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switchgear secondary equipment based on plug
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Study on the quick reconstruction scheme of switchgear secondary equipment based on plug and play technology

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Abstract: The secondary equipment in the switchgear has complex transformation period, difficult construction and long time consuming. How to improve the efficiency is a problem in the engineering transformation. To solve this problem, this paper adopts the “plug and play” design concept to realize the modular assembly of new equipment through the equipment framework, and to set the green terminal flange of original equipment at the rear of the module and complete the cable wiring to new equipment to achieve the prefabricated wiring of the cable during the on-site transformation. A quick transformation scheme for the wiring-free equipment is proposed. The scheme may significantly shorten the transformation time and improve the operation and maintenance efficiency, and the application effect of the scheme is verified combined with the engineering application of the 110kV substation.

Key words: plug and play, secondary equipment, wiring-free, design, quick

I. Introduction

In the substation, the primary equipment has long service life and the secondary equipment has relatively short service life. The first batch of digital protection has been running for more than ten years, the aging of secondary equipment is getting more and more serious and the reliability gradually declines, posing serious hidden dangers to the safe and reliable running of the power system, so it needs to be transformed urgently. However, during the transformation, the re-wiring of

impact of the transformation scheme.

To solve the above problems, a quick transformation scheme for secondary equipment in the substation based on the “plug and play” technology is proposed, with reliable plug-in, and simple, flexible and quick replacement of equipment, which can simplify the field work and improve the work efficiency.

II. Status Analysis

Because a different scope of transformation is required for each substation, there is no clear code requirements for the transformation scheme of secondary equipment in the 10kV (35kV) switchgear. The current situation of the transformation of secondary equipment in the 10kV (35kV) switchgear is as follows:

A. The switchgear of primary equipment in the substation shall not be transformed and the external cables on the switchgear shall not be changed, and only the protection of the secondary equipment shall be transformed;

B. The switchgear of primary equipment in the substation shall not be transformed, and the secondary protection equipment shall be transformed and the secondary cables are required to be re-arranged;

These two transformation schemes require a lot of manpower and effort both in terms of scheme design and on-site construction, and the error rate of these two

transformation schemes is also high. How to provide a simple and reliable operation and maintenance method when the board to be transformed of secondary equipment in the switchgear is replaced is a problem that needs to be solved urgently.

As for the above problems, this paper conducts the analysis and research based on the “plug and play” and designs an adapter board on the secondary equipment, to realize the modular assembly of new equipment through the equipment framework and to realize the plug and play of secondary equipment and the wiring-free transformation of secondary equipment through the adapter board, which will improve the transformation efficiency and ensure the transformation quality.

III. Design principle

A kind of installation frame is designed based on the field dimension and the heat dissipation of secondary equipment. With device framework integrated design, installation, integration, integrated wiring, installation, integration after installation of the product can completely replace the secondary protection device, the protection device after replacement, the original device terminal plug received adapter plug directly connected to design a device with the original corresponding adapter plug-in and a corresponding to the second replacement equipment installation frame, connecting plug-in based on "plug and play" mode, to realize the scene of secondary equipment modification backup terminal zero connection. The overall framework designed is shown in Fig. 1:

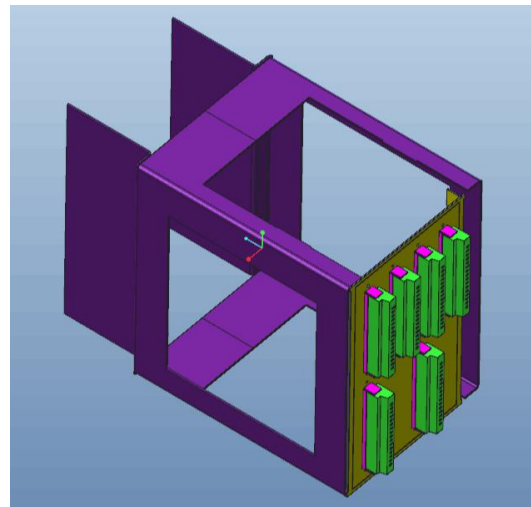


Fig. 1 Overall Framework Diagram

IV. Analysis of Key Technologies

The “plug and play” technology means that new external equipment is automatically connected into the system and the system automatically recognizes configuration changes, completely without the need for manual intervention. It has been widely used in various fields as the concept of industrial standardization technology. The use of plug and play technology can make the whole system have easy operation, high efficiency, reliable data collection, flexible display and convenient dynamic configuration.

The entire “plug and play” design in this paper includes three key technologies: design of adapter board technology, design of terminal layout of adapter board and design of installation method. Each of these three key technologies is described in more detail below.

A. Design of Adapter Board Technology

The analysis of replacement of wiring terminals of 820 series for those of XJ’s 820C series secondary protection equipment is conducted. The common wiring terminals of 820 series low voltage equipment are of SFUN’s F16-MSA-5.08 type, with 16-core wiring and terminal pitch of 5.08mm, and they are installed on the equipment with the plug-in method and the conversion terminal is considered to be used for conversion. The current terminal is integrated with the current board and the current connection is directly connected to the equipment board. The wiring removal and wiring must be conducted on site again and the conversion is not

considered temporarily.

(一) Selection of conversion terminal

After comparison, the conversion terminal model is determined to be F16-IC-STGF-5.08, which has the following advantages:

- 1) It is fully compatible with F16-MSA-5.08 series terminals.
- 2) It is connected to F16-MSA-5.08 series terminals in a plug-in method and may achieve the plug and play on site.
- 3) Both F16-IC-STGF-5.08 and F16-MSA-5.08 are provided with reinforced screw flanges for reliable connection.
- 4) The screw connection after the terminal conversion is realized.



Fig. 2 F...-MSA-5.08 Plug Terminal Diagram



Fig. 3 F...IC-STGF-5.08 Socket Terminal Diagram



Fig. 4 F...-MSA-5.08 and F...IC-STGF-5.08 Plug-in Diagram

B. Design of Terminal Layout of Adapter Board

Based on the backplate wiring board of secondary equipment, an adapter board self-adaptive to replace the on-site equipment is designed. After analysis, the adapter boards of 820C series equipment are designed to include six F16-IC-STGF-5.08 terminal modules and have the same number of terminal modules as that of terminal modules of 820 series protection equipment. Considering that the boards may be inserted in the wrong position on site, the same order and layout in the same direction are used in the design. When the boards are inserted on site, there is no need to check the corresponding boards one by one, and the direct conversion can be used to avoid mis-insertion. As shown in Fig. 5:

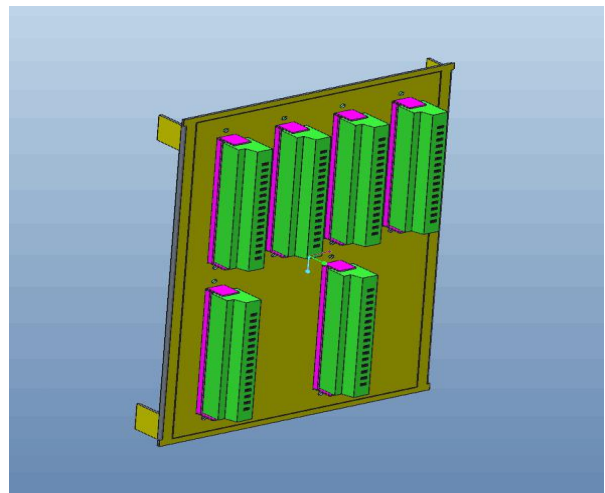


Fig. 5 Layout Scheme of Terminal of Adapter Board

C. Scheme Design of Equipment Framework

Based on the wiring of on-site switchgear and the difference between secondary protection equipment before and after the replacement, the equipment framework is designed by considering various factors such as heat dissipation performance of equipment and others. It is necessary to meet the depth and existing hole size of on-site switchgear, and also to meet the transformation effect of the whole switchgear after the transformation.

Taking the secondary protection equipment before and after the replacement installed on the switchgear by XJ as an example, the framework transformation scheme is designed based on the following two factors:

1) WXH-820 and WXH-820C have different hole sizes and fixing methods.

WXH-820 hole chart and WXH-820C hole chart are as follows:

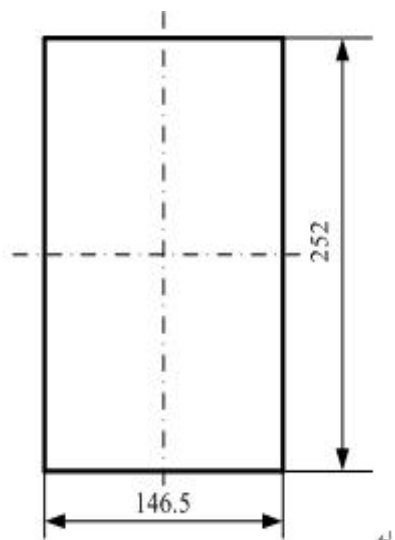


Fig. 6 WXH-820C Hole Chart

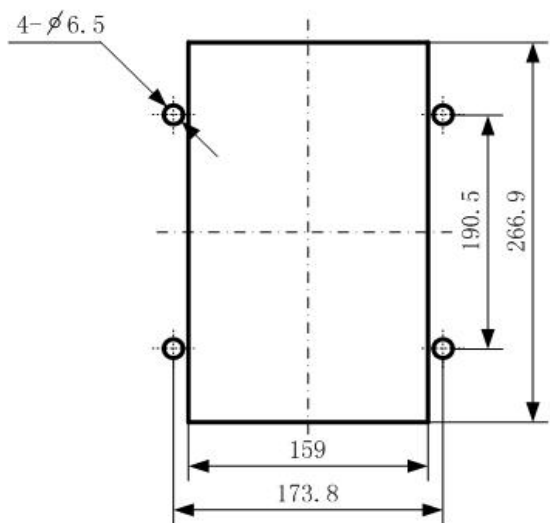


Fig. 7 WXH-820 Hole Chart

As can be seen from the figures, WXH-820 is fixedly installed by screws, while WXH-820C is installed by the embedded method, and the hole size of these two series secondary equipment is not the same and the hole size of WXH-820 is slightly larger than that of WXH-820C. The new secondary equipment cannot be holed on site, and if the new secondary equipment is directly installed on the on-site hole, the aesthetics of the whole switchgear will be affected; therefore, there is no need to open a hole on site, but it is necessary to add a corresponding installation framework so that WXH-822C can be installed in the hole of the original equipment in the

switchgear.

2) The cables in the on-site switchgear cannot be moved.



Fig. 8 Installation Plan of Secondary Equipment Room in Switchgear

As can be seen from the above figure, the cables in the secondary equipment room are hard cables and have been bundled and fixed. Therefore, the adapter board can only be installed in its original position to use the original cables.

The installation framework is designed by considering the above two problems, which not only meets the on-site hole size and installation method, but also does not change the position of cables in the switchgear, so that the new equipment can be seamlessly installed in the original hole of the switchgear.

The installation framework protrudes 100mm from the switchgear panel, leaving room for wiring between the adapter board and the equipment terminal, without changing the position of original cables.

When wiring, the protection terminal is wired to the switching module and the cable mark is made based on the time and the connection position to facilitate maintenance. Measures for handling cable bundling and crossing: the wrapping band, flexible metal conduit and other materials are used to wrap the cables and the cable crossings are wrapped separately for protection, to ensure that the cables are neat and insulated from the outside.

The protection equipment, installation framework and adapter board are packaged, transported and installed on site as a whole. The overall installation effect is shown in the figure below:

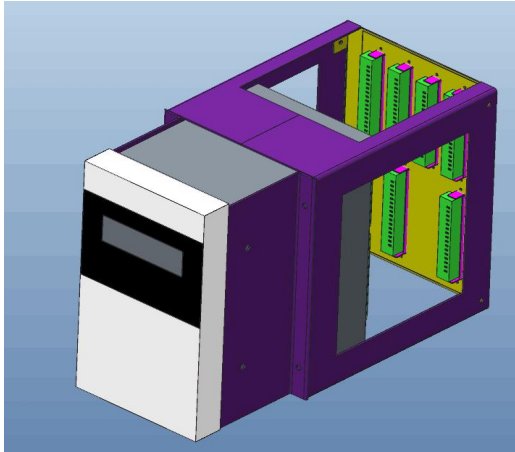


Fig. 9 Integrated Installation Diagram of Adapter Board,

Installation Framework and Equipment

D. On-site Implementation Scheme

The protection equipment, installation board and installation framework of secondary equipment in the factory are factory-processed and assembled, and sent to the site after the wiring is completed. The real-time scheme flow after arriving at the site is as follows:

1. Pull out the terminals of original protection equipment
2. Remove the original protection equipment
3. Install the new protection equipment
4. Conduct the current terminal wiring, status terminal inspection and power grounding terminal wiring
5. Plug in the cables in the switchgear
6. Conduct the commissioning of the whole unit of equipment

V. Case Analysis

The design scheme adopts the “plug and play” technology, which can completely replace the on-site protection equipment in the protection function, installation size and external wiring, and can realize the quick transformation of secondary equipment in the substation. To verify the feasibility and practicability of the quick transformation scheme, Yaozhai 110kV substation in Zhengzhou is selected as a pilot project. The transformation scale of the project is: one 35kV line, six 10kV section I busbar lines, four 10kV section II busbar lines, one station service transformer protection, one capacitor protection, one standby automatic switch-in protection, and a total of 14 secondary

equipment. Compared with the conventional two schemes, the comparison chart in hours is shown in Fig. 10.

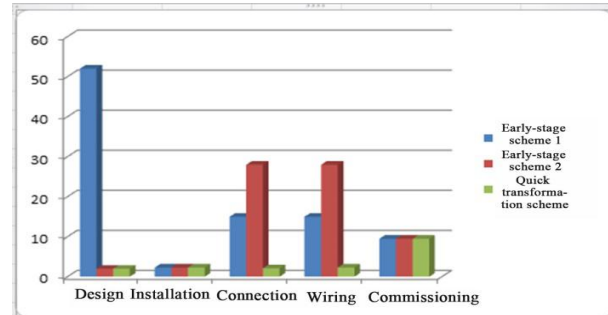


Fig. 10 Comparison of Three Transformation Schemes

As can be seen from the above figure, the transformation period of the scheme is shortened by more than 70%, the transformation workload is reduced by more than 80%, and the transformation efficiency can be improved by more than 3~4 times. Therefore, it can effectively solve the contradiction between shortage of maintenance personnel in power companies and large workload for transformation.

VI. Conclusion

The design scheme is applied to the transformation of secondary equipment in the switchgear and promotes the optimization of substation transformation design scheme and the innovation of operation and maintenance technology and management through the plug and play. The application of the scheme makes it possible to apply the full life cycle of the substation. The application of the scheme will shorten the overall transformation period of the substation, improve the work efficiency and management level of substation design, operation and maintenance, and play an important role in promoting the cost saving, energy conservation and environmental protection.

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