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Analysis and Research on the fault disposal process of the electric energy metering devices

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Abstract—With the wide application of electronic equipment, the electric energy metering device of site operation is often subject to various types of interference. Due to the complex operation environment, various kinds of fault problems often occur in the electric energy metering devices. However, the actual failure disposal methods were not unified and standardized, which often results in the waste of electric energy metering device assets. In view of the above problems, the faults disposal methods of the electric energy metering devices were studied, the work flow of standardized fault disposal of electric energy metering devices was sorted out and the disposal requirements of each link were identified, which provides a good foundation for standardizing the unified and efficient disposal of the failed electric energy metering devices, deepening the quality management of the whole life cycle of the electric energy metering devices, and realizing the effective reuse of the electric energy metering devices.

1. INTRODUCTION

With the wide application of electric energy metering devices (including smart electricity meter, acquire terminal and transformers), the number of electric energy metering devices operating on site was huge. Due to the quality of energy metering devices or the influence of operating environment, the number of the fault energy metering devices was huge^[1]. The corresponding disposal methods were various, the management of fault metering devices is not standardized, the number of scrapped devices was large, and the disposal was inappropriate, which brings unnecessary troubles to asset management^[2-3]. The faults of the electric energy metering devices, the electric energy meter and the low-voltage metering centralized reading device were analyzed and researched in the related papers without combing their technological process, and without clearing specific methods and requirements, and only the measures to strengthen product quality and management were proposed^[4-9].

In order to effectively improve the asset management level of power metering devices, deepen the requirements of life cycle management, and improve the treatment efficiency of fault metering devices, the workflow of fault metering devices from fault identification, fault disposal, change back, sorting, returning to the factory, identification, scrapping to reuse were analyzed and studied. The disposal process methods and requirements were unified to provide technical support for field work and sorting work.



2. ANALYSIS AND RESEARCH ON FAULT PROCESSING FLOW

According to the actual work of fault disposal of metering device and life cycle management requirements, the processing flow of fault metering device was divided into field disposal, removal and retention warehouse, equipment sorting, sorting detection, sorting disposal analysis, due cleaning, technical identification and scrap disposal. According to different types of equipment and links, the relevant disposal work were carried out, the process and efficiency of disposal were improved.

The flow chart was shown in Figure 1, when the fault of the electric energy metering devices occurred, filed disposal should be carried out first, after the faults were eliminated, the task were completed. If the faults could not be solved on site, the electric energy metering devices should be removed, then the classification work were completed through cleaning and sorting for preliminary screening. Using automatic means supplemented by manual sorting detection, the four states to be scrapped, to be repaired, to be compensated and to be verified were determined, and finally the final disposal of asset scrapping or reuse was realized.

3. FIELD DISPOSAL

The operation of electric energy metering devices should be closely monitored, in case of faults or suspected faults of electric energy metering devices were occurred, the "work sheet for fault disposal of electric energy metering devices" should be filled and a good registration would be made. The field staff of metering should carry out on-site inspection and treatment, and the faults of electric energy metering devices would be record into the marketing business application system.

The on-site fault conditions should be accurately analyzed and judged by the on-site disposal personnel, and accordance with the relevant regulation, the corresponding treatment in strict should be carried out. In case of any breach of contract and electric larceny were occurred by the customer, the power inspector should be informed immediately to deal with it. In case of major equipment failure, major human error, general equipment failure and general human error, the site should be protected and reported to the superior immediately and handled by the investigation team. Obstacles and minor human errors should be handled directly. If there is no obvious abnormality but the electric energy metering devices was suspected with abnormal, the abnormality of the electric energy metering devices was necessary to be judged. Replacing the faultless electric energy metering devices at will was strictly forbidden.

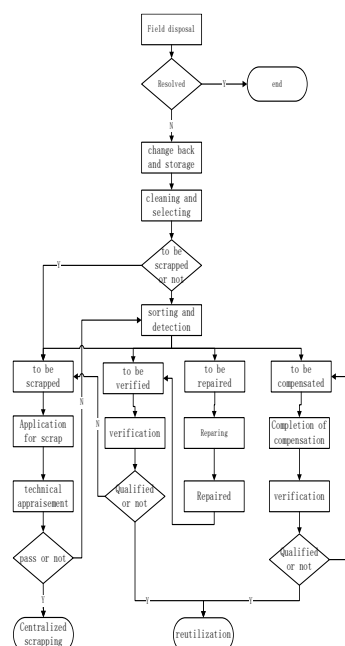


Figure 1 Disposal flow chart

When batch fault or quality hidden danger was found in electric energy metering devices, relevant provisions should be strictly implemented, and "approval form for batch failure of electric energy metering devices" and "analysis report on major quality problems of electric energy metering devices" should be prepared. The power metering devices with the failures caused by wrong wiring, poor connection or external environmental factors should be handled on site, which was forbidden to change. For example, the module with damage should be replaced separately, the software with fault or defectiveness should be upgraded. If electric quantity error was occurred, electric quantity compensation should be carried out in strict accordance with regulations. After the faults and errors were handled, to ensure no new faults and errors occur, the electric energy metering devices should be checked carefully.

4. CHANGE BACK AND STORAGE

The relevant business management department was responsible for checking the seal of the removed electric energy metering devices and taking photos, then the metering information (such as the bottom indication of the electric energy meter) related to the electric energy settlement should be entered into the marketing business system. The removed electric energy metering devices should be classified and managed according to the fault category, disassembly time, wiring mode, etc. For the convenient to recheck for future reference or objection raised by the customer, the removed electric energy metering devices involved the settlement of electricity charges should be stored in the storage room at least one meter reading cycle or electricity fee settlement cycle.

For the removed electric energy metering devices that needs to be verified and calculated, the verification conclusion should be issued firstly by the business processing unit, and the sorting could be carried out after the completion of the electric energy return and compensation processing and the filing of the business process. The rest of the removed electric energy metering devices which were confirmed by the power customer that there was no objection of power return and compensation, could be sorted after the business process was filed.

The removed electric energy metering devices could be sorted and the fault phenomenon could be identified by the sorting devices that meet the requirements of relevant regulations were equipped by all units, the sorting results should be inputted into the Measurement of Integrated Production Dispatching System and be synchronized to the Electric Power Marketing Business Application System as the reference for the operation quality of the equipment.

5. CLEANING AND SELECTING

Equipment selecting was mainly to screen out the removed electric energy metering devices that were faulty due to the damage and do not have detection conditions before sorting and testing. The removed electric energy metering devices for this part of the separation (such as burning, overload, lightning strike, terminal damage, etc.) should be taken photograph and kept (named with the asset number) as the basis for technical appraisalment of asset retirement.

The removed electric energy metering devices with testing conditions should be completed the preparation work before testing such as equipment cleaning, screw filling, etc.

6. SORTING AND DETECTION

6.1. Sorting

Equipment sorting and testing were carried out by the provincial Metering Center or the power supply companies. According to the actual situation to carry out the sorting work, the corresponding sorting devices which were also divided into different types should be selected correctly by the users.

According to the priority of the fault phenomenon, the actual faults of the removed electric energy metering devices could be quickly detected out, and according to the faults, the removed electric energy metering device could be divided into four states: to be compensated, to be repaired, to be

verified and to be scrapped. Finally, the sorted electric energy metering devices was pasted with sorting labe.

TABLE1 FAULT CLASSIFICATION OF ELECTRIC ENERGY METERING DEVICES

Order number	1	2	3	4	5
Fault classification	Equipment quality	Working quality	External factors	vis major	other

The faults of the electric energy metering devices were mainly divided into five categories, as shown in Table I, including the faults of the electric energy metering devices caused by the equipment quality and working quality, the faults of the electric energy metering devices caused by external factors and vis major and other faults.

According to the actual situation, for those electric energy metering devices which were meeting any requirement with failure due to non-equipment quality reasons (work quality, external factors, natural disasters), electric energy metering devices with a age of more than 6 years, suppliers having closed down, obsolete types or products, re-change back electric energy metering devices with a age of more than 4 years after repairing can be sorted to be scrapped. Only those electric energy metering devices whose equipment quality failures occur in the warranty period can be disposed of as compensation. The electric energy metering devices with operating time less than 6 months, good appearance, no faults, no battery undervoltage and clock overrun risk can be sorted out as the state to be verified. The rest of the change back electric energy metering devices with the age of less than 5 years should be returned to the provincial metering center and be sorted out as the state to be repaired. The provincial metering center will sort and test the electric energy metering devices and determine the final state. According to the actual failures, the electric energy metering devices whose age were over 5 years can be sorted by city power supply company^[1].

In addition, all sorting work could also be carried out by power supply companies, and the sampling recheck on the electric energy metering devices that had been completed sorting work would be carried out by the provincial metering center, so as to check the sorting work.

6.2. Disposal after sorting

The electric energy metering devices to be verified (or to be tested) should be verified (or tested) before installation by the local power supply company within the specified period. The qualified electric energy metering devices could be installed and reused, and the unqualified fault electric energy metering devices could be sorted according to the unqualified items, such as to be scrapped.

The electric energy metering devices whose state was to be scrapped should be submitted to the scrapping application by the municipal power supply company on a monthly basis, then the on-site or sampling technical appraisal would be carried out by the provincial metering center. The reason for the non reuse and the disposal method of scrapping were specified by the appraisal report which should be issued by the provincial metering center for the electric energy metering devices passed the appraisal and verification. Then the scrapping disposal of the electric energy metering devices should be completed by the local power supply company. The sorting and disposal analysis should be carried out again for the unqualified electric energy metering devices, according to the verification opinions.

The electric energy metering devices whose stste was to be compensated should be checked and handed over by the provincial metering center and the supplier on a regular basis. At the same time, the specifications, technical requirements and delivery time limit of new products should be specified. The new electric energy metering devices arrived after replacement should be registered, and the full inspection and acceptance should be completed. After verification, the unqualified electric energy metering devices should be compensated again, the qualified electric energy metering devices should be distributed. If the supplier failed to complete the supply within the agreed time limit, the supplier would be included in the supplier performance evaluation.

The electric energy metering devices whose state was to be repaired should be returned to the factory for repair within the agreed time limit, the repaired electric energy metering devices should be verified for the first time in the provincial metering center.

6.3. Disposal of electric energy metering device under special circumstances

The electric energy metering devices which were often damaged due to some unexpected circumstances should be taken special treatment. The customer should be responsible for the compensation because of the damage and loss of the electric energy metering devices caused by the customer. The customers should be communicated in time, the notice of compensation for the electric energy metering devices would be filled in, and the compensation would be paid to the business office of the unit in charge of the equipment by the customers. The information of compensation collection would be fed back with the asset team and the competent department of the equipment timely. The scrapping procedures for the compensated electric energy metering devices would be handled by the asset team.

If the electric energy metering devices were lost, the management unit should immediately call the police to help investigate and recover. For the equipment that cannot be recovered, the unit where the equipment was located should issue a description of the reason for the loss of the equipment. After being confirmed and signed by the person in charge of the unit under the jurisdiction of the equipment, the relevant supporting materials and equipment loss instructions should be filed, and the asset loss process should be handled.

In case of damage to the electric energy metering devices in the process of storage, distribution, delivery or installation, the provincial metering center or power supply company should contact the manufacturer for back of the electric energy metering devices to factory maintenance, and implement relevant responsible person, damage reason, compensation measures, etc. For the electric energy metering devices that could not be repaired, the "Fault analysis report of electric energy metering devices caused by the accident" should be prepared and submitted to the marketing department of the provincial company and the provincial metering center. After approval, the scrapping procedures of the metering assets could be handled.

7. TECHNICAL APPRAISEMENT AND SCRAP DISPOSAL

7.1. Technical appraisal

After sorting, the electric energy metering devices could be divided into four states: to be verified, to be repaired, to be compensated and to be scrapped. Among them, the electric energy metering devices in three states: to be verified, to be repaired and to be compensated could be reused after being verified as qualified, which will become qualified in the storage room and wait for re-installation and operation. The status of the un reusable electric energy metering devices was to be scrapped which would be technically identified. The qualified part would be scrapped regularly and the unqualified part would be sorted again.

For the electric energy metering devices that met the scrapping conditions, the modules with relatively independent and good functions, such as the carrier module and tail cover of the electric energy meter, the remote communication module, carrier module and antenna of the acquisition terminal, the switch of the metering cabinet, etc. should be stored by category and used as spare parts.

Firstly, the to be scrapped electric energy metering devices should be submitted for scrapping application, and the technical appraisal of the electric energy metering devices would be carried out by the provincial metering center, finally the verified qualification devices would be scrapped. The electric energy metering devices that did not meet the scrapping requirements through technical identification should be sorted again.

For the electric energy metering devices to be scrapped which were not installed and operated should be sent to the provincial metering center for testing, and the relevant reasons should be

explained. According to the actual fault of the electric energy metering devices, the relevant scrap type should be selected. The equipment scrap types were shown in Table II.

7.2. Scrap disposal

After the scrapping was approved, the measured assets should be drilled according to the asset scrapping approval form, and the factory certificate, measurement seal, verification certificate, asset barcode, nameplate, etc. should be removed or damaged, and destroyed in a centralized way.

TABLE2 REASON CLASSIFICATION OF EQUIPMENT SCRAPPING

Scrap type	Scrap type breakdown
Quality inspection and supervision	eliminate
	Functional obsolescence
	become due
Fault replacement	fault
	Damage
lose	lose
other	other

8. CONCLUSION

The disposal processing flow and the characteristics of each link for the fault disposal of the electric energy metering devices were analyzed in this paper, the overall process was sorted out and the work flow chart was designed. Then, the requirements of each link of the process were studied, the disposal methods of each link were clarified, and the special situations were summarized. The consistency of electric energy metering devices faults handling was realized and the handling efficiency was improved.

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