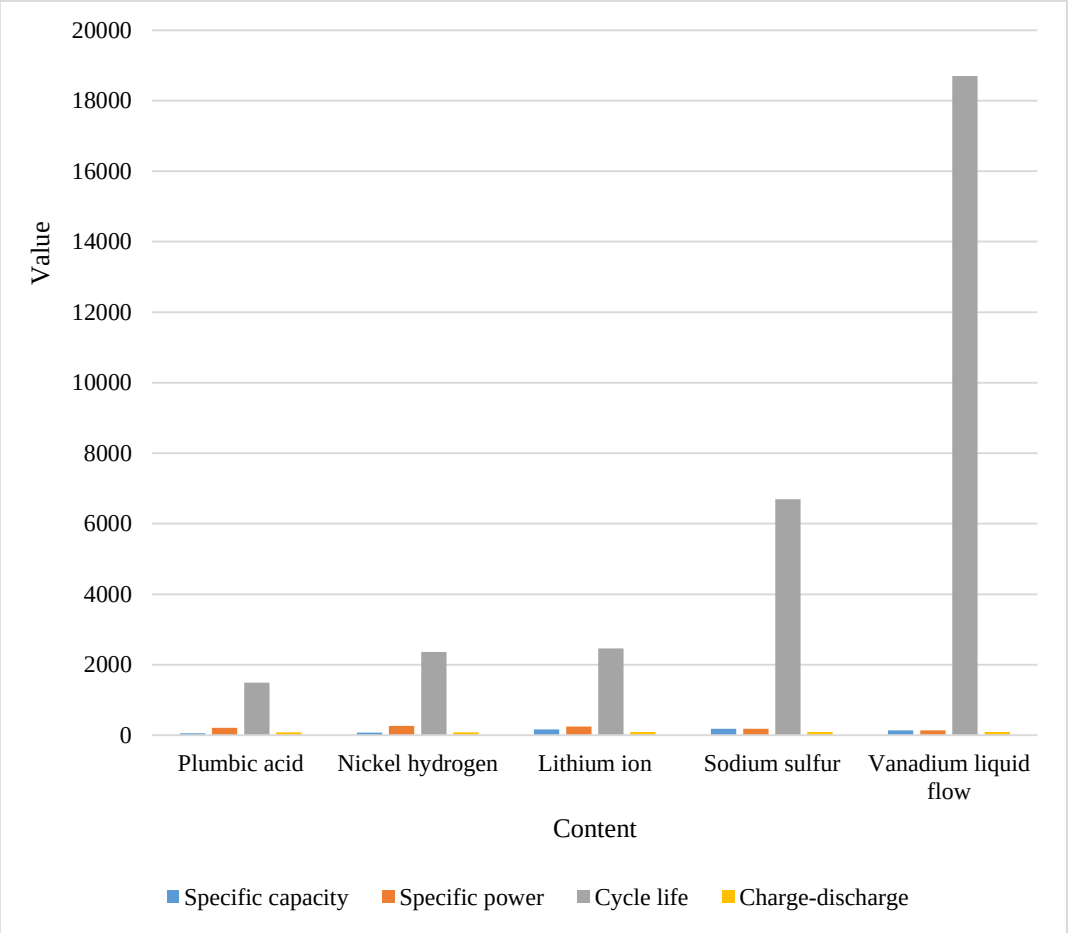

Figure 1. Comparison chart of power energy storage data

4.2. Distributed Power Generation System under Smart Grid

The important load and control power of the whole plant are provided by the DC system located in the energy center, so as to have uninterrupted power supply. First, according to the actual load of each workshop, the total load of each workshop is calculated. Because the items of each workshop

are the same, only the values are different. The calculation results are shown in Table 2 and Figure 2:

Table 2. Energy center load calculation

Equipment	The number of ark	Need coefficient	Dead-weight capacityLoad (watts)	Gross capacity Load (watt)
Block relay	53	0.8	4.6	123.6
Latching electromagnet	54	0.75	53	1345
Breaking coil	53	0	345	1436
Surge loop monitoring	51	1.6	1.3	59
Main protection relay	30	1.8	4	72

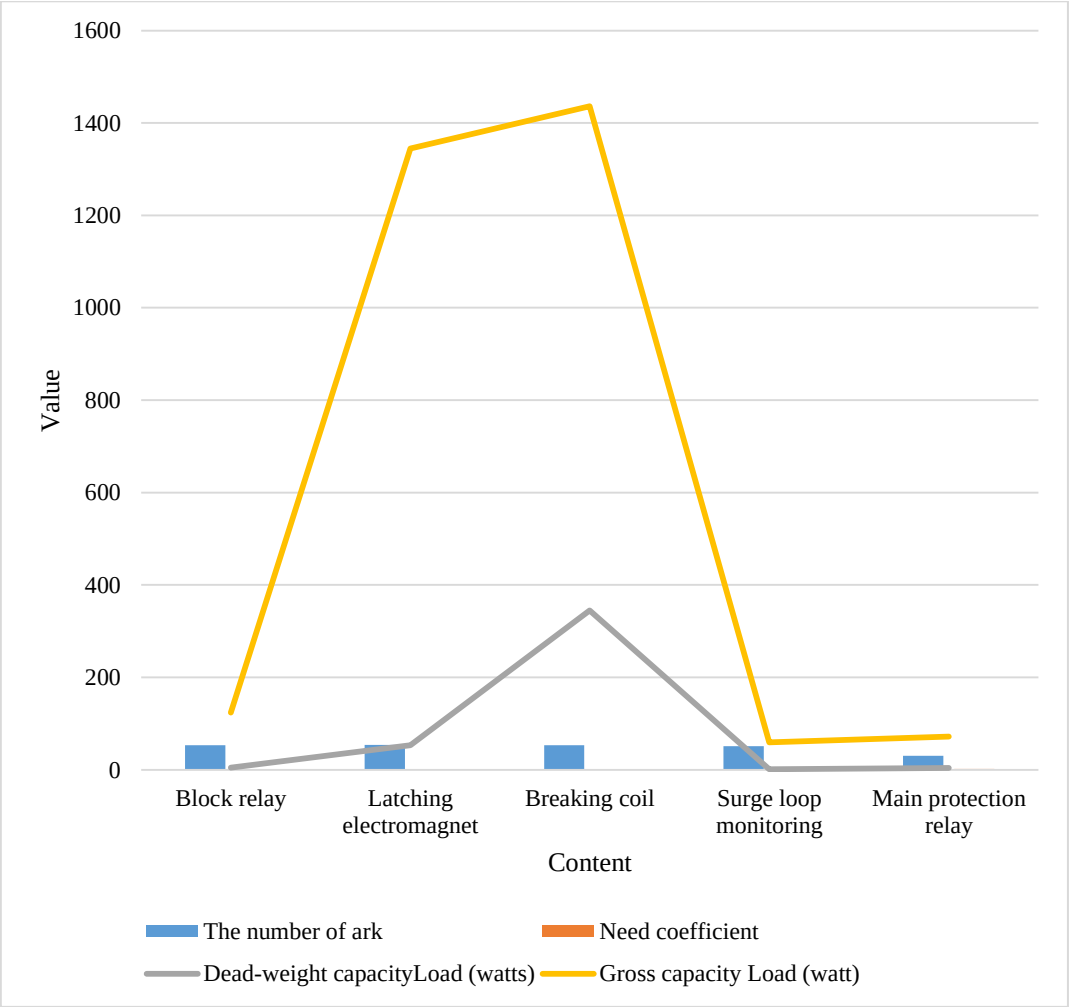

Figure 2. Comparison diagram of energy data of distributed power generation system

Calculate the total load required by the energy center, fill in this value in the table, and so on into the load of each workshop. The power compliance of each workshop is shown in Table 3 and Figure 3:

Table 3. Load table of each workshop

Converting station	Connection capacity (W)	Calculated capacity (W)
Energy center	6325.2	6400
Stamping room	3615.8	2800
Body shop	2697.5	1900
Logistics and Assembly Workshop	2459.6	1700
Supplier workshop	2963.4	2300
Painting workshop	3645.3	2900
Emergency generator room	2965.4	2000

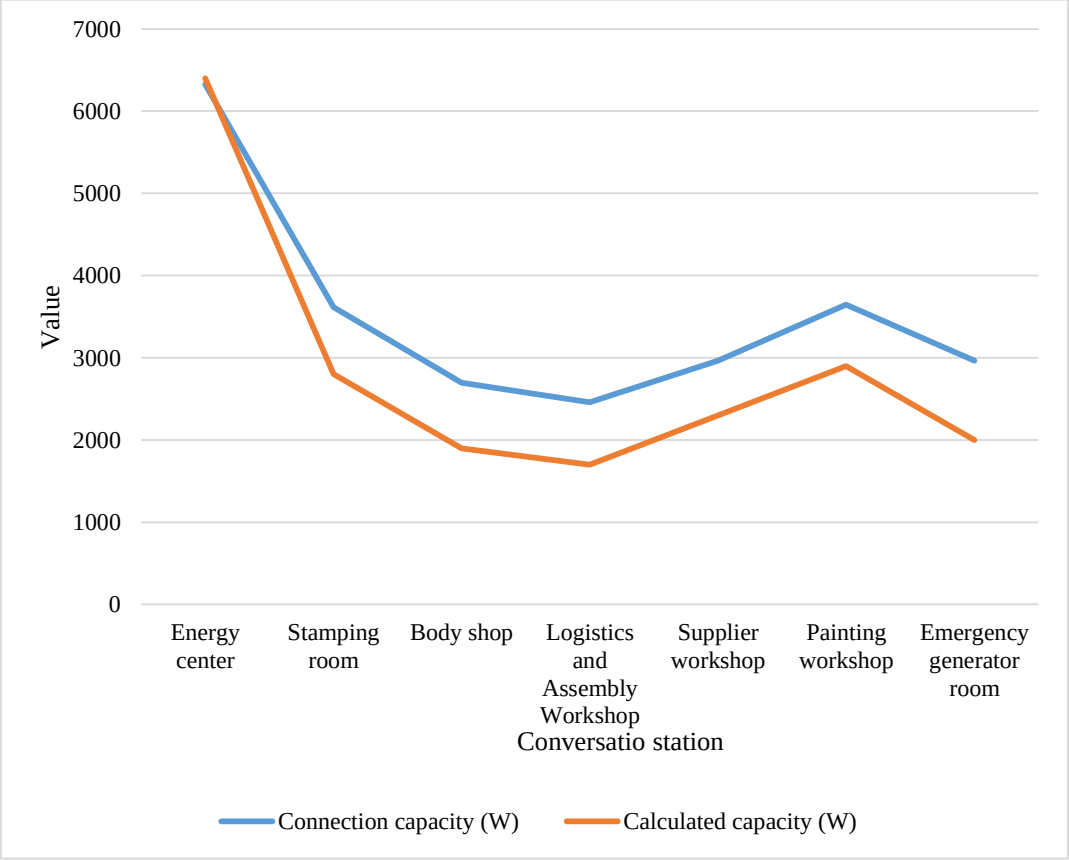

Figure 3. Comparison diagram of workshop power generation data

Combining distributed generation technology and smart grid technology, based on distributed generation system and power energy management system, the optimal scheduling method of smart grid is found. The optimization problem of minimizing total distribution losses is solved by constructing an objective function. Based on the distributed generation and load forecast demand, a

power reference schedule is generated to control the distributed generation system of the system. The energy efficiency optimization scheduling method based on the distribution network has a very positive effect on improving the utilization rate of distributed energy and realizing the safe and stable operation of the distribution network.

5. Conclusion

Due to the increasing depletion of global traditional fossil energy, the demand for electricity in the global economic development is increasing day by day. Therefore, the distributed power generation technology based on renewable energy such as wind energy and solar energy has gradually become a research hotspot at home and abroad. Distributed power is connected to the power grid on a large scale in the form of micro-grid. On the basis of improving the existing energy storage technology, the concept of new energy storage development is put forward, and efforts are made to realize the safety and high efficiency of energy storage devices and reduce the production cost of energy storage devices. Increasing the energy storage capacity provides a solid technical guarantee for the rapid development of technology.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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