Research on fault identification technology of electricity information acquisition terminal

Shang Ying, Sun Li-na, Li Zhong-cheng, Kang Li-yan, Tang Ye, Zhang Mu-xin, Wu Qiu-tong, Liu Xin-ran
19 / f, hunnan east road, hunnan new district, shenyang,110000
476473516@qq.com

Abstract. There are many kinds of faults in electricity information acquisition system, and the magnitude of acquisition terminal is more than 10,000, so it is necessary to find the faults of acquisition terminal actively by technical means. Starting from the analysis of the reasons for the low success rate of acquisition, this paper further studies how to discover the fault of acquisition terminal and the process of troubleshooting. Thus, it can help the operation and maintenance personnel of the acquisition system to identify the fault of the acquisition terminal remotely, and improve the quality and efficiency of the acquisition and maintenance.

1. Introduction

It has been nine years since the State Grid Corporation fully popularized the power users'electricity information collection system in 2010. Most of the provincial companies have achieved full coverage. With the gradual completion of "full coverage" and "full collection" of the acquisition system, the focus of the acquisition system has gradually changed from system construction to operation of the acquisition system[1]. Common faults of acquisition system can be divided into main station faults, terminal faults, watt-hour meter faults, system file parameters faults, communication channel faults and other types.

The main station faults of electricity information acquisition system can be divided into front-end faults, server faults, database faults, system program faults, etc. The faults of acquisition terminal can be divided into power supply faults, communication faults, main control board faults, display board faults, interface board faults, ESAM module faults, etc. Faults, metering chip faults, overload, overvoltage, wiring errors, etc. Communication channel faults can be divided into SIM card faults, wireless private network base station faults, wireless public network faults, upstream communication module faults, 485 interface faults.

2. Electric energy data acquire terminal

Electricity information acquisition terminal is the equipment for electric power information acquisition at various information acquisition points, referred to as the acquisition terminal[2]. The acquisition terminal can realize data acquisition, data management, data bidirectional transmission, as well as transmission or execution of control commands. Acquisition terminals can be divided into three types according to their application sites: specialized acquisition terminal, centralized meter reading terminal (including concentrator, collector), distributed energy monitoring terminal and so on.

2.1. specialized acquisition terminal

The specialized acquisition terminal is a device that collects the electricity information of transformer users. It can realize the data acquisition of electric energy meter, the working condition of electric energy
metering equipment and the monitoring of power quality of power supply, as well as the monitoring of customer's electricity load and energy. It also manages and transmits the collected data in two directions.

2.2. centralized meter reading terminal
The centralized meter reading terminal is a device which collects the electricity information of low-voltage users, including concentrator and collector. Concentrator is a device that collects data from collectors or watt-hour meters, processes and stores them, and exchanges data with master station or handheld devices. The collector is a device for collecting electric energy information of multiple or single watt-hour meters and exchanging data with the concentrator. The collector can be divided into basic collector and simple collector according to its function. The basic collector copies and temporarily stores the energy meter data, and uploads the stored data to the concentrator according to the order of the concentrator. Simple collector directly transfers commands and data between concentrator and watt-hour meter.

2.3. distributed energy monitoring terminal
Distributed energy monitoring terminal is a device for monitoring and controlling the user-side distributed energy system connected to the public power grid. It can realize information collection and power quality monitoring of bidirectional energy metering equipment, and can accept the command of the main station to control the access of the distributed energy system to the public power grid.

3. Fault phenomena classification of acquisition terminals
No matter what faults the acquisition terminal finds, the acquisition success rate can be displayed in the main station side of the acquisition system[3]. Fault phenomena of acquisition terminals can be divided into three categories.

3.1. The success rate of acquisition is 0%, and the acquisition terminal is not online for a long time.
- Power supply failure (no power supply or insufficient voltage equipment can not operate normally).
- Fault of acquisition equipment (damage of acquisition terminal or upstream module or antenna).
- The upstream parameters of the acquisition terminal in the main station of the acquisition system are set incorrectly (IP, port, APN, terminal address).
- Communication failure, SIM card problem (arrears, damage) or GPRS service is not open; antenna damage, local signal problem (bad signal, no signal or strong interference signal).

3.2. The success rate of acquisition is 0%, and the acquisition terminal is on-line.
- Fault of acquisition equipment (damage of acquisition terminal or routing module).
- The parameter setting of watt-hour meter (the parameter of watt-hour meter is not sent down or wrong, and the reading time of concentrator is wrong)[4].
- Carrier scheme mismatch (concentrator routing module and field meter or collector carrier module are different manufacturer scheme, mismatch).
- Procedure problems of acquisition terminal (unable to store read data or not read related data items, stop copy, crash).

3.3. The success rate of acquisition is not 100%, and individual watt-hour meter reading fails.
- Acquisition equipment failure (meter damage, collector damage, carrier module damage).
- The archives of the main station of the acquisition system (the parameter error of electric energy meter, the communication address error of the acquisition unit, and the serial area of individual meters).
- Procedure problems of acquisition terminals or watt-hour meters (concentrator program problems lead to missing, missing, vacant success marks, or individual watt-hour meter program problems can not be answered properly).
- Power supply failure (meter without power supply, meter terminal voltage loss or overvoltage).
- Meter malfunction (meter removal, carrier module installation, 485 wiring problem of collector scheme).
- Carrier scheme mismatch (concentrator routing module and field meter or collector carrier module are different manufacturer scheme, mismatch).

4. Fault Diagnosis Method of Acquisition Terminal

4.1. Fault Diagnosis Principles
- Priority is given to the main station of the investigation and acquisition system. When the fault is found, the main station side of the acquisition system should be given priority to analyze and find out the causes, so as to improve the ability of the main station of the acquisition system to eliminate the fault and reduce the difficulty and workload of the field work.[5]
- Analyzing and locating step by step. Considering the actual situation of each link of power information acquisition, the problems of fault location and processing are analyzed and sorted out from the main station, remote channel, acquisition terminal and intelligent energy meter of the acquisition system, so as to achieve fast and accurate fault location and processing.
- Batch priority. When encountering multiple concurrent faults, we should consider the impact scope of each fault, recovery time and the difficulty of emergency repair. We should give priority to dealing with the faults that affect more users and have less difficulty in repairing.
- Disposal in place at one time. For the different faults found in the same area/station area, the dispatch of workers should be checked and handled simultaneously at the same time as possible. According to the possible causes of failure, materials should be prepared in advance to dispose of the failure at one time.

4.2. Troubleshooting process
- The main station of the acquisition system analyzes and classifies the failure users of meter reading, and checks and analyses the failure users one by one, preliminarily determines whether the failure is on-site, and preliminarily determines the fault treatment scheme.
- When the batch acquisition terminal drops off, it is necessary to investigate whether the remote communication channel is running normally and whether there is power outage and overhaul of the power grid.
- Before the preliminary investigation, the number of electric energy in the acquisition system and the setting parameters of the acquisition terminal should be checked. If the parameter setting errors are found, the parameter data should be maintained first, so as to eliminate the failures in the field.

5. Typical faults of acquisition terminal
The fault phenomena and treatment methods of acquisition terminals are different because of different models and manufacturers. Typical faults of acquisition terminal can be divided into power supply faults, communication faults, main control board faults, display board faults and interface board faults.

5.1. Power failure
Power failure of acquisition terminal is mainly manifested by no display on the acquisition terminal panel after boot-up, and the indicators are not on. At this time, we should focus on checking whether there is 220V or 110V voltage at the input of AC power supply of the acquisition terminal. Is the AC power outlet and fuse inserted properly? If the input voltage of AC input is normal, the output voltage of switching power supply should be checked. The switching power supply of the acquisition terminal usually has a power supply indicator, which can be used to judge whether the acquisition terminal is malfunctioning by observing whether the power supply indicator is on or not. If the power indicator is not on, the AC voltage of the switching power supply input can be tested with the AC voltage of the
multimeter. If the input voltage is normal, then the output voltage of the switching power supply is tested by DC voltage bar. Usually, the output voltage of the terminal power supply is +12V, -12V, +5V or +13.8V. If there is no above voltage output of the test switching power supply, it proves that the output of the switching power supply is abnormal. Switching power supply should be replaced.

5.2. Communication failure
Communication failures are mainly manifested in the following three phenomena: 1. The acquisition terminal can not receive the command issued by the main station; 2. The acquisition terminal can receive the command from the main station, but can not return the code correctly; 3. The terminal receives and receives the data normally, but the main station fails to call the test data. The main causes of Communication Faults are: 1. modem board faults; 2. main control board faults; 3. radio faults; 4. antenna and feeder system faults[6].

5.3. Main Control Board Fault
The main failure phenomena of the main control board are the program crash of the main control board, the failure of meter reading and the automatic reset of the terminal at intervals. The terminal clock does not go, the acquisition terminal is running or the self-checking lamp is always on or off, and the communication failure of the acquisition terminal. When the processing board of the new acquisition terminal fails, the communication abnormality of each interface can be detected by the terminal self-checking function. After the fault of the terminal main processing board is detected, the fault can be eliminated by replacing the main board directly.

5.4. Display board failure
The main faults of the display board are the program crash of the display board, the display code disorder, the LCD screen not bright, the display board not showing, the display image without Chinese characters, the display button failure and so on. For the terminal whose voice circuit is designed on the display board, the failure of the display board may also cause the acquisition terminal to have no voice alarm function. The display board is one of the external output devices of the acquisition terminal. According to its display status, it is easy to judge the fault location. For the display board failure, the problem can be solved by replacing the display board.

5.5. Interface board failure
Interface board is the interface unit between acquisition terminal and external equipment for data acquisition and control. The interface board provides pulse input interface, switch state acquisition interface, control relay output interface and 485 meter reading interface. Interface board faults are mainly manifested in the absence of terminal pulse power and power data, failure to collect user switching status, control output relay inactivity and other phenomena. The problem can be solved by replacing the interface board.

6. Conclusion
By analyzing the classification of power information acquisition terminals and fault phenomena of acquisition terminals, this paper proposes a method to identify the fault of acquisition terminals by analyzing the success rate of acquisition. This method can help the acquisition and maintenance personnel find the fault of acquisition terminals actively from the main station of acquisition system, and improve the quality and efficiency of acquisition and maintenance. The reliability of the acquisition system has been improved.

References
[1] Ding H, Ju H and Zhu E 2016 Research on reliability experiment of electric energy data acquire terminal J. China measurement & Testing technology. 42(4) 136–139,144
[2] Hu J,Zhu E and Du X 2014 Application status and development trend of Power consumption
information collection system J. Automation of electric power systems. (2) 131–135

[3] Xiao J, Sun J and Chen H 2016 Research on operation environment simulation and detection on electricity information collection terminal J. Electronic Measurement & Instrumentation. 53(7) 101-106

[4] Qu W 2014 Common Faults and Treatment of Electricity Information Acquisition Terminal J. Power Demand Side Management. (1) 60-60

[5] Wei F, Chen R and Xiao Y 2012 Development and application of the information collection terminal remote fault diagnosis system J. Electrical Measurement & Instrumentation. 49 (z1) 105-109

[6] Liu K, Zou X and Zhong Z 2015 Research and implementation of the automatic feeder and local communication schemes of the electric data acquisition terminal communication hardware port J. Electronic Measurement & Instrumentation. 52(2) 17-21