

Equipment for Anti - Electricity Stealing with Remote Monitoring

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Abstract—The power theft monitoring is an important research in electric power system, and electricity-stealing prevention became a big problem to the electricity board. based on the kind of electricity-stealing and actual demand of prevention of stealing electricity, the equipment of electricity-stealing with remote monitoring is designed, with PIC microcontroller as the control core. In this the standard energy meter and user energy meter are used to calculate and judge whether electricity-stealing happen or not. Results of the user application show that the system not only realizes monitoring the behavior of electricity stealing, accurately recording the time of electricity-stealing occur and finish, the quantity of electricity-stealing and sends the information to the area field man through SMS to detect the electricity-stealer , but also realizes the behavior of electricity-stealing with remote monitoring, which is convenient for centralized management .In addition, the system offers a solving method to the data of meter reading.

Keywords- Electricity-Stealing, Remote Monitoring , Electricity Energy Meter.

Introduction

The power theft monitor is an important research in electric power system, and electricity-stealing is the chief problem facing by the electric board people. Due to electricity stealing , lot of electricity generating companies are running under losses. so to overcome their losses they are taking adverse decisions like increasing the cost/unit etc..Electricity-stealing is a long term problem, however, each power supply department has made huge investments of manpower and material, the phenomenon of defending stealing electricity has increased and not abated, and the method of electricity-stealing is

continuously improved. The behavior of electricity-stealing not only makes the power industry suffering huge financial losses but also threatens the main power supply security and reliability. Due to the kind of electricity-stealing and actual demand of preventing electricity stealing , based on that equipment of electricity stealing with remote monitoring is designed, which not only monitors the time electricitystealing occur but also offers the electricitystealing quantity and sends the SMS to the local field man to catch the thief with positive proof to handle lawbreakers with the behavior of electricity-stealing.

I. The Analysis of Electricity- Stealing Method

The metering of electric energy meter is mainly according to the relationship with voltage, electric current and power-factor angle. if any factor is changed, electric energy meter slow turning, stalling and even reversal will be caused, so the purpose of electricity-stealing is attained. According to the analysis, there are many electricity-stealing trick about electric energy meter, the methods could be approximately divided into undervoltage, undercurrent, phase shifted and difference expansion (DE) to their principles.

A. Stealing electricity by undervoltage technology

Electricity-stealer adopts all kinds of technology to deliberately change the wire splice of voltage circuit which metered by electrical energy, or make malfunction of measuring voltage circuit, voltage curve of pressure loss or both side of voltage decrease about the electric energy meter are caused, thus less measuring electric power is happened. Here are some more common tricks:

- 1) Unhooking technology of electricity-stealing. Secretly destroy the lead sealing of electric energy meter, open voltage hook of terminal in junction box,

and make no electric current through, all using quantity of electricity steal.(mostly used technique)

- 2) Loose zero curve technology. Open input zero curve of meter, ground output zero curve of meter.
- 3) One fire one ground technology. Take the ground wire as naught line, generally take the water pipe or caliduct as ground wire, the risk is bigger(most dangerous).
- 4) Violated wire connection.

B. Stealing electricity by undercurrent technology

Electricity-stealer adopts all kinds of technology to deliberately change the wire splice of electric current circuit which is metered by electrical energy, or makes malfunction of measuring electric current circuit, causes current curve of the electric energy meter through with no or part of electric current, thus less measuring electric power is happened. Here are some more common tricks:

- 1) Loop of short electric current, which makes the electric energy meter shift slow.(most used technique)
- 2) Cross meter to connect wire, added bypass to reel across electric energy meter, which makes no or less electric current through, stall or less measurement.
- 3) Exchange fire wire and zero wire.

C. Stealing electricity by phase-shifted technology

Electricity-stealer adopts all kinds of technology to deliberately change normal wire connection of electric energy meter, takes use of specifically connecting method of inductance or capacitance to change the normal phase relationship of voltage and current in the loop of electric energy meter, thus the electric energy meter shift slow even reversal is happened. Here are some more common tricks:

- 1) Reverse the in and out fire wire. Make electric current in the current coil reverse, and the electric energy meter reverse.
- 2) Make the electric meter reverse by using external power supply. Adopt hand generator with voltage and current output or inverter power supply to joint into the electric meter, make the electric energy meter reverse rapidly.(rarely used technique and dangerous)

D. Stealing electricity by difference expansion (DE) technology:

Electricity-stealer disconnects electric energy meter privately, adopts all kinds of technology to change inner structural performance of electric energy meter to cause itself error increase. Make use of current or mechanical force to destroy electric energy meter, and change its installation conditions, to make less

electric energy record. (this condition can be avoided by using digital energy meter).

Besides this above four electricity-stealing methods, the worst is that the user in private draw or connect wire disorderly to steal electricity without reporting enter, this stealing method with no meter always causes people injuring and fire accident easily, and so on. They should be enforced and punished strictly.

II. System Hardware Realization

A. System composition

The system has two parts, they are the link method facility and remote terminal facility in control room, principle as shown in the Fig.1, Fig.1 (a) is the remote terminal facility in control room, Fig.1 (b) is the link method facility.

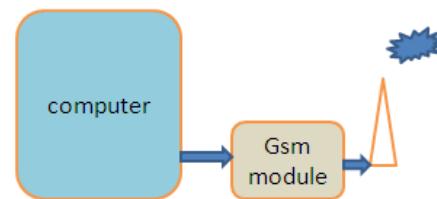


Fig.1 Remote terminal facility in control room

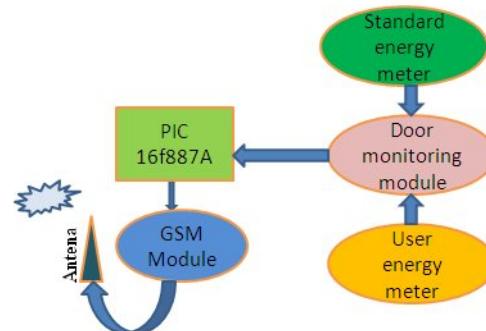


Fig.2 link method facility

The remote terminal facility in control room is made up by personal computer (PC) and GSM communication module. The special monitoring software is installed in PC to realize monitoring quantity of electricity in one pot and the state of electricity-stealing in long-distance. The link method facility is made up by PIC microcontroller, GSM communication module, door monitoring module in the user's meter, and standard energy meter module.

GSM communication module realizes the wireless data transmission by using GSM mobile networks, transports the data to the remote terminal facility in control room in real time, these data contain the time of electricity-stealing , pocket door, and information of stealing to field man and so on .

B. The principle of system implementation

1) Link method of on-spot monitoring facility

It is a series link method which is used between standard electric energy meter and the user's single-phase electric energy meter. Standard electricity measure module is connected in series between the user single-phase electric energy meter and fire wire, zero wire of enter user, the output of standard electricity measure module and the user's single-phase electric energy meter are separately photoelectric isolated, then outputted to the microcontroller to measure electricity. The link principle is shown in Fig.2.

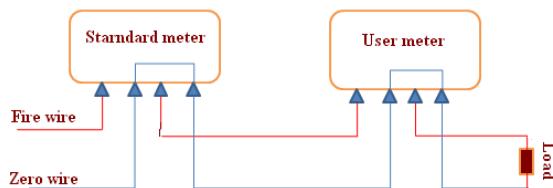


Fig.3 Series link method

2) Electricity-stealing defense principle of link method facility

The using circuital voltage and current are monitored by standard electricity measure module in real time. When loaded by using electricity, standard electricity measure module outputs impulse which has a proportional relationship with power (the number of output impulse per kilowatt), the output of user singlephase electric energy meter also has a proportional relationship with power. If electricity-stealing is took place, the user singlephase electric energy meter cannot measure accurately, then discrepancies will come up between the number of output impulse in standard electricity measure module and user single-phase electric energy meter in unit time, it is considered electricity-stealing happen or user electric energy abnormal when the discrepancies accumulative total arrives certain level. When the abnormity of electricity measure impulse in two paths is monitored by system software in control room, current time is record, the beginning time of electricity-stealing and alarm information are transmitted to the fieldman through GSM network.

At the same time, system separately counts the output impulse of standard electricity measure module and user electric energy meter, calculates the current real electric consumption and electric energy consumption record by user electric energy meter, this two difference value are the number of user Electricity-stealing after stealing electricity. When electricity-stealing is finished, standard electricity measure module output impulse is in keeping with user single-phase electric energy meter, system considers electricity-stealing finish, and the software detects the stealing and displays the error message on the screen where the stealing is happening/happened and at the same time the details of the stealing are sent to the area fieldman through GSM network. System monitor the state of user's measuring pocket and standard measuring pocket. When measuring pocket door is illegal opened, magnetoelectricity which installed in measuring pocket is cut down by switch due to loose the magnetic field action. The illegal opened door is detected by the microcontroller(PIC 16f887A) .the information of opening time is sent to the remote control room. Then an message is displayed in the display in control room and at the same time the meter id where the meter door is opened is sent to the area fieldman through GSM network. If workers of electricity department need to do a relevant check to the user's measuring pocket, when ever they got special command from the control room.

IV. System Software Designing

A. The software of remote terminal facility in control room

The software of remote terminal facility in control room was developed by VC++ language, and embedded C.

Control software interface is showed in Fig.3.

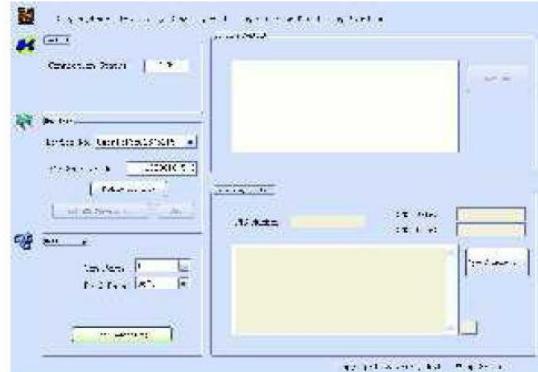


Fig.3 Remote software interface in control room

B. The software of link method facility

The software of link method facility adopts embedded C language, realizes collecting the output impulse signal of standard electricity measure module and user single-phase electric energy meter by using two paths of the terminal signal in external. realizes I/O signals, and also the control of GSM communication module by using serial port. Fig.4 gives out software control flow.

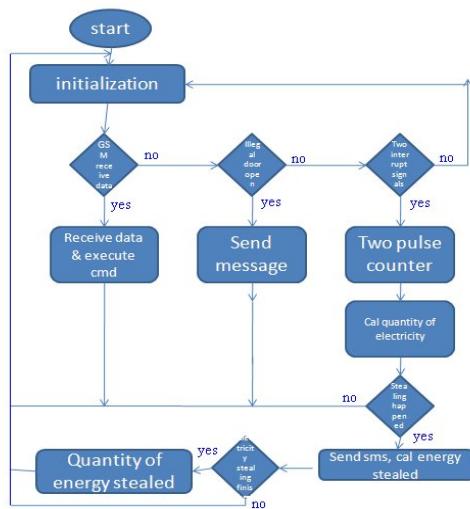


Fig.4. Software flow block diagram of on-the-spot monitoring facility

After system is powered on, firstly the initialization work of microcontroller memory and each module are carried, the initialization parameters of each memory and functional module are set up. Later, the system will separately judges the state of receive data of GSM communication module; the door of measuring pocket; and two paths of impulse signal, once the change of each state is tested, the corresponding function subprogram will be run, they conclude the command of receiving data and alarm when the door of measuring pocket is opened, computation about electricity quantity and the state of electricity-stealing, GSM alarms remotely when electricity-stealing and memory of the quantity of electricity-stealing are happened, and so on.

III. System experiment

In order to test the system performance, standard user electric system is constructed in library; artificial behavior of electricity-stealing is imitated. When electricity-stealing starts, link method of monitoring facility begins to alarm electricity-stealing to the remote terminal facility in control room. After finishing electricity-stealing, the quantity of

electricitystealing and finish time to the remote terminal facility in control room and also sends the information to fieldman to catch the thief red-handedly. Make use of the standard electric energy meter of class 0.5 in the library to monitor the quantity of electricity-stealing, the five times measuring results showed in table 1. It can be seen that the maximal relative error is +0.57% in the five times simulation from Table I, the accuracy is reached with the metrical requirement of electric energy meter.

Table 1 . Contrast data of quantity of electricity-stealing

Serial number	The device	Standard electricity measures quantity (kWh)	Error (kWh)
1	1.056	1.050	0.006
2	1.118	1.123	-0.005
3	1.106	1.104	0.002
4	1.008	1.004	0.004
5	1.020	1.022	-0.002

IV.Conclusion

Due to electricity-stealing the electrical companies are running in losses and also the power quality is degrading. so to degrade the electricity stealing by catching the thief's with redhead by the information given by this technique, this method is developed . equipment of electricity-stealing with remote monitoring is designed, which realizes monitoring the time of electricity-stealing occur and finish, offering accurate compute of electricity-stealing quantity, and intimation will be given to fieldman based on GSM network. It turns out that, the system can accurate monitors the behavior of electricity-stealing, giving alarm prompt in time, reduces losses of electricity-stealing to the minimum, decreases country property loss. In addition, system offers a solving method to the data of meter reading.

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