The Method Researching for Increasing the Successful Rate of Remote Electric Charge Control

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Abstract. The failure for power-off or the restoration often happened in the tripping or closing activity during the actual application of remote electric charge control, which increases the difficulty of timely recovery of the electric charge and brings the risk of user complaints. The lower successful rate executed was researched deeply for electric charge control work orders in Liaoning Electric Power Company LTD. in the paper. The reasons of the transmission failure in the of electric charge control work was comprehensively analyzed orders executed from different perspectives of master station, communication, field terminal, energy gauge. Through the above analysis, we obtain the factors that affect the successful rate of electric charge control execution. We seek the best solution to increase the successful rate for the electric charge control execution and put forward to methods to increase the successful rate of the electric charge control execution in the whole province in this article.

1. Introduction
The remote electric charge control system can send out early warning and the work order for power-off and restoration\cite{1}. The early warnings and the work orders were generated by measuring and calculating the user’s balance of the electric charge account and comparing it with the alarm amount and limit of overdrawn account. We can calculate the user’s balance of the electric charge account based on the user’s electric charge, advance payment information, the electric charge calculation period set in the marketing activity application system and the energy readings sent by the energy information collected system every day.

2. The program for the remote electric charge control execution
The current electric charge used and usable balance can be measured and calculated by the remote electric charge control system every day. And the average electric charge of a day can be calculated based on the electric charge issued in six months by the marketing activity application system. Meanwhile, the current electric charge balance and the last settlement readings gotten from the marketing activity application system are used to measure and calculate the current electric charge used and usable balance. Also, the frozen energy readings at zero hour on the date from the energy information collected system\cite{2} are useful. The usable account balance can be compared with the content of electric charge control tactics selected in the user’s file. If it is lower than early alarm value, the early alarm report will be formed and sent to the marketing activity application system, at same time the early alarm message will be sent to the message platform. After the message sent successfully and feedback, the user in the electric charge control system will be set in “early alarm status”. If the usable account balance in user’s electric charge account exceeds the early alarm value, “early alarm
status” will be released. If the user does not pay the electric charge in time and the account balance measured and calculated someday is lower than the overdrawn amount of electric charge control tactics selected in the user’s file, the power-off work order will be formed and sent to the marketing activity application system. After examined and approved, the user will be set into power-off situation, the order will be received by the energy information collected system and the execution result feedback to the remote electric charge control system. After the user’s payment, the electric charge will be calculated immediately, if the usable account balance exceeds overdrawn amount, the restoration work order will be created automatically by the remote electric charge control system and sent to the marketing activity application system. After examined and approved, the restoration work order will be received by the energy information collected system. After the execution result feedback is sent, the remote power restoration will be successful at same time[3].

3. The failure reason analysis on the work order of the electric charge control

The failure reason was comprehensively analyzed by the master station, communication, site terminal and gauge from different angles based on the failure reason for the electric charge control execution of Liaoning Electric Power Company LTD from January to May 2018 and the result was collected and classified. The statistics for the failure reason of power-off or restoration work order execution to electric charge control user according to the order frequency is shown as the following table:

Table 1. The Statistics for The Failure Reason Analysis on Electric charge Control Order Execution

| No. | Failure Reason (daily information) | Failure Amount | Proportion (%) | Problem Classification |
|-----|-----------------------------------|----------------|---------------|------------------------|
| 1   | Task manager: terminal not online | 9314           | 28.83         | Terminal online instability |
| 2   | Energy gauged response: denial    | 6802           | 21.06         | Carrier communication unstable |
| 3   | Energy gauge response: password error/unauthorized | 5389 | 16.68 | the power supplying guarantee not relieved |
| 4   | Front-equipment response: the terminal waiting for response exceeding | 3493 | 10.81 | Terminal online and carrier communication unstable |
| 5   | Terminal response: denial         | 2589           | 8.01          | Terminal file parameter problem |
| 6   | Terminal response: Data transmission exceeding | 1320 | 4.09 | Carrier communication unstable (The line too long) |
| 7   | Energy gauge: other error         | 1270           | 3.93          | Carrier communication unstable |
| 8   | Front-equipment response: the terminal waiting for response exceeding 1B | 769 | 2.38 | Terminal online and carrier communication unstable |
| 9   | Terminal response: Data transmission failure | 495 | 1.53 | The gauge not receiving the corresponding instruction or the electric charge control instruction not resolved properly |
| 10  | Energy gauge response: authentication failed | 267 | 0.83 | The problem of energy password |
| 11  | Encryption machine: internal communication failure with EASM Encryption machine service | 170 | 0.53 | Master station problem |
| 12  | Encryption machine: the on-authentication message returned | 148 | 0.46 | Terminal software problem |
4. The influence factor for the successful rate of the electric charge control execution

4.1. The communication problem between the carrier and the concentrator
This problem resulted in the failure rate for work order execution is 30.63%. The reasons for the timeout of the electric charge control orders include a terrible carrier channel, an unstable carrier communication, an unclear division of the transformer, gauge file error or no power supply, unissued gauge file[4], a too long distance between the concentrator and gauge and so on. These reasons cause the execution for the electric charge control order exceeding the time limited, and the problem of the carrier communication instability needs to be eliminated on site.

4.2. The energy gauge problem
This problem resulted in the failure rate for work order execution is 0.87%, and three cases are as follows:
- The state of the public key or the fault of energy gauge leads to the failure of electric charge control execution.
- The clock abnormality of energy gauge. The clock on the energy gauge should be called and tested to determine the abnormality existed by the collection system, if the clock drift exists, the energy gauge should be timed in field or replaced for the 09 version; the energy gauge for the 13 version can be remotely timed in the system and issued to test again[5-6].
- The damaged energy gauge. The energy gauge burned or hardware damaged should be replaced.

4.3. The communication problem between the concentrator and the master station
This problem resulted in the failure rate for work order execution is 50.03%, and the main reasons are as follows:
- The concentrator drops, which needs to test on line.
- An error occurred on the file or file issuing. The file needs to issue correctly.
- There are problems about the software or hardware of the equipment from different manufacture. The equipment should be rectified or replaced.
- It exists field interference or earth line charged at the scene.
- GPRS signals are weak in buildings, mountains, or other vulnerable areas by the obstructions. The signals were changed from 4G to 2G or disappeared signals entirely.
4.4. The master station abnormality
This problem resulted in the failure rate for work order execution is 1.33%. The problem from the front-equiment in the master station, such as the message packing or sending failure, the network communication abnormality between encryption equipment[7]. Although the proportion is very small, the master station strategy still needed a room to adjust. The master station level should be improved to coordinate to develop and support the new electric charge control mechanism. The problem can be effectively improved if the fault elimination process for the system server operation is carried out in time.

4.5. The work order execution for power-off under the power supplying guarantee not relieved
This problem resulted in the failure rate for work order execution is 16.68%. The main reason is the personnel operation fault, i.e. the electric charge control order was given directly under the power supplying guarantee not relieved, and leads to the electric charge control order unexecuted by the energy gauge. After the power supplying guarantee was relieved, the electric charge control order can be executed again and the work order of the electric charge control can be executed successfully.

5. The method for the successful rate of remote electric charge control improved

5.1. The expansion for the bandwidth of up and down communication channel

5.1.1. The expansion for the bandwidth of the up-link communication channel. The bandwidth of the up communication channel can be expanded by the following methods:
- The concentrator device moved up.
- GPRS communication extension device added to the concentrator
- The antenna tighten in the better signal position.
- The signal amplifier added.
- Replacement with planar antenna or yagi antenna.
- 2G module of the uplink communication in the concentrator replaced by 4G module.

5.1.2. The expansion for the bandwidth of the down-link communication channel. Ninety percent of the down-link energy gauges in the scheme of Liaoning Electric Power Company LTD. is a narrow-band low-speed carrier scheme. The narrow-band low-speed carrier scheme has some disadvantages compared with narrowband and broadband carrier in terms of communication speed and anti-interference etc.

The carrier communication with narrowband and low-speed is vulnerable to high frequency interference. The slow speed often leads to the communication failure. The poor carrier channel and the unstable communication can lead to the gauge response denied or other faults, which will cause the electric charge control order sending failure. The broadband carrier has the advantages of strong anti-interference ability and fast communication speed, which can completely satisfy the work target of “the electric charge control in the whole grid” for State Grid Corporation of China.

5.2. The technology for the task transparent transmission introduced
The execution for the strategy of the electric charge control is the transparent transmission mode between the master station and the energy gauge at present. The entire channel resource will be occupied by one time of communication and other orders cannot be executed at the same time. When the carrier channel unstable or some component fault, the connection between each link will be defective in result of the execution failure for electric charge control. A new implementation mechanism of "transparency mission" should be introduced to develop the research and application for new technologies to change the original single "transparency transmission" mode to "transparency mission" mechanism in allusion to the defects and shortcomings of the existing mode of the transparency transmission, so that the successful rate of electric charge control can be raised.
According to the condition of the electric charge control at different area or municipalities in the whole province, we plan a pilot test. Through the pilot test, we compare the "transparency mission" with the "transparency transmission" for electric charge control to verify the applicability and effect of the new technology.

5.3. The number of work orders execution increased
The work order of the electric charge control is sent to the collection system via the interface by the electric charge control system, and executed by the collection system according to the instruction of work order. This is one of the execution phases of the entire electric charge control system, and it is the execution strategy for the electric charge control system, which should be further improved. The work order strategy for electric charge control is that breaking once issued and closing three times issued.

Testers adjust the original execution strategy of the power-off work order from the once issued for the previous power-off electric charge control strategy to three times to verify the performance effect of the power-off work order.

5.4. The strategy execution of the electric charge control order optimized
The work order of the control work order is sent to the collection system via the interface by the electric charge control system. The electric charge control order will be studied and judged by the system before the work order of the electric charge control sent. The relay status will be inquired remotely before the work order executed by master station. If the relay status of the gauge can be returned, the online instability of the part terminal and the carrier communication will be avoided (which influencing the electric charge control work order more than 80%), and the result of the relay status will be recorded by the master station and compared with the work order for electric charge control to satisfy the electric charge control strategy. The work order with the record of the relay status can be executed by the master station for the electric charge control. The work order can be executed by the master station for the electric charge control, which the relay status is not fed back by the energy gauge, and the collection and operation personnel is prompted to verify the reason that the relay status not feedback by the energy gauge. The relay status should be inquired remotely and recorded by the operator after the settlement. The work order for the electric charge control can be executed by the collection system with the result of the relay status fed back by the energy gauge and the execution efficiency of effective order can be promoted. The relay status was inquired remotely and recorded but the execution of the work order for the electric charge control is still failure, which should be calculated as the failure of the electric charge control execution. The work order for electric charge control shall be selected by the collection system through judging and recording the condition of the relay status before the execution, and then the work order can be executed. It prompted that the manual processing by the collection, operation and maintenance personal as soon as possible if the judgment condition does not pass. After the processing, the data should be remotely inquired and recorded and the work order for the electric charge control sent to execute manually.

6. Conclusion
The concrete reason was explained for the failure execution of the work order for electric charge control in Liaoning Electric Power Company from January to May 2018 in this article. The technical means of the bandwidth expansion of communication channel, the number of executions increasing and transparent task transmission was put forward to raise the successful rate of the execution for the remote electric charge control and up to more than 90%. The successful rate of the execution for the remote electric charge control has obviously increased compared with the successful rate for the current electric charge control strategy. The electric charge control execution strategy for the collection system optimized also was put forward at same time and the management work for Power-Off or On to the electric charge control users was supplied with the technical support. The company’s operating cost was reduced and the customer’s satisfaction was increased.
References

[1] Guo Q, Cao J and Chen L 2018 Research on optimization and upgrading strategy of the remote electric charge control system for electric power marketing *J. Hunan Electric Power*. **38**(1) 55–58

[2] Li C 2015 Application of the remote electric charge control system in marketing activities *J. Power Demand Side Management*. **17**(4) 58–60

[3] Yang F, Hou X and Wei D 2016 Exploration for the load switch failure for the electric charge control of the energize Gauge under different short-circuit conditions *J. Electronic Measurement Technology*. **39**(10) 178–182

[4] Wang Z, Guan Y and Kang L 2013 The application of wireless data network technology in the power using information collection system *J. Northeast Electric Power Technology*. **34**(7) 1–4,43

[5] Shang Y, Zhao Y and Kang L 2017 Research on the method for the automatic and accurate timing of the power using information collection system *J. Northeast Electric Power Technology*. **38**(2) 16–18

[6] Guan Y, Wang Z and Zhao Yu-dong 2017 Research and application of the technology for the intelligence Gauge Freezing Instantaneously at low-voltage power transformer area *J. Northeast Electric Power Technology*. **38**(2) 25–28

[7] Kang L, Wang Z and Sun F 2012 The method for poor data analysis and processing power user information collection system *J. Northeast Electric Power Technology*. **33**(11) 46–48