Intelligent Diagnosis of Acquisition Equipment Failure
Promote "Multi-integration" Application

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Abstract. The information collection system of State Grid Corporation has accessed a large number of smart energy meter, water meter, gas meter and heat meter data, implemented the “multi-integration” collection and construction to improve the public service level of the society, and actively respond to the call for government smart city construction. However, many operating equipment and complex operating environments often generate various equipment failure problems. It is difficult to identify faults and has low efficiency in troubleshooting. The intelligent diagnosis of the collection equipment fault is based on various information such as operation and maintenance, environment, fault analysis and acquisition. It uses big data analysis and artificial intelligence technology to conduct Intelligent Diagnosis Model of Acquisition Fault research, so as to solve the accurate judgment of the failure of the collection device, qualitative analysis of equipment fault and on-site, workflow troubleshooting guidance issues. Using the intelligent diagnosis of faults to solve the problem of “multi-integration” collection and maintenance, it can effectively improve the efficiency of fault handling, better promote the application of “multi-integration” and promote the construction of smart cities.
1. Introduction
The integrated collection of electricity, water, gas and heat information is the only way for the development of “Internet +” smart energy. State Grid Corporation adheres to the idea of building smart energy and serving the public society, vigorously promotes this project, taking the lead in combining the industry, make full use of the equipment resources and network resources of the company's existing power information collection system, to realize the common collection of electricity, water, gas and heat information. Integrate existing resources to avoid duplication of construction and waste of resources. The construction of “multi-integration” uses intelligent equipment to realize remote automatic collection of measurement meters, which promotes the development of smart cities. However, the numerous operating equipment, complex operating environments, and various types of equipment failures at the site have led to increasing pressure on the collection and processing of faults. The traditional fault handling mode is difficult to meet the requirements for metering lean management.

Unified data collection combined with cutting-edge theory and technology such as big data analysis for abnormal analysis and diagnosis can greatly improve system application efficiency. By comprehensively collecting on-site fault information. On-site operation and maintenance personnel use data collection data, status data, environmental data, maintenance analysis and other data to construct intelligent fault diagnosis and processing models using big data analysis and artificial intelligence technology (machine learning).to achieve intelligent fault diagnosis, qualitative and quantitative analysis of faults, to quickly solve problems, to achieve the goal of accurate operation and maintenance.

2. Introduction of "Multi-integration"
The integrated collection of four meters of electricity meter, water meter, gas meter and heat meter is an inevitable requirement for resource intensive sharing and building a conservation-oriented society. In order to build a customer-oriented “big service” mechanism, the State Grid Corporation will meet the intelligent energy needs of customers, promote the construction of smart cities, and comprehensively promote the “multi-integration” information collection and construction work. In the important period of comprehensively promoting the construction of smart cities, providing high-quality energy service is an important part of smart city construction. The mining customer energy behavior, intelligent push energy recommendations, to create a user service model based on "Internet + multi-table copy", so that the people enjoy The one-stop service of “one card, one payment” fully supports the construction of smart cities.

In order to reduce the cost of “multi-integration” collection and transformation, reduce the inconvenience caused by construction to residents, and improve the operational stability of “multi-integration” collection, State Grid Corporation uses the built-up electricity information collection system to realize remote information collection of data such as electricity, water, gas and heat, relying on the existing power information collection system main station and marketing business application system to achieve data collection and storage. By sharing resources and reducing costs, through centralized collection, unnecessary public infrastructure duplication can be reduced, and customer life data can be collected uniformly, which provides basic support for the government to carry out big data analysis.

The “multi-integration” construction strictly implements the company's unified technical standards on the technical solutions, so as not to affect the functions of the original marketing information systems, fully share the existing power information collection system equipment and channel resources as the principle, select the typical technical solution, the original structure of the electricity information collection system is unchanged, and the communication interface converter is newly installed or replaced. The concentrator uplink communicates with the power information collection system through GPRS/CDMA, and the downlink communicates with the power meter and the communication interface converter through the power line carrier; The communication interface converter can communicate with water meters, gas meters and heat meters through micro power.
wireless or M-BUS. ensure data collection and transmission security. The collection application technology scheme is shown in Figure 1.

Figure 1. Technical solution block diagram.

3. "Multi-integration" information collection common faults

3.1 Concentrator is not online
(1) Parameter problem, because the concentrator APN, IP, port number and other file parameter settings may be wrong, the terminal address code is set incorrectly and so on.
(2) Antenna problem, the field antenna may be faulty. The antenna is often damaged at the scene. If the antenna is broken, the antenna is cut short and there is no antenna at the scene. There are also hidden antenna faults. For example, when the concentrator case is switched, the antenna body is squeezed, resulting in breakage inside the antenna, no obvious breakage of the appearance, or loose connection between the antenna and the module, and the screw buckle is not tightened, resulting in poor signal contact. The signal is unstable, causing the concentrator is not on the line.
(3) The SIM card is faulty. First, the concentrator is used for a long time, and the metal part of the SIM card has an insulating gel, which causes poor contact. The second is the SIM arrears, and the third is the location of the SIM card slot is damaged, resulting in the inability to detect the signal.
(4) The concentrator equipment itself is faulty, and there are obvious damages on the site, such as concentrator burnout, concentrator black screen, frequent concentrator program errors, and crashes.
(5) The concentrator is powered off at the site, which is also the reason why the concentrator is not on the line.

3.2 Concentrator online does not read the meter
(1) The concentrator clock is incorrect, causing the rewritable real-time data to not freeze.
(2) The concentrator downlink communication failure.
(3) The parameter is wrong, the water meter, gas meter, and hot meter communication rate are set incorrectly.
(4) The water meter, gas meter, and heat meter table number are set incorrectly.
(5) Water meter, gas meter, hot meter with converter address meter reading mode, the water meter, gas meter, heat meter converter address and field converter address in the acquisition system are inconsistent, resulting in the concentrator not reading the meter.

3.3 Transformer area meter reading is unstable
(1) In the transformer area, if the power carrier is used between the concentrator and the converter, the file division in the system is incorrect. A total of zero crosstalk will occur in the zero-zone area, and
the water meter, gas meter and heat meter of the adjacent transformer area will be copied back, lead to unstable reading.

(2) The converter carries too much water meter, gas meter and heat meter, resulting in unstable reading.

(3) The M-BUS port or the 485 port communication line of the converter is connected by a virtual connection, and the meter is connected to the virtual connection, resulting in unstable meter reading.

(4) The files in the concentrator and the files in the collection system are inconsistent. The concentrator has a table file that does not exist on the site. The downlink route repeatedly reads the meter that is not on the site, resulting in slow meter reading and unstable meter reading.

### 3.4 Parts of water meters, gas meters, and heat meters date cannot be read

(1) The water meter, gas meter, and gas heat meter are faulty. If there is no data in the field using the handheld device, it can be judged as a communication failure.

(2) Water meter, gas meter, heat meter M-BUS line, 485 line and bus are virtual or line break, resulting in missing read.

(3) Transformer area error, the user does not belong to the station area, and the handheld data can be read by the handheld device on the spot.

(4) There is no user file in the concentrator, which leads to missed reading.

(5) The on-site communication address of the water meter, gas meter, and heat meter is inconsistent with the acquisition system, resulting in missing read.

(6) The converter address does not match the parameter address in the acquisition system.

### 4. Intelligent diagnosis of acquisition fault

Key technologies involved in intelligent fault diagnosis research include big data analysis and artificial intelligence. Through big data analysis, discover equipment fault data characteristics, related factors and main causes, and fault prediction. Through artificial intelligence, combined with fault diagnosis standards and faults historical records, through continuous training and learning, optimize fault diagnosis methods and improve diagnostic efficiency.

Firstly, it is necessary to comprehensively collect and sort out the on-site fault information of the electricity consumption information, formulate the classification of the on-site fault, and investigate the technical requirements of the on-site fault treatment. There are various types of faults in the collection field. Different equipment manufacturers and operating environments have different fault diagnosis rules and processing standards. According to different field operation conditions, the business rules for collecting fault intelligent diagnosis and the standardized operation guidance of field equipment faults are formed. Provide accurate standard procedures for on-site operations personnel. According to the collection of fault information on the collection site and the investigation of fault handling technology, construct a collection abnormality diagnosis function model, and uses the big data technology to analyze data such as collected data, status data, environmental data and other data. using artificial intelligence technology to construct an on-site fault intelligent diagnosis model for electricity information collection equipment, and qualitative analysis of equipment failure. Combined with the on-site operation and maintenance fault handling process and fault handling experience, the fault handling model is established to automatically process the faults with intelligent processing, provide accurate, convenient and efficient fault handling solutions for on-site operation and maintenance personnel troubleshooting operations.

### 5. "Multi-integration" information collection anomaly identification

For each type of collection site failure, on-site operation and maintenance personnel can use the acquisition fault intelligent diagnosis and processing according to the data collected by the equipment, status data, environmental data, maintenance analysis and other data to achieve qualitative and quantitative analysis of faults (such as module failure, circuit Faults, component failures, etc.), accurately identify the cause of the fault, and at the same time give a targeted fault handling solution
to improve the responsiveness, work efficiency, safety and standardization of the processing equipment. It can also provide data support including classification and statistics of equipment failure and operation and maintenance failure, cause analysis, high-frequency fault warning and rapid processing, equipment remaining life prediction, in-service equipment status assessment and prediction, and energy meter cycle status maintenance rotation.

For the abnormality of the archive data, you can compare the real-time and historical data of the water meter, gas meter and heat meter by extracting 1-2 online collection terminals, and compare the real-time and historical data with the historical data values saved in the system. To judge the rationality of the data. For example, the historical data call results should be consistent with the historical data values (including data, time stamps, meter reading time, etc.); historical data call results and real-time data call results data trends should be reasonable; call measurement points number should be consistent with the file in the system, and the data time stamp and meter reading time should be reasonable. Using the intelligent diagnosis of the collection system to discriminate and query the data collected by the “multi-integration” terminal, and judge whether the trend of the indication values in the multi-table data is consistent. If there is an inconsistent trend in the indication values of the electricity meter, water meter, gas meter and heat meter, then I think that the data is abnormal and the data is identified, and the problem is solved in a targeted manner.

6. Conclusion
Unified data collection combined with cutting-edge theory and technology such as big data analysis for abnormal analysis and diagnosis can fully utilize system functions, improve application quality, and greatly improve system application efficiency. On the basis of the acquisition, technical support and system performance can be improved to better realize the interoperability of electricity, water, gas and heat, and promote the development of smart cities.

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