

Study and Monitoring of Distributed Generation

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Abstract. With gradually increasing scarcity of traditional energy sources and electricity load, distributed power being environmentally friendly, efficient, with flexible features has attracted wide attention. Development of distributed power generation technology and the establishment of new power grid containing distributed generation power system will become an inevitable trend in the development of distributed power, at the same time it will negatively influence the power quality in the modern power system. This paper introduces the influence of distributed power supply on the power quality, analyzes the system voltage deviation of the distributed power source, describe effects of harmonic distortion and voltage fluctuation as well as other power quality hazards. The paper further designs a set of power quality monitoring system aimed to achieve an online monitoring and analysis of distributed power quality.

1 Introduction

With the economic development needs, electricity load is growing rapidly. Expanding the grid size, bulk power system has some drawbacks, such as large-scale blackouts sent tracking load changes can not be flexible. The gradual depletion of traditional energy sources, and energy conservation and to achieve sustainable development. Development of reliable, economical and safe use of the new grid is presented and received widespread attention. In order to achieve the development and use of locally available energy sources, to reduce the loss of long-distance transmission, smart grid distributed generation has become an important part of the cause of scientific research workers seriously. Distributed power has become one of the key directions of power system studies.

Distributed power electric energy in the proportion is increasing. Solve the energy problem has brought positive results, widely distributed power applications will impact the traditional power system, including the distribution network power quality, system stability and so on. With modern equipment and instruments for power quality requirements continue to increase, the impact on distributed power quality is important. Distributed power has an important position in the distribution network, it is useful to bring to the grid and also have an impact on power quality. For distributed power grid caused by power quality problems, this paper designs power quality monitoring system that provides data analysis for the management of power quality, and promote the healthy development of distributed power supply[1].

2 Introduction Distributed Power

2.1 Distributed Power Overview. DG is a direction of energy development, the developed countries of the older and relatively mature, has been vigorously promote the use, and large-scale distributed energy grid with the application, the power system has been recognized by many experts, this model can improve the power supply system reliability. Meanwhile, the distributed power of diversity to improve the power supply system flexibility.

The main form of distributed energy: photovoltaic, small hydropower, wind power technology, the emerging fuel cell technology.

2.2 Distributed Power Features. Distributed power has three main characteristics, namely, to improve the reliability and stability of the grid. In recent years, it occurred repeatedly worldwide blackouts, resulting in a very large economic losses. This is a traditional large power grid system is an important flaw. Distributed power in scattered locations, independently of each other between the power supply, with the use of large power grids, to ensure uninterrupted power supply important users at large grid problems. The second is the location of distributed power dispersed, usually small scale, the nearest to the user power supply, to reduce the traditional large power transmission losses, reduce investment costs, less harmful to the ecological environment; third is the use of renewable distributed power resources, such as solar power, wind power, etc. However, compared with the traditional fuel, environmental hazards small.

2.3 Main types of distributed power

Photovoltaic power generation. Solar energy is renewable energy for decentralized use, it is an important part of today's large power plants, large power grids centralized energy supply and an important complement to the new energy system. Photovoltaic power generation system consists of a photovoltaic array, battery, solar controller, DC - AC inverter and AC power distribution equipment and other components. Solar power system with AC grid parallel operation, the solar photovoltaic power generation system eliminates the need for battery parts, the system is simple, low investment cost of the system, the solar power generation system is one of the main energy photovoltaic power generation in the future.

Wind power. Wind power is the kinetic energy in wind into mechanical kinetic energy, then the kinetic energy of the mechanical energy into electricity. Principle of wind power, the use of wind driven windmill blades rotate, then the rotational speed increase through the growth machine to encourage generators. Wind power is forming a boom in the world, because the wind does not require the use of fuel, it does not produce radiation or air pollution.

The fuel cell. The fuel cell with high efficiency, cleanliness, etc. has a very strong competitive edge. The biggest advantage of distributed power generation fuel cells are highly efficient, clean, and its efficiency up to 40% -65%. Currently the fuel cell performance has been greatly improved, reducing costs. In the field of fuel cell distributed generation applications have many applications in the energy market, such as: cogeneration small neighborhood, large central power stations and the like[2][3].

3. Effects of distributed power grid power quality

With the penetration of distributed power distribution system and continuously improve, the impact of distributed power brought even more serious. Distributed power supply system of distributed power impact, including in terms of distribution network planning, network losses, system protection, power quality and reliability. Distributed power to the electricity distribution network to introduce some disturbance, such as: the current dramatic changes caused by transients; periodically changing voltage fluctuation turbine power output caused; imbalance caused by single-phase generator sets; short-circuit current level increases causing large voltage dips and the like.

DG adverse impact on power quality mainly in the following aspects.

The traditional distribution network structure generally radially, power system under steady-state operation, the voltage along the feeder direction of the trend is gradually decreased after access to distributed power since the transmission power on the feeder and reduce the output of reactive power support, so along node voltage of each load feeder is raised, it may lead to some load node voltage

offset exceeded.

Distributed power grid cause a lot of power electronic converters applied to the system, and its frequent switching device on and off the switching frequency harmonic component is easy to produce near, harmonic pollution on the grid.

Starting and distributed power outages and user needs, the electricity market and other factors, erratic start and stop distributed power grid power output fluctuations cause, directly or indirectly caused by voltage fluctuations and harmonics. Distribution network and cause significant voltage fluctuations.

Distributed power supply and distribution network load uncoordinated run, will affect the quality of the power distribution grid. Distributed power generation capacity when the load changes with local inconsistencies, increase the voltage fluctuation of the system. Due to the distributed power grid location, capacity and control mode selection unreasonable, so the trend line changed greatly increase the difficulty of adjusting the voltage distribution network, resulting in voltage fluctuations.

Distributed power supply voltage three phase degree will have an impact, photovoltaic and wind power are becoming more common, single-phase generator sets low-voltage distribution system will bring the three-phase imbalance[4].

4. Power Quality Monitoring Platform

Since the sampling frequency of the signal power quality detection system is relatively high, a large amount of signal processing, data management capabilities and more complex human-machine interface, this paper designs using ARM microcontroller and integrated technology, simply can not be achieved using the ARM microcontroller or system data accuracy and real-time data processing system. Because the task of power quality monitoring system to deal with many kinds, including data sampling, various data computing, communications, human-computer interaction and other events.

Processor hardware platform design to be considered high-speed CNC processing speed and processing power, but also to ensure the system's real-time task processing, design cost is a factor in the design. ARM high-speed processing, and other electric energy data management, human-computer interaction and communication functions, a higher cost microcontroller as the next crew to complete the acquisition, filtering, data processing, etc., ARM microcontroller coordination and completion requirements of power quality monitoring system[5].

The Block diagram of power quality monitoring system platform is shown in Fig.1.

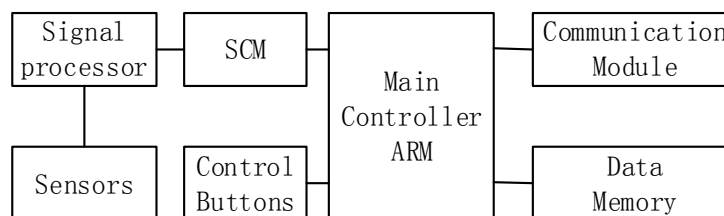


Figure.1 Block diagram of power quality monitoring system platform

5. Design of Power Quality Monitoring Software

Power quality monitoring system real-time monitoring of power quality parameters, and power quality data recording, complete the remote communications. The system uses a digital signal processor core controller.

ARM mainly to complete the sampling of distributed power power signal, parameter calculation, harmonic analysis, liquid crystal display and GPRS communications. In order to improve the program

computing power and real-time interrupt function of the input signal in real-time acquisition and computational analysis. Software design is divided into the main program and the interrupt program, the main program mainly to complete the initial configuration data, parameter calibration, data storage, LCD and other tasks, the interrupt service routine is divided into signal acquisition, parameter calculation and GPRS communications.

In the grid, the use of non-linear elements, there has been a large number of harmonics, this time for power calculations must take into account the impact of harmonic factors. Therefore, the calculation of non-sinusoidal signal distortion power-related parameters, we need to get the voltage and current fundamental and harmonics.

Active power is expressed as formula(1).

$$P = \frac{1}{T} \int_1^t u(t) * i(t) dt \quad (1)$$

$u(t)$ and $i(t)$ using a Fourier series expansion as formula(2).

$$P = U_1 I_1 + \sum_{m=2}^N U_m I_m \cos(\theta_m - \varphi_m) \quad (2)$$

U_1 and I_1 is the amplitude of the fundamental voltage and current, U_m and I_m ; m is the number of harmonics, N is the maximum number of harmonics, θ_m is the m -th harmonic voltage component of the phase angle, φ_m for the m -th harmonic current component phase angle, Reactive power as formula(3).

$$Q = U_1 I_1 + \sum_{m=2}^N U_m I_m \sin(\theta_m - \varphi_m) \quad (3)$$

6. Conclusions

Distributed Power is a new form of power source that is attracting more attention in the modern power generation and distribution system. The introduction of distributed power sources into the main power grid has not only brought new advanced technology in the generation of power but has also brought into existence various risks and challenges, the effects of which are more prominent and serious on the power quality. The paper summarizes the types of distributed power, the effects of distributed power on power quality, and also gives an outline of the design process of a set of distributed power quality monitoring system. The system hardware and software parts of the system are lucidly explained.

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