

Development of 4G-based power quality monitoring system

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Abstract: Continuous monitoring and analysis and evaluation of power quality information are the prerequisites for finding power quality problems and improving power quality levels. Several main reasons for power quality problems in power systems are discussed. composition. The working process of the monitoring system is mainly discussed, that is, the monitoring data is transmitted to the server by the 4G power quality monitoring terminal. Send a message to the mobile phone of manager via WeChat or SMS to inform the abnormal station changes and abnormal data. The application of the 4G-based power quality monitoring system is to analyze the development trend of power quality and control technology, and has a broad application prospect.

1. Introduction

With the development of society, the issue of power quality has attracted more and more attention from society. The reason is not only related to the power sector, but some power quality indicators (such as harmonics, voltage fluctuations and flicker, and three-phase voltage imbalance) are often Caused by user interference, it involves generators, power suppliers, and consumers, and is related to the interests of all parties. Therefore, in order to effectively maintain the common interests of the power sector and power users, ensure the safe operation of the power grid, and purify the electrical environment, it is necessary to strengthen the management of power quality in the power system and establish a comprehensive power quality monitoring and analysis system in order to accurately measure the power quality The development and improvement of detection, evaluation, and classification of power quality monitoring technologies are related to the safety issues of the power grid and power consumption^[2].

Power quality not only affects the safe and economic operation of power grid enterprises, but also affects the safe operation of users and product quality. Access to a large number of distributed energy sources (such as wind and solar power) will further deteriorate power quality. Continuous monitoring and analysis and evaluation of power quality information are prerequisites for finding power quality problems and improving power quality levels. The power quality monitoring system (hereinafter referred to as "monitoring system") uses the power quality monitoring terminal (hereinafter referred to as "monitoring terminal") installed on the grid side or user side to transmit monitoring data to the monitoring center (monitoring main station or substation))^[1], to achieve the simultaneous monitoring of multiple locations, and release power quality related information, is an effective means of power quality monitoring and evaluation.

2. Current status

There are several reasons for the power quality problems in power systems:

(1) Non-linear problems in power system components

The non-linear problems of power system components mainly include: harmonics generated by generators; harmonics generated by transformers; harmonics generated by DC transmission. In addition, there are factors such as substation shunt capacitor compensation devices that affect harmonics.

(2) Non-linear load

In industrial and domestic electrical loads, non-linear loads account for a large proportion, which

is the main source of harmonic problems in power systems. Electric arc furnaces (including AC electric arc furnaces and DC electric arc furnaces) are the main non-linear loads^[3], and their harmonics are mainly caused by the time delay of arcing and the severe non-linearity of the arc. In the life load of residents, the volt-ampere characteristics of fluorescent lamps are severely non-linear and will cause more serious harmonic currents, with the third harmonic content being the highest. High-power rectification or frequency conversion devices will also generate serious harmonic currents, cause serious pollution to the power grid, and also reduce the power factor.

(3) Power system failure

Various faults in the operation of the power system can also cause power quality problems, such as various short-circuit faults, natural disasters, human misoperations, changes in the working state of the generator and the excitation system when the power grid fails, and the failure of power electronic equipment in fault protection devices Start-ups will cause various power quality problems.

The problem of power quality is not only related to the reliability and safety of the operation of electrical equipment, but also to the standardization of the power supply market. Its generation may come from the power transmission and distribution system of the power supplier, or from unreasonable power consumption at the user end, or from natural phenomena such as lightning. Only by effectively monitoring the power quality can there be a clear understanding of the problem's occurrence and impact, so as to provide a real basis for the improvement of power quality, the coordination of the power supply and consumption parties, and the regulation of the power supply market in order to adopt effective solution. In such an environment, it is of practical significance to explore related theories and control technologies in the field of power quality and analyze the development trend of power quality management and control in China.

3. Project achievement goals

According to the concept of the ubiquitous electric power Internet of Things proposed by the State Grid Corporation of China, in order to improve the intelligent level of distribution networks, ensure the strength of the power grid, achieve customer satisfaction improvement and lean management of operations, use the Internet of Things technology to build a distribution transformer station management "Pivot open sharing" power quality online monitoring platform. Use Rogowski coil (open and close) current transformers to monitor the three-phase current and neutral current phase, amplitude, harmonics, inrush current, and current fluctuations around the clock, and simultaneously to three-phase voltage power failure, voltage drop, voltage rise, instantaneous Pulse, voltage fluctuation and flicker, harmonics, frequency deviation, etc. are monitored in real time. According to the capacity of the transformer and the nature of the load, the alarm threshold for voltage and current abnormalities can be set, abnormal waveforms can be captured and stored in real time, and the voltage and current amplitude, phase, harmonics and other data can be transmitted to the PC management background for recording and summary in time. , Generate time, voltage, current change trend chart, can also read the parameter values in real time from the background, directly through data or WeChat to the management staff mobile terminal, timely adjustment and treatment of hidden dangers such as three-phase imbalance. The monitoring data is transmitted to the server by the 4G power quality monitoring terminal, and the full range of three-phase voltage, three-phase current and neutral current sampling data are recorded regularly, and a summary report is generated.

4. 4G-based power quality online monitoring platform equipment composition

The 4G-based power quality monitoring system consists of the following parts:

- a) Power quality monitoring and acquisition terminal;
- b) Cloud server;
- c) Taiwan area management client;
- d) APP mobile management terminal;

e) Local Storage Server

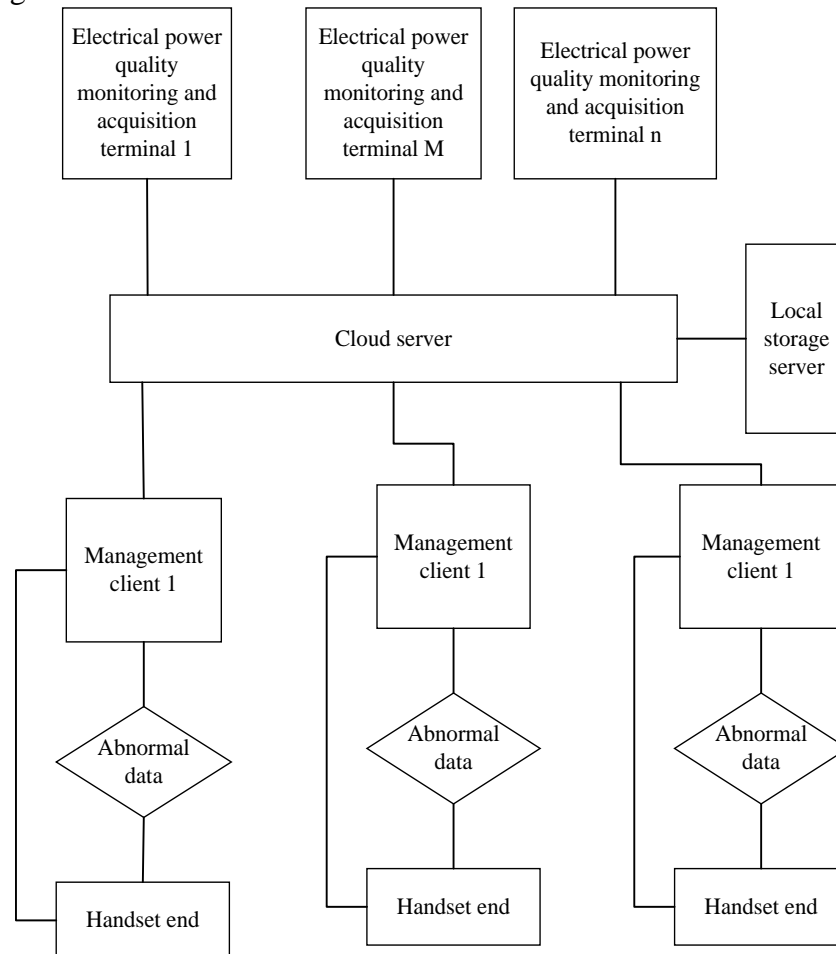


Fig.1. 4G Power Quality Online Monitoring Platform Equipment Composition

5. Work flow based on 4G power quality monitoring system

Name the installed 4G power quality monitoring terminal on the PC, including the location of the installation site and the setting of the equipment number ledger and other information. At the same time, the basic information of the Taiwan Transformer is established in the background database of the PC, including the setting of the four current amplitudes, harmonics, inrush currents, fluctuation states, three-phase balance, and alarm upper and lower limits, including three-phase voltage power failure, pulses, and fluctuations. Alarm settings for numerical abnormalities such as flicker, harmonics, and frequency deviation, including the telephone number of the management staff of the station transformer, and the setting of management authority.

The opening and closing current transformers supporting the 4G power quality monitoring terminal are clamped on the four current lines including the neutral line, and the current signals are sampled through the transformer, and the signals are amplified, filtered, and analog-to-digital converted. The discrete sampling points are transmitted to the single-chip microcomputer; the voltage test line is connected to the three-phase four-wire, and the voltage signals of each channel are sampled, and the discrete sampling points are transmitted to the single-chip microcomputer through signal amplification, filtering processing, and analog-to-digital conversion. The single chip computer obtains the fundamental wave, harmonic voltage, current amplitude, phase, frequency and other information through DSP operation, and transmits it to the PC through the Internet of Things module and cloud server for recording, summarizing, and storing.

When the power quality is normal, the 4G power quality monitoring terminal will periodically send data to the cloud server, and send abnormal alarm data in real time when the data is abnormal. After receiving the data sent by each monitoring device, the PC performs preliminary processing on

the data. When the test data is abnormal, it sends a message to the mobile phone of the manager via WeChat or SMS to inform the abnormal station change and abnormal data; Transfer to PC to record test data and generate intuitive charts. Test data over a period of time can be exported to an excel form. When the PC needs to monitor the sampling data of a test point in real time, it sends instructions to the cloud server to the corresponding monitoring device, and the monitoring device receives the instructions and returns the real-time data to the PC.

6. Conclusion

The station management personnel can also view the real-time data, historical data and historical alarm records of all test points in the management station at any time through the mobile phone. To ensure data security, ensure the durability of data storage, and reduce the load on the cloud server, a local storage server can be added for the cloud server to access and store at any time. The application of the 4G-based power quality monitoring system combines related theories and control technologies in the field of power quality. It is an analysis of the development trend of power quality and control technologies, and has a broad application prospect.

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