Judgment and Analysis on False Wiring of Electric Energy Metering

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Abstract. In the electric energy metering device, due to errors of a current transformer or a voltage transformer phase sequence and polarity, wiring false often happens in the electric energy metering device. It affects the accuracy of electric energy metering device and results in inaccurate metering. For this reason, it is necessary to analyze, check and calculate correction coefficients of the error electric quantity, after that you can obtain electric charge refund correctly. This paper lists several common false wiring and inspection methods of three-phase and three-wire electric energy meter. Through the analysis of the vector, it can deduce active power expression of the electric energy meter false wiring, calculate correction coefficient, and confirm electric charge refund.

Introduction

The electric energy metering device is used as a scale of the trade settlement charge. There is close relationship with inaccurate metering electric energy, cost accounting, reasonable scheduling, saving electricity and strengthen the administration of enterprises. It is not only related with economic benefits of the power supply enterprise, but also power user and problems that families care about. Because the power generation possesses continuous completing characteristic of generating electricity, supplying electricity, transmitting electricity and consuming electricity, and it is not interrupted and stored in the middle[1, 2]. In order to ensure electricity safety, design and maintain metering device, power supply enterprise is responsible for it all the time. Due to varieties of electrical properties, many electricity enterprises, especially it is not free to power failure in the process of smelting, on the one hand, checking whether the wiring of metering device with keeping electric is correct or not; on the other hand, how to determine what kind of false wiring after wrong connection, and precisely calculate the error electric quantity[3]. It is important to reasonably apply the electric charge refund. It needs metrology members not only seriously carry out national law, regulations, professional verification regulations, standard, but also possess and master necessary field analysis, basic knowledge and ability of fault estimation. After that it ensures fair and justice of metering, to make “the government and people satisfactory”.

Wiring inspection of voltage circuit

Because three-phase and three- wire electric energy meter contains various and probabilities of false wiring, it is not easy to judge errors while appearing wrong connection. These electric energy meters measure large amount of electricity, so the influence and results are serious. It's necessary to inspect wiring before commissioning or in operation. There are two methods about power failure checking and keeping electric checking[4, 5].

Power failure checking generally takes inspecting wiring method, and it can find out false wiring. For the electric energy metering device of power failure checking, it's important to keep electric checking after commissioning. Methods and procedures of keeping electric checking:

(1) Measuring the secondary voltage wiring inspection

While measuring U_{12}, U_{23}, U_{31}, the values are nearly equal and 100V. If you find out three line voltages inequality and there are large differences, it shows that there are disconnections,disconnecting the insurance or winding polarity in a voltage transformer primary

side and secondary side.

1) For a voltage transformer of V/V connection, if there are 0V,50V in line voltage, it may be disconnection in primary side or secondary side. When one line voltage is equal to 173V, it shows that there is winding polarity in a voltage transformer.

2) For a voltage transformer of Y0/Y0 connection, if there is 57.7V in line voltage, it may be disconnection in primary side or there is winding polarity in a voltage transformer.

3) Using meter to measure values, if it appears disconnection, no matter what kind of wiring method is used; the connection line voltage is equal to 100V. According to the distribution, the other two voltages are based on the distribution of load impedance.

(2) Measuring phase sequence of three phase voltage

Voltage terminal a,b,c of the phase sequence table is correspondingly connected with voltage terminal a,b,c of the electric energy meter, and this method can measure voltage phase sequence. The condition conforms to regulations of wiring diagrams. You can also use volt-ampere phase meter to measure phase angle of U_{12}, U_{23}, U_{31}. The result can judge phase sequence of voltage. Sometimes it can also judge phase sequence of voltage through multi-function electric energy meter with voltage phase sequence indicator function, such as MB3 of Weisheng and Hengtong III meter. If the phase sequence is the reverse sequence, liquid crystal display possesses the reverse sequence indicator.

(3) Checking earth point and giving phase

Connect one end of a voltmeter with ground, the other side connects the voltage terminal of the electric energy meter, and it can judge grounding of a voltage transformer.

1) If three sides of a voltmeter are zero, it shows that secondary side of a voltage transformer doesn't connect with ground, and can't form loop.

2) Two sides of a voltmeter are 100V, one side is 0V. It shows that two single phase voltage transformers connect with V, may be three single phase voltage transformers or a three-phase and five pillars voltage transformer connect with Y, their B phase connects with ground, pointer that is zero is B phase. According to phase sequence, it must deduce A phase and C phase.

3) Three sides are $100\sqrt{3}$ V, it shows that a voltage transformer is Y wiring and its neutral connects with ground. In this case, it can't judge one phase.

Connect one end of a voltmeter with the voltage terminal of the electric energy meter, the other side with long insulated wires connects secondary side of a voltage transformer. Using methods that same-phase voltage is 0V and out-phase voltage is 100V to judge different phase. Disconnect primary side B phase fuse of a voltage transformer, and line voltage that secondary side is 0V is B phase voltage. If using above methods can't judge phase, you can also use measuring vector diagram methods to judge correctness of electric energy meter.

Wiring inspection of current circuit

(1) Measuring the current order

Disconnect A phase or C phase voltage, and observe whether electric energy meter is rotating or not. When you check it, you must disconnect A phase or C phase voltage terminal of electric energy meter, and electric energy meter disc is rotating.

1) If disconnect A phase, electric energy meter disc isn't rotating. It shows that current circuit of second element may be short circuit or disconnection.

2) If disconnect C phase, electric energy meter disc isn't rotating. It shows that current circuit of first element may be short circuit or disconnection. Especially attention, when power factor COSΦ=0.5, measuring power of first element is 0. For this case, disconnect C phase voltage at the same time; connect C phase voltage to terminal of A phase voltage, measuring power of first element.

$Pa=U_{cb}I_aCOS150^\circ=-1.732UI$

At this time, there is obvious reverse in electric energy meter, otherwise A phase current circuit may be short circuit or disconnection.

(2) Determine the current transformer for reverse polarity

Use clamp ammeters to measure first element,second element and current of concentration wire. Secondary side of A, C phase current transformers respectively access current terminal of electric energy meter without concentration wire. When you measure concentration wire current, you can combine two phase to measure current. If three-phase load is balanced, measured values is equal; If concentration wire current value is $\sqrt{3}$ times as much as the other phase current, there is reverse polarity of transformer.

Pay attention, measuring methods of concentration wire current can't judge reverse polarity of two transformers.(concentration wire current value is value of the single phase current, but direction is reverse).

(3) Judgment correctness of current loop grounding

Use a short-circuit wire with two terminal clips, and one side connects with ground, the other side connects current terminal of electric energy meter. If you can't connect with ground, current coil is short circuit by ground wire, current of current coil is shunted, electric energy meter disc rotates slowly. When you connect terminal with ground, rotating of electric energy meter doesn't change, you can judge which terminal connects ground and judge it by this way.

If you don't use above methods to judge connection of electric energy meter, you must use B phase voltage methods, voltage cross methods or phasor methods to check whether connection of electric energy meter is right or not.

There are phase methods analysis and judgment false wiring methods.

Calculation of error electric quantity

Except for correction connection, false wiring of electric energy meter needs to calculate error electric quantity of false wiring. According to practical situation, you can implement electric charge refund. If you calculate error electric quantity, you must obtain correction coefficient of false wiring, which can calculate circuit actual electricity consumption during false wiring.

There are testing,calculation two methods in calculation of correction coefficient.

(1) Testing method:

According to false wiring, original electric energy meter is still operating. According to correcting wiring, access a relative error qualified electric energy meter, select representative load and power factor operates in a period of time, you can calculate correction coefficient G.

G= correcting wiring electric quantity of electric energy meter/ false wiring electric quantity of electric energy meter

(2) Calculation method:

In any case, measuring electric quantity is proportional to the load power. According to power expression of electric energy meter, you can calculate correction coefficient.

$G=P_0/P$ (1)

Correcting wiring power expression/ false wiring power expression

According to correction coefficient G, you can calculate circuit actual electricity consumption W_0.

$W_0=GW$ (2)

W—electricity consumption during false wiring

Error electric quantity:

$\triangle W=W0-W=(G-1)W$ (3)

There is relative error in the electric energy meter, when calculate error electric quantity, you must correct electric energy meter own errors. At this time:

$\triangle W=W0-W=GW/(1+r\%)-W$ (4)

R is the relative error of electric energy meter during false wiring. The calculation results, if △W is positive value, it shows that electricity customers should pay electricity bills, if ΔW is negative value, it shows that the company gives electricity bills back to electricity customers.

For some false wiring, error electric quantity can't be calculated and calculate correction coefficient G. If you can't calculate false wiring of error electric quantity, electric charge refund is based on electricity regulation.

The instance 1

A three-phase and three-wire 10kV high voltage user, the ratio is 1000, table base goes 5300 to 4700 during false wiring, power factor is 0.866, how much is electric quantity during false wiring?

1) Calculate power expression during false wiring firstly:

P＝-2UIcos(30°-φ)

2) Calculate correction coefficient:

$$G=\frac{P_0}{P}=\frac{\sqrt{3}UICOS\Phi}{-2UICOS(30°-\Phi)}=\frac{\sqrt{3}UICOS\Phi}{-UI\sqrt{3}COS\Phi-UISIN\Phi}=-\frac{\sqrt{3}}{\sqrt{3}+tg\Phi}$$

When power factor is 0.866, tgΦ＝0.577

$$G=-\frac{\sqrt{3}}{\sqrt{3}+0.577}=-0.75$$

W_0=GW=-0.75×（4700-5300）×1000＝450000kW·h

So the electric quantity is 450000 kW·h during false wiring.

The instance 2

A three-phase and three-wire user, the ratio is 1000, meter reading indicator of electric energy meter is 4500 in last month, and equipment is repaired after a few days, when equipment is repaired well and transmitting electricity, table base is 5000. Due to repairing, it causes false wiring, make electric energy meter reverse. When you check it, meter reading indicator of electric energy meter is 4800, the error of reverse electric energy meter is -4%, load power factor cosΦ＝0.866(capacitive character), meter reading indicator of electric energy meter is 6000 after correction. How much is practical electricity consumption this month?

1) Calculate power expression during false wiring firstly:

P＝-UIsinΦ

2) Calculate correction coefficient:

$$G=\frac{P_0}{P}=\frac{\sqrt{3}UICOS\Phi}{-\mathrm{UIsin}\Phi}=\frac{\sqrt{3}UICOS\Phi}{-UISIN\Phi}=-\frac{\sqrt{3}}{tg\Phi}$$

When power factor is 0.866, tgΦ＝0.577

$$G=-\frac{\sqrt{3}}{0.577}=-3$$

Correct electric quantity during false wiring

$$W_0=\frac{GW}{1+r\%}=\frac{-3\times(4800-5000)\times1000}{1-0.04}=625000\ kW\cdot h$$

Practical electricity consumption of this month

$W=W_1+W_0+W_2$

W=(5000-4500)×1000＋625000+（6000-4800）×1000

W=500000+625000+1200000

W=2325000kW·h

So practical electricity consumption of this month is 2325000 Kw·h

Conclusion

The advantage of vector analysis method is versatility and systemic, and judge various of false

wiring methods, when you experience false wiring in practical work, you should think more, analyze carefully, combine other methods with practical work experience, you will find out false wiring methods quickly and correct in time.

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