

Design of Intelligent Microgrid New Energy Power Generation System

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Abstract. According to the limitations of remote areas without electricity, areas without electricity for farmers and herdsmen living scattered, away from the traffic and power grid, not conducive to the construction of transmission lines without power supply, this paper has designed intelligent microgrid new energy power generation system, through the introduction of new energy generation technologies, distributed monitoring management and mobile Internet technology. It constructs the system framework of new energy, analyzing photovoltaic cell, wind turbine and converter, also with remote control system, through the mobile terminal and the Internet technology to achieve the scientific management of distance of new energy. The implementation shows that the new energy system that improves energy efficiency, optimize energy utilization, realize remote management, and ultimately bring energy saving, environmental protection, low-carbon new life style, improve the quality and level of people's lives.

Introduction

With the vigorous development of renewable energy industry in China and encouraging the development of new energy measures promulgated, and the implementation of “send electricity to villages project”, the State Grid Corporation of China, in accordance with state regulations, actively promotes small hydropower, wind power, solar photovoltaic power plants and household power station, continuing to promote the construction of power transmission projects in areas without electricity. Farmers and herdsmen living in remote areas are more dispersed, and the villages and villages are far from each other, so far away from the traffic and the power grid, which is not conducive to the electric transmission lines. For hundreds of years, Inner Mongolia's pastoral areas have long been unable to get effective power supply, which has been plagued by electricity management authorities and local governments.

In this paper, the design of the intelligent microgrid new energy power generation system is the use of solar power, wind power, diesel auxiliary power, GPRS technology, mobile terminal and Internet technology, providing a new energy system, which can realize the home microgrid electricity. As a very important renewable energy, solar energy has received extensive attention. Photovoltaic power generation is currently the most direct way to use solar energy [2-3]. Wind power, solar power and other renewable energy have sprung up. With its advantage of pollution-free, renewable and mature technology, it has gained rapid development in recent years.

The implementation of the new energy power generation system can bring great convenience to the residents of the pastoral areas, and improve the level of electricity consumption and quality of life. New energy plus system network reflects the essence of the third industrial revolution.

System General Structure Designing

System Framework

The overall framework of the system, shown in Figure 1, is a combination of photovoltaic power generation, wind power generation, diesel power generation, energy storage facilities and other integrated power supply systems and remote control management systems. When the sun is very good during the day, it uses solar energy to generate electricity; when cloudy, rainy or windy nights, it uses

wind energy to generate electricity; when not using the sun and wind power generation, it takes means of diesel auxiliary power, and applies GPRS monitoring and management system to provide remote monitoring and control, automatically switching power, ensuring the reliability of the users' power consumption and the maximum utilization efficiency of the energy.

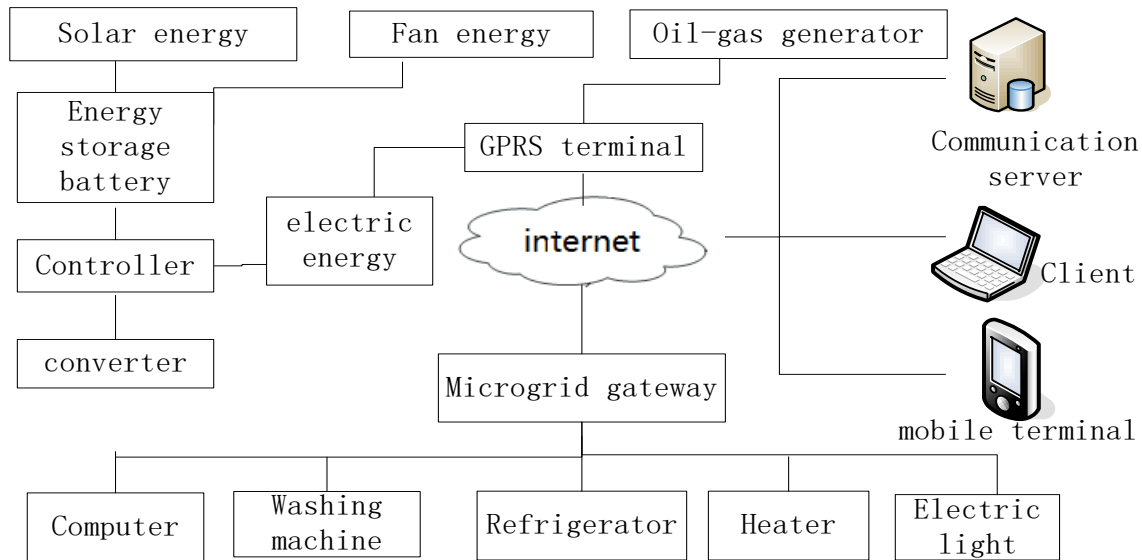


Figure 1. Overall structure of new energy power generation system.

System Features

1) Generated power: The maximum generated power of photovoltaic cells in the solar, wind and diesel auxiliary power generation system is 1.56kW, which of the wind power generation system adopting vertical axis fan is 600W, and of the solar and wind power generation system is totally designed about 2kW. Since the solar and wind power generation system is the intermittent power supply, in order to guarantee that it still can load the power supply when the system does not generate electricity, therefore, equip the system with the 4kWh energy storage battery and the rectifying installation, moreover configuring the 3kW diesel engine generator.

2) Telecommunication: GPRS communication realizes remote status information monitoring and control, ensuring real-time and online maintenance performance.

Generation System Designing

Photovoltaic Cells Designing

In the microgrid power generation system, the battery components are important. In the project, to achieve the maximum power generation target of 2kW, it is necessary to select the battery components. A comparison of various types of solar cell components is shown in Table 1.

Table 1. Comparison of various types of solar cell components.

Battery components	Technical maturity	Advanced technology	Construction cost	Environmental friendliness
crystalline silicon	good	normal	higher	good
multicrystalline silicon	good	normal	normal	good
amorphous film	normal	advanced	lower	good
cadmium telluride	good	advanced	lower	worse

The multicrystalline silicon is the most popular product currently on the market. It has the characteristics of reliability, universality and economy. It has higher efficiency and smaller footprint,

so it is suitable for roof photovoltaic applications. Therefore, through comparison, the multicrystalline silicon is adopted in the project design.

Solar Module Designing

In order to save the floor space, a pasturing area family adopts the scheme of a square matrix as a unit and a photovoltaic parallel connection. Six 260W components are laid paralleling in a square matrix area, so that the total capacity can reach 1.56kW, and the basic parameters of 260W multicrystalline silicon solar modules are shown in Table 2.

Table 2. Basic parameters of 260W multicrystalline silicon solar modules.

Parameter names	Parameter values	Parameter names	Parameter values
peak power	260W	open circuit voltage	43.78V
peak voltage	36.72V	maximum voltage	1000V
peak current	7.63A	short circuit current	7.98A

Energy Storage Battery Designing

Converter technical parameters for the input voltage is 48V, according to the current market battery specifications, commonly used two kinds of batteries: 180Ah/24V colloid lead-acid battery and 4kWh vanadium battery. In this design, two 180Ah/24V colloid lead-acid batteries are connected in series to form a 48V DC power supply system. The capacity of two 180ah/24v colloid lead-acid batteries is $2 * 180 \text{ Ah} * 24\text{V} = 8.64\text{kWh}$, and charge and discharge depth is 46%, which meets the capacity requirements of $2\text{kW} * 2\text{h} = 4\text{kWh}$ of the system.

Converter Designing

The converter is photovoltaic power generation can be reversed to alternating current of 220 V, with the function of storage battery charging and discharging, and can supply power to load, with the function of protection, start and stop control and switching, requirements of technical parameters of the design are shown in Table 3.

Table 3. Converter technical parameter.

Parameter names	Parameter values
power	3kW
input mode	AC two wire system; DC two wire system
input voltage	DC240V~350V
input frequency	45Hz~55Hz
input power factor	≥ 0.95
output voltage	220Vac $\pm 3\%$
output power factor	≥ 0.8
overload capacity	125%
bypass overload capacity	135%
bypass switching time	20ms

Remote Control Management System Designing

GPRS Terminal Designing

GPRS terminal is mainly composed of single - chip microcomputer, memory which is set with GPRS server, IP address, port number, password and so on, GPRS module and serial interface, the memory. GPRS terminal adopts ARM7 system, LPC2136 single - chip microcomputer, uplink through the GPRS module and TCP/IP protocol connecting and communicating with communication server, downlink through RS485 sending and receiving data, one of which communicating with intelligent instrument, realizing acquisition of electrical energy, another of which communicating with controller, monitoring and controlling the power generation.

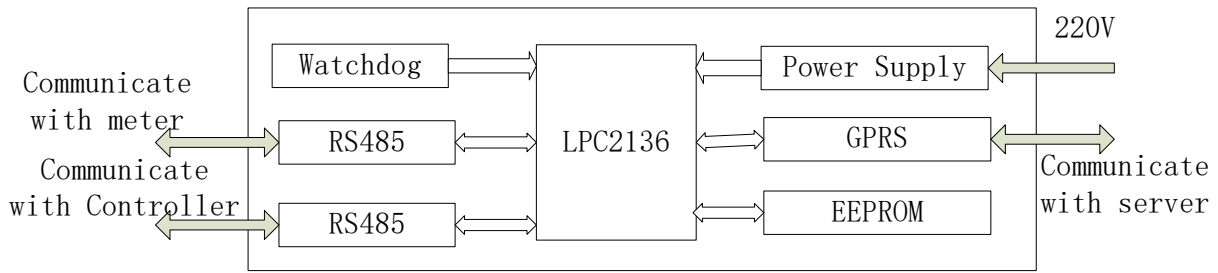


Figure 2. Principle block diagram of GPRS terminal.

Communication Server Designing

According to the characteristic of distributed system, the GPRS terminal realizes the connection with the communication server through the wireless network, and the communication server establishes the Webservice and Servlet service, the main functions of which includes: 1) The WEB master station accesses the communication server through Http to realize monitoring and management functions; 2) The intelligent terminal accesses the communication server through soap to realize the remote connection with the GPRS terminal, portable implementation of energy monitoring and management functions. The functional block diagram of the communication server is shown in Figure 3.

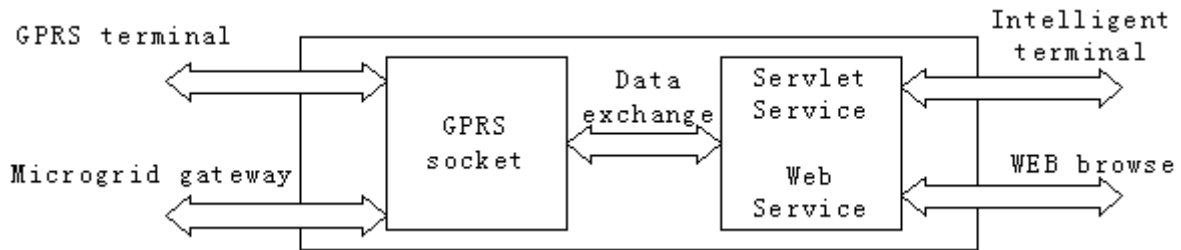


Figure 3. Principle block diagram of communication server.

Intelligent Terminal Software Designing.

The system mobile client is based on Android system, and the designed software has three layers of management interface: firstly, the login interface; secondly, the management interface, which displays the user information managed by this administrator; thirdly, the power generation monitoring interface and intelligent microgrid control interface, not only can monitor the power generation information in real time, but also can choose control scheme to control the appliance.



Figure 4. Intelligent microgrid control.

Due to the fact that the maximum power generation of the system is about 2000Wh, the designed energy storage battery system is in 4000Wh, and the maximum amount of one day used is 4000Wh. When water heaters and air conditioners are used at the same time, the problem of insufficient power is brought about. Therefore, a user scheme needs to be set up so that the intelligent home gateway knows the power of each home appliance and manages it automatically. This is the advantage of intelligent microgrid new energy power generation system. The scheme design interface is shown in Figure 4.

Real Time Operation Result Analysis

Intelligent microgrid new energy power generation system has been developed and practical, and real time power generation information is shown in Figure 5. It can be analyzed from the monitoring of power generation information: daily power generation is about 5 degrees, and monthly power generation is about 150 degrees, basically meeting the living needs of pastoral residents.



Figure 5. Power generation information.

Conclusions

Intelligent microgrid new energy power generation system, due to adopting advanced wind power, solar power generation technology, network technology and mobile terminal technology, and system reliability, stability, security being guaranteed, realize the rational allocation of resources, improving the utilization efficiency of energy and the residential electricity level and the quality of life. Of course, the system still needs to be studied and expanded, and it also needs to deeply study the power generation data analysis technology. How to make the new energy system improve the utilization efficiency of energy at the lowest cost is a long-term research topic.

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