
Optimization of Data Signal Based on Power Monitoring Terminal in Mountain Gorge

Biguang Kong, Xiaoxin Liu, Xudong Chen, Fukun Yu, Yunxue Li,
Yongsheng Pu, Zengping Chen, Jiang Yang, Jieli Chen, Xuqiu Lin

Yunnan Power Grid Co., Ltd. Nujiang Power Supply Bureau, China

Abstract

According to the geomorphic features of Nujiang alpine gorge, the reasons for the weak signal data of the terminal are analyzed and selected. Combined with the fact that the signal tower of communication operator is not fully covered and the investment of Beidou satellite is large, a GPRS signal enhancement device is added beside the power monitoring terminal, High-gain directional antenna, up to GPRS upload and download data accessibility, low investment, quick, easy to promote, effectively solve the mountain gorge power monitoring terminal data signal optimization problems.

1. Introduction

With the promotion of smart meters, low set down and cover all the production voltage monitoring density increased, Nujiang mountain canyon, there are high mountains and steep slopes, difficult terrain, bad weather and other factors, serious impact on the electrical measurement terminal data signal transmission and reception quality, resulting in Nujiang power grid under the jurisdiction within the scope of marketing of electric energy metering has set down more than 180000, the production of more than 600 voltage monitor, about 5% meter installed in communication signal blind, almost no communication users, telecom operators are reluctant to invest, and about 10% of the instrument data upload, real-time monitoring data is very difficult, only manual copying, not only increased operating costs, data quality discount rate, automatic meter reading terminal, the line rate fell sharply, seriously affected the normal data collection and payment, bring some negative to the enterprise surface effect. This paper is in the production of voltage monitoring terminal device by enhanced GPRS signal, signal optimization by means of technology, used in conjunction with high gain directional antenna, optimize to achieve the purpose of electric signal measurement terminal data is very weak, the realization of GPRS wireless communication data uploading and downloading data accessibility.

2. Signal optimization practice process

2.1 Signal optimization practice direction determination

On the basis of the communication operator transmission, according to the actual work, a micro signal transmitting and receiving device is added near the marketing energy metering meter and the production voltage monitor, so as to realize the GPRS communication wireless upload and download data without obstacles. Nujiang power grid under the jurisdiction of a total of 30 outlets and 26 power supply range, the electric power marketing measure set copy more than 180000, more than 600 in the production of voltage monitoring, the smart meter promotion, low set down in Nujiang has not yet achieved full coverage, and the application of Beidou satellite investment, therefore, the selected operation 4 over the years, the production of voltage monitoring points with GPRS wireless communication data upload and download function, as the signal optimization practice direction.

2.2 Weak signal factor analysis and treatment measures

(1) Signal strength and dBm value, asu value of the relationship analysis

dBm and asu are Android-defined signal units, dBm is a 1-milli-watt decibel, which is the signal-to-noise ratio converted per milliwatt transmit power, and asu is an independent signal unit. The conversion between asu and dBm is: dBm value -asu value = -140.

The commonly used mobile phone as a signal test medium, through the "Settings-More Settings>About SIM-SIM card status-Signal Strength" to test, always signal strength in 0 - 101dBm range and the corresponding asu value, the electrical terminal signal transmission data quality is good, when the signal strength in the -102--113dBm range and the corresponding asu value, a small part of the signal transmission data quality intermittent, time and signal strength in the -103--122dBm range and the corresponding asu value, most of the signal transmission data quality interruption, the normal transmission of signals cannot be received, -122dBm above the scope and the corresponding asu value, all the signal transmission data quality interruption, no signal. The following is through the monitoring point and communication signal tower near and far, under different weather conditions, a large number of field tests, derived from the phone signal strength, dBm, asu, and signal transmission data effect table:

Table 1 cell phone signal strength, dBm, asu, transmission effect correlation table

dBm value	asu value	Phone signal strength display	Transfer data from time to time effect
0~-89	140~51	Four grid	Good
-90~-101	50~39	Three grid	Good
-102~-113	38~28	Two grid	Poor
-114~-122	26~18	One grid	Extremely poor
-123below	17below	No display	No data

(2) Signal receiving function weakened

From time to time signal strength in the range of 0 - 101dBm and the corresponding asu value, the electrical terminal signal transmission data quality can be transmitted normally. If in this range, the signal quality of the signal transmission terminal is still poor, the maximum possible with the GPRS card, remove the card, clean, and then try again; the card into the support of the carrier's mobile phone or other voltage monitoring inside try ; Re-insert the card, find other phone cards and other methods to try. None of the above methods, it may be the phone's own hardware problems, signal reception module may be weakened and other issues, manufacturers and service can be negotiated settlement.

(3) Out of coverage of communication operator signal

Beyond the communication operator coverage area, this is the signal blind area. Remote mountain villages or remote suburbs usually have insufficient signal coverage at base stations and remote base stations, resulting in the popularization of mobile phone signals in remote areas and smart meters that rely on data transmission from communication operators. The low-voltage collection covers the entire area and the monitoring signals of production voltage monitoring points are weak. Signal frequency 900MHz or so, penetrate the reinforced concrete building materials difficult, resulting in the city under the high buildings under the signal is also very weak.

(4) Monitoring terminal VPN settings unreasonable

In order to avoid the repeatability of the VPN mapping address of the power monitoring terminal, the monitoring terminal VPN settings are generally complex, easy to input errors, VPN settings are not reasonable, resulting in VPN string addresses, logical confusion, the data cannot upload and download properly.

(5) The impact of changes in the weather

After comparing and analyzing the signal quality of the weather data monitoring and communication operators from December 2016 to October 2017, the weather changes have some influence on the signal quality of the telecommunication operators. Good signal when the weather is fine, the rainy weather signals are followed, the thunderstorm and fog weather has the biggest impact. The same monitoring points in different sunny weather and thunderstorms, fog test weather, the scene test data differ by 3 ~ 10dBm value.

(6) Ping-pong effect and islanding problems exist

High-level users receive several nearby base station signals, the signal is not blocked and the signal strength is similar, the signal is frequently switched between several base stations ping-pong effect and may receive non-adjacent base station signal, the better the signal can receive, But not adjacent to the signal cannot be switched to a good base station island effect still exists, ping-pong effect and islanding effect is the communication signal transmission problems, no longer analyzed.

2.3 Signal Optimization Electro-test terminal screening

Smart meter promotion, low voltage meter copy in the Nu River has not yet been fully covered, and the Beidou satellite application of large investment, therefore, choose GPRS wireless communications applications relatively mature production voltage monitor as a pilot. From December 2016 to September 2017, 2560 months data, 76800 days data and 22118400 5-minute data, the voltage monitoring points with lower qualified rate were screened, and the signal optimization objects were identified in different regions. In Lushui County And Lanping County area, the signal quality is extreme fluctuations, the township signal is very good, without optimization, the mountain signal is very poor, cannot be optimized; in Fugong County and Gongshan County region, the signal quality fluctuations, the township signal is very good, not Optimization, poor mountain signal, intermittent, is ideal for signal optimization. Through step-by-step screening, the final selection Gongshan County regional signal intermittent 35kV Tikai substation 10kV Qi Lang when the line Shiguangtaigu Shigu 400V outlet Mr. Ye hone (head), 35kV Bikai substation 10kV Qi Lang when Line Shiguang Sishu 400V qualifying Mr. Yu hone (terminal), 35kV Bikai Substation 10kV black bottom line pull black station change black home 400V line Mr. Li hone (head), 35kV Bikai substation 10kV black bottom line Pull black station black home 400V qualifying Mr. Li Jin hone (end) and other four monitoring points as the research object.

2.4 Signal Enhancement Device Technology Feasible Analysis

In the production of voltage monitoring terminal next to the addition of GPRS signal enhancement device, with high-gain directional antenna to achieve the purpose of data terminal measurement signal to enhance the optimization of GPRS upload and download data accessibility. The working principle logic of signal enhancement device is as follows:

The useful signal is amplified by the antenna, the frequency-converted signal is filtered by the filter, amplified by the power amplifier, transmitted by the retransmission antenna to the base station, the retransmission antenna is used to receive the uplink signal of the base station, processed by an uplink amplification link along an opposite path, filters, power amplifiers and then transmitted to the base station, so as to achieve the two-way communication between the base station and the signal enhancement device. Signal quality, largely based on signal-to-noise ratio, signal-to-noise ratio is generally not improved by a simple amplification, because the signal amplification is also amplified, the noise signal is also amplified. To improve the signal quality, it is necessary to improve the signal energy and reduce the system noise as much as possible. The high quality signal received by the high gain antenna must solve the problem that the high gain antenna is connected to the power monitoring terminal and reduce the interference between the high gain outdoor antenna and the power Monitor transmission loss between terminals, when selecting components, consider the potential instability and absolute stability of the amplifier.

3. Signal enhancement device application effect verification

In October 2017, of the four monitoring points of the research object, two monitoring points far away from the communication base station signal were screened out again, and the signal strength of the mobile phone displayed as one grid at a time. As a site monitoring, that is, the straight line distance from the communication base station was 1260 m 35kV Bikai substation 10kV Qi Lang when the line Shiguangtaigu Shigu 400V qualify Mr. Yu home (terminal), and the communication base station straight line distance 1090m 35kV Cikai substation 10kV black bottom line pull black station change black home 400V line Mr. Li Jin Home (end) 2 monitoring points, as the tracking device to enhance the signal tracking device, signal extraction device to enhance the device before and after the worst signal when the scene data is as follows:

Table 2 Mr. Yu hone (terminal) signal enhancement device input data comparison table before and after

Mr. Yu hone (terminal) signal enhancement device input data comparison table before and after						
	Upload the number	Should upload the number	Upload rate (%)	dBm value	asu value	With or without data
Input before	269	288	93.4	-121	19	No
Input after	284	288	98.61	-103	37	Have

Table 3 Mr. Li Jin home (end) signal enhancement device input data comparison table before and after

Mr. Li Jin home (end) signal enhancement device input data comparison table before and after						
	Upload the number	Should upload the number	Upload rate (%)	dBm value	asu value	With or without data
Input before	265	288	92.01	-122	18	No
Input after	286	288	99.3	-100	40	Have

The following is a screenshot of live test of Signal to Noise Ratio (dBm) and Independent Signal (asu) test time and signal strength before and after the signal boost device is put into operation, through the "Settings - More Settings - About Cell Phone - SIM Card Status - Signal Strength" test.

	BEFORE	AFTER
Signal intensity	-121 dBm 19asu	-103 dBm 37asu
Mobile network type	LTE	LTE
Service state	In use	In use

Figure 1 Mr. Yu hone (terminal) signal enhancement device before and after the input data comparison chart

	BEFORE	AFTER
Signal intensity	-122 dBm 18asu	-100 dBm 40asu
Mobile network type	LTE	LTE
Service state	In use	In use

Figure 2 Mr. Li Jin home (end) signal enhancement device before and after the input data comparison chart

According to Tables 2 and 3 and Figures 1 and 2, GPRS signal enhancement device is installed next to the production voltage monitoring terminal. The signal strength of the two monitoring points is raised from 1 cell to 2 cells at a time, and the voltage monitoring system data and the field data are extracted consistent, the basic can upload and download the normal time and data, to test the signal terminal electricity is very weak signal optimization and upgrading purposes. Based on the above two monitoring results, gradually in a number of production voltage monitors and marketing of energy metering terminal set to use, in particular the key to dBm value of -114 and below, and cell phone signal strength display of a cell terminal data upgrade .

4. Conclusion

Addition of GPRS signal enhancement device beside the production voltage monitoring terminal adopts the high gain directional antenna to achieve the purpose of optimizing and improving the signal with very weak terminal data. Especially the dBm value is between -102 and -113, the real-time signal strength of the mobile phone shows the effect of improving the data of the electric terminal with two cells is obvious. However, dBm value was between -114 and -122, there was no obvious improvement in the data of the terminal with the real-time signal strength of the cell phone. The reason is that the power amplification is not enough and needs to be further studied. Power monitoring terminal data signal optimization, can achieve the efficient communication of GPRS communication data to improve the collection of marketing power meter reading accuracy, the production voltage monitor data rate of return, liberation of labor productivity, to achieve power monitoring and control instrumentation, control, Indirectly reduce production and operation costs and enhance social satisfaction, and provide better marketing and production services