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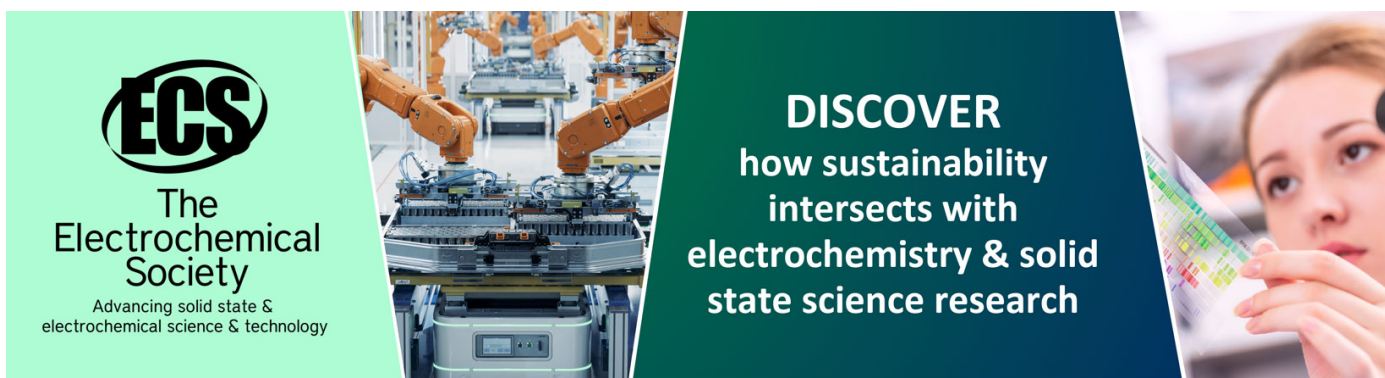
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Research on Dedicated Insertion Bar for Field Calibration of Energy Meter

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Abstract. The on-site verification of electric energy meters has become an indispensable part of power system equipment maintenance. Recently, under the call of the State Grid Corporation of China to further optimize the business environment, in order to reduce the time of power outages for customers, the “non-interruption meter replacement” business is also actively promoted. A special wiring board is installed in the single-phase energy measurement box to ensure replacement. The meter does not lose power, but this measure has greatly affected the on-site verification of the energy meter. This article is based on the new environment of “uninterrupted power meter replacement”, in-depth demonstration of the necessity, feasibility, and ease of development of a dedicated plug-in meter for the on-site verification of electric energy meters. Based on the premise of modularization, a special plug-in strip for the on-site verification of electric energy meters has been developed to ensure that the on-site verification of the electric energy meters is not affected.

1. Introduction

In recent years, the State Grid Shanghai Electric Power Company has focused on customer needs to further optimize the business environment and improve the quality of power services. With the active promotion of these new service measures, in order to reduce the power interruption caused by the replacement of energy meters, which affects residents and affects the electricity consumption experience of the residents, China National Offshore Electric Power Co., Ltd. has gradually adopted the “sensorless power outage” operation mode to promote residents' energy meters to be replaced without power outages. Table to further improve power supply reliability.

In order to realize the replacement of single-phase smart energy meters without power outages, it is necessary to install a “dedicated wiring base plate” in the single-phase energy metering box, and use them in conjunction with the “non-power failure meter replacement plugs” to provide solid equipment for the work of replacing the energy meters without power failure.

However, due to the installation of a “special wiring board for non-interruptible power meter replacement” on the site, this has a great impact on the field verification of single-phase energy meters. The previous method of field verification and wiring cannot be used, and the on-site energy meter calibration cannot. Wiring makes the on-site verification work impossible. In order to adapt to the “special wiring board for non-interruptible power meter replacement”, it is necessary to complete the



on-site verification of the energy meter and make corresponding changes to the on-site verification and wiring method of the energy meter.

This article is based on the new environment of "uninterrupted power meter replacement", in-depth demonstration of the necessity, feasibility and manufacturability of the development of a dedicated plug-in meter for the field test of electric energy meters. Provide a theoretical basis. At the same time, with the on-site verification as the starting point, the premise of safety, and the modularization as the idea, a special plug-in strip for the on-site verification of the energy meter was developed to ensure that the on-site verification of the energy meter is not affected.

The uninterruptible power meter replacement device is currently only used domestically, and it is the first of its kind for the State Grid Shanghai Electric Power Company. Therefore, the field test dedicated plug-in board is also the first for the State Grid Shanghai Electric Power Company, and is used in the field test of energy meters.

2. The wiring method of the original single-phase energy meter on-site verification

Because Shanghai uses the virtual load method for the on-site verification, before the verification, first cut off the power meter outlet switch, unplug the power meter's incoming fuse, and then connect the on-site energy meter calibration device to the power meter wiring circuit. The voltage loop of the energy meter field calibrator is connected in parallel to the energy meter wiring loop, and the current loop is connected in series to the energy meter wiring loop. The actual site wiring diagram is shown in Figure 1.



Figure 1. Actual wiring diagram of on-site verification of electric energy meter.

3. Impact of New Type "Special Wiring Substrate for Uninterrupted Power Meter Replacement" on Site Verification

With the "Uninterrupted Power Meter Replacement" business, more and more dedicated uninterruptible power meter replacement wiring boards are applied to the scene (as shown in Figure 2 left). During the on-site verification of single-phase watt-hour meters, due to the structural design of the special wiring baseplate for uninterrupted power meter replacement, the strong electric terminals of the watt-hour meter are blocked (as shown in the right of Figure 2), so the voltage and current test leads of the field calibrator cannot be directly connected. The wiring to the single-phase energy meter being tested cannot be verified on site.

This affects the normal operation of the on-site application of the energy meter, and the energy meter has to be removed and transferred to the laboratory for verification. This not only greatly affects the efficiency of the on-site verification, but also takes a long time for the application process of the energy meter for the customer. The increase is contrary to the call of the State Grid Corporation to further optimize the business environment.



Figure 2. Schematic diagram of special wiring baseplate for uninterrupted power meter replacement.

4. Design of special plug-in strip for on-site verification of electric energy meters

4.1. Design ideas for special field test strip

In order to completely eliminate the impact of the "special wiring board for non-interruptible power meter replacement" on the on-site verification work, it is imperative to design a special plug-in bank for on-site verification of electric energy meters. This plug-in strip can not only affect and destroy the normal function of the "special wiring board for uninterrupted power meter replacement" in the environment where the "special wiring board for uninterrupted power meter replacement" has been installed, but also ensure that the on-site verification work is normally performed.

In the design of the special plug-in for the field verification of the energy meter, the following basic requirements must be met at the same time:

- (1) The working principle must conform to the wiring principle of field verification work.
- (2) The structure must be compatible with the "special wiring baseplate for meter replacement without power failure".

According to the above two basic requirements, the design idea of the special plug-in for the field verification of the energy meter is as follows:

- (1) With reference to the wiring principle of the on-site verification work, complete the design of the working principle of the dedicated plug-in strip for the on-site verification of the energy meter.

The single-phase watt-hour meter terminal wiring is shown in Figure 3. The phase line current enters through the watt-hour meter terminal 1 and exits from the watt-hour meter terminal 2. The neutral line enters through the watt-hour meter terminal 3 and exits from the watt-hour meter terminal 4. The connector of the uninterruptible power meter changing device is provided with a pin guide hole for fixing, that is, the terminals 1, 2, 3, and 4 have a pin guide hole, which lays a foundation for the development of a special plug for field verification.

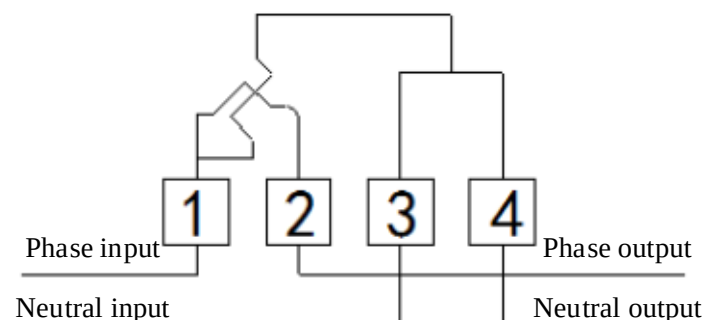


Figure 3. Energy meter terminal wiring diagram.

Dedicated plug-in strip for field verification is used to cooperate with the special wiring board for non-interrupted power meter replacement to realize on-site verification of energy meters. The structure includes (1) plug-in with insulation protection sleeve (retractable), (2) snap structure, (3) movable button (4) Front connection studs, as shown in Figure 4.

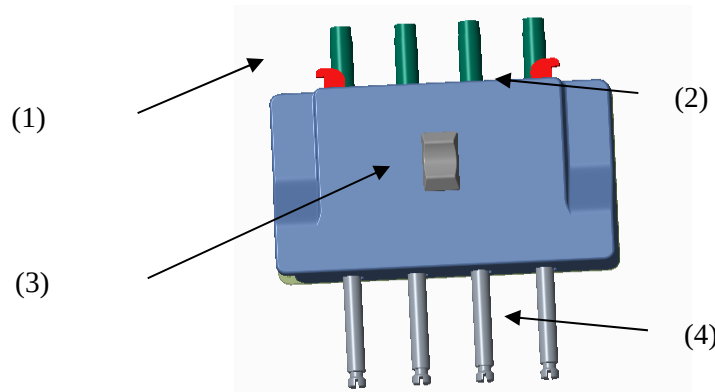


Figure 4. Structure chart for field test.

When the on-site verification of the energy meter is needed, remove the anti-theft cover plate, insert the four pins of the on-site verification special plug-in board into the four uninterrupted plug-in board guide holes of the safety protection baffle, and insert them securely. The tester's voltage and current test leads are connected to four front connection studs.

(2) With reference to the aperture and spacing of the "special wiring baseplate for non-interruptible power meter replacement", the structure and size design of the dedicated plug-in strip for the on-site verification of the energy meter is divided into five modules.

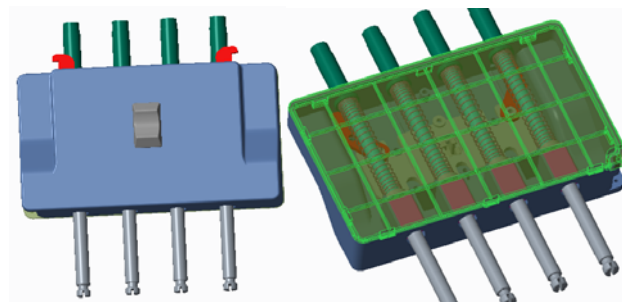


Figure 5. Structure drawing-upper and lower cover.

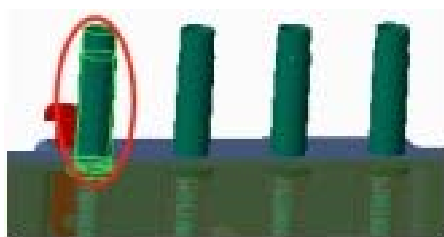


Figure 6. Structure drawing-sleeve.

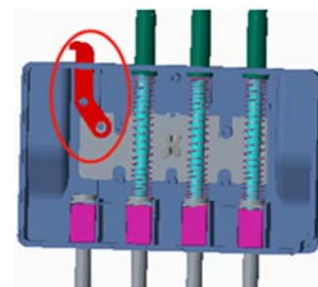


Figure 7. Structure drawing-buckle structure.

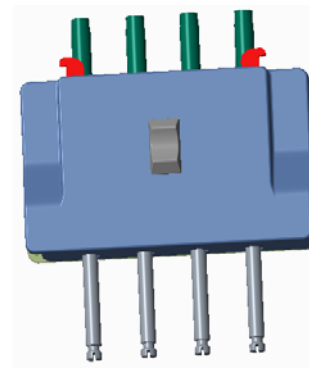
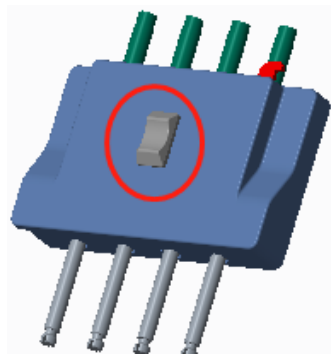


Figure 8. Structure Diagram-Activity Button. **Figure 9.** Block Diagram-Front Connection Stud.

4.2. Ideas for Trial Production of Dedicated Plug-in Prototype Machine for Field Verification

Since the dedicated plug-in meter for the field test of the energy meter is a hardware product developed for the first time and trial-produced, its structural applicability and overall coordination must pass multiple rounds of experimental verification to finally form a mature product. It is considered that 3D printing technology is used in the process of prototype production. The flow chart of trial production is shown in Figure 10.

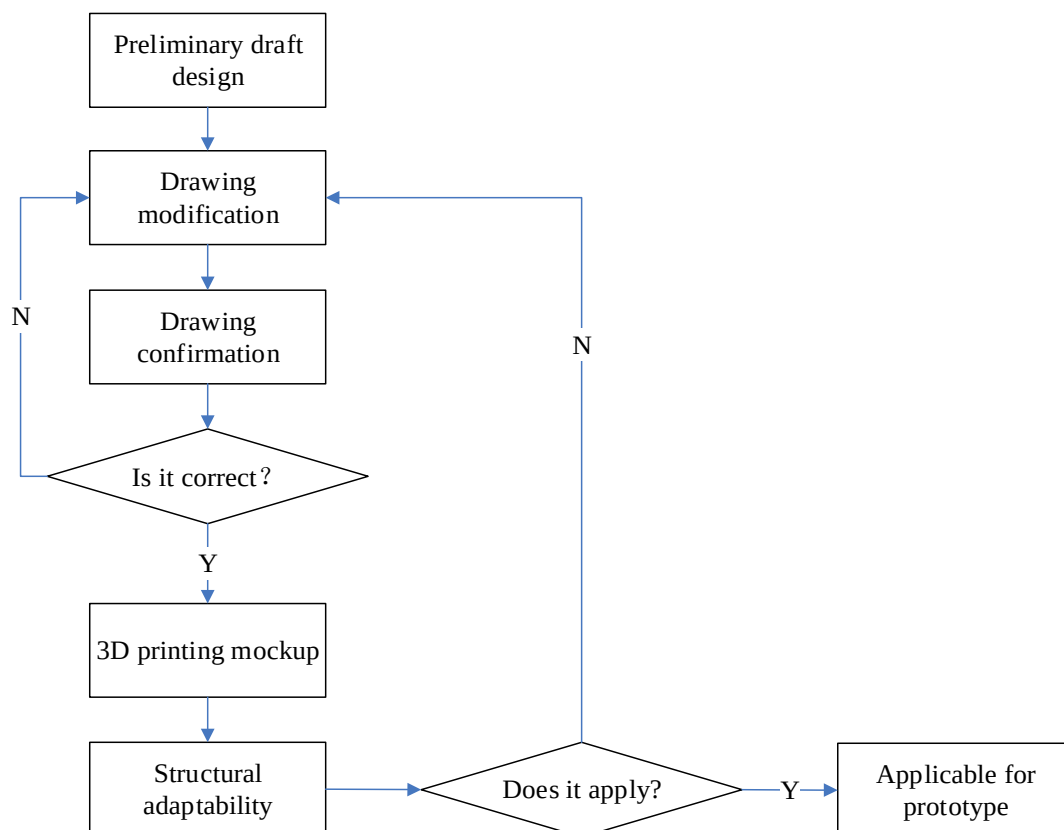


Figure 10. Flow chart of trial production of special insert.

4.3. Trial Ideas for Dedicated Plug-in Prototype on-site Verification

Since the special plug-in strip for the on-site verification of electric energy meters is a hardware product developed for the first time and trial-produced, its applicability and effect must be determined after actual trial. The trial method of the dedicated plug-in strip for the on-site verification of the energy meter

adopts the scheme of laboratory test and then field test. Both schemes use the PDCA cycle method to control the test quality, that is, plan, execute, check, and process. Comprehensive testing and trials in functions, reliability and other aspects.

5. Conclusion

In this paper, the necessity, feasibility, and ease of development of a dedicated plug-in meter for field verification of electric energy meters are thoroughly explored and demonstrated, and a dedicated plug-in meter for field verification of electric energy meters is developed. In the environment where power outages and meter replacement are increasingly popularized, the on-site verification of energy meters is not affected. In the early stage of product trial production, economic efficiency is mainly considered, and 3D printing technology is used as the prototype setting method. In the later stage, it is recommended to use standard molds for mass production.

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