

# Study on Maintenance and Test Method of Primary Equipment in modern substation

Biao Cai\*, Fuqun Zhang

State Grid Zhenjiang Power Supply Company, Jiangsu, china

\*zfqtz@126.com

**Abstract:** In the modern social and economic development, residents and industry more and more high demand for electricity utilization, electricity quality requirements increase, so in order to ensure the safety and stability operation of substation, to strengthen the supervision of power system at the same time, attach importance to an equipment maintenance and test work, and integrate the past problem effective prevention measures are put forward. In substation work state, a device as a foundation for the application of grid design content, practice quality directly affect the efficiency and safety of power grid, so this article in the understanding of modern substation operation condition, on the basis of an equipment and maintenance according to the common sense, key research with computer technology platform as the core equipment maintenance and testing methods, This provides an effective basis for ensuring the long-term development of electric power enterprises.

**Keywords:** Substation; Primary equipment; Maintenance and repair; Test method; Transformer

## 1. Introduction

As urbanization gradually accelerated, and the city electricity quantity gradually rise a substation equipment as part of the basis of construction of power system operation, practice quality directly affect the efficiency of the whole system, so in front of the substation work demands more and more high, the electric power enterprise and the staff to strengthen the maintenance and testing of a device, Pay attention to master more valuable data information so as to lay the foundation for the sustainable development of the power industry. [1.2.3]During the operation of the power supply system, regular detection and maintenance of the equipment can not only avoid too many safety problems, but also effectively control the cost and reduce their safety hazards during the work. At the same time, the staff of each department can quickly understand the efficiency of the equipment according to the test results, and thus formulate a scientific and standardized maintenance plan, to ensure that the equipment can play an important role in the power system. Understanding the operation of modern substations shows that a large number of electrical equipment installed in them are mainly used for monitoring, conversion, protection, stopping and other basic operations. The primary equipment refers to the content related to receiving and distributing electric energy and changing electric energy voltage. It needs to withstand high voltage in the working state, so it is also known as a high-voltage appliance or equipment. The most representative primary equipment is:

First, power transformers. The significance of substation is to reduce high voltage to low voltage based on transformer. When the power transformer is working, it can transfer the electric energy from its primary side to the secondary side through the conversion of electromagnetic energy. At the same time, the voltage will be increased or decreased according to the demand of transmission and distribution. The main components of the main transformer are body, oil tank and box cover, protection device, cooling system, etc., as shown in Figure 1 below:[4.5]

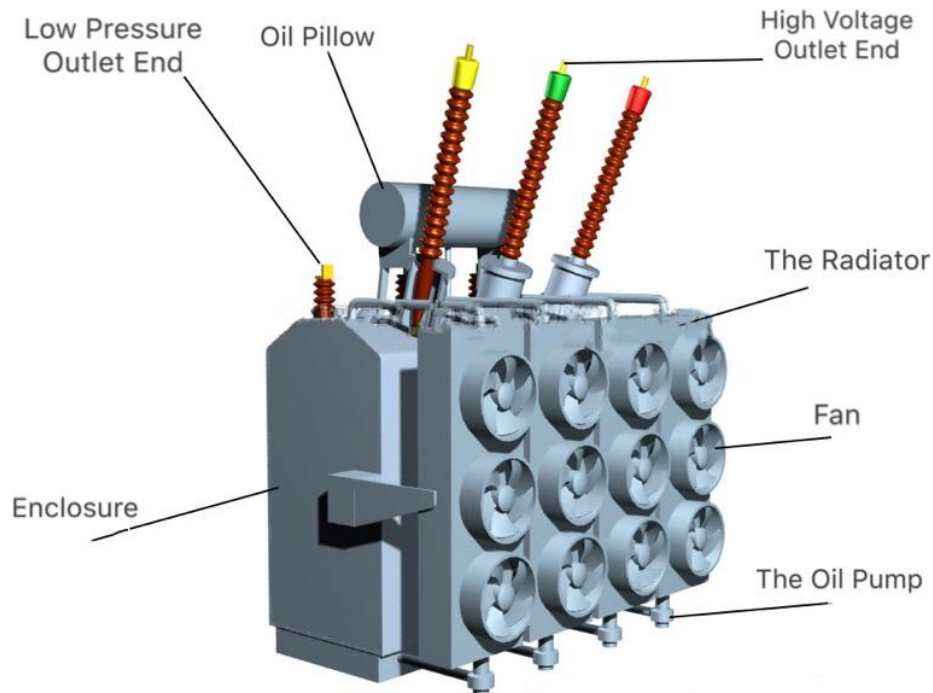


Figure 1 Structure diagram of the main transformer

Second, the bus. This equipment will be connected to each electrical interval, its role is to collect, distribute and transmit electrical energy, so that the stop power transmission operation is flexible, and can facilitate the maintenance and handling of all connected electrical equipment on the bus;

Third, high pressure circuit breaker. This equipment is one of the most important and complex electrical equipment in a power system. It has a perfect arc extinguishing device and high speed transmission mechanism, can connect and disconnect the current in the high voltage circuit under various circumstances, to complete the change of the main wiring movement mode and remove the fault circuit as soon as possible. From the point of view of the operation of the power system, the high voltage circuit breaker is mainly used to break the load current and no-load current when the power system is normal. It can be cooperated with the relay protection and automatic device to quickly cut off the short-circuit current.

Fourth, disconnecting switch. This Equipment Is A Kind Of Switchin Equipment Without Special Arc extinguishing device, in the opening state has obvious visible fracture, in the closing state can reliably pass the normal working current and short circuit fault current, but can not be used to break the normal working current and short circuit fault current. The main function of the disconnecting switch is to isolate the power supply, cooperate with the circuit breaker to complete the reverse operation and point, close the small current;

Fifth, current transformer. The current transformer plays the role of current converter and electrical isolation. It is in the power system measuring instrument, relay protection and other secondary equipment to obtain the electrical primary circuit current information of the sensor, the high current proportional to the low current conversion;

Sixth, voltage transformer. The busbar voltage transformer converts high voltage into standard secondary voltage of 100V or lower grade in proportion for protection, measurement and instrumentation. At the same time, the voltage transformer can isolate the high voltage from the electrical workers and simplify the secondary equipment.

Seventh, the lightning arrester. The zinc oxide arrester makes use of the good nonlinear voltage-ampere characteristics of zinc oxide, so that the current flowing through the arrester is minimal at normal working voltage. When overvoltage action, the resistance drops sharply, release the energy of the voltage, to achieve the effect of protection;

Eighth, the reactor. The REACTOR can limit the short circuit current and high harmonic in the power grid, maintain the effective high residual voltage of the bus, and effectively limit the impact

of the short circuit current of the low-voltage side of the main transformer on the main transformer winding during the operation of the system.[6.7]

Now, our social economy has entered the development trend of world economic integration, how to meet the increasing power demand, the reasonable application of new technology and new equipment, to ensure that power system can output normally, to fully meet the needs of People's Daily life and social construction, is the main problem discussed in the power industry. One of the most representative is computer information technology. Assuming that the transmission and distribution system is regarded as a whole, the substation is the execution terminal of the whole system and the information source during the operation of the transmission and distribution system. The computer technology platform as shown in Figure 2 below can be used to further optimize the operation level of equipment maintenance and experiment. Especially under the background of the development of power system toward integration and intelligence, the design ideas and application methods of substation will also be reformed, so as to better meet the requirements of grid construction and provide high quality energy services for social residents. Therefore, on the basis of determining the development status of modern substation, according to the common application content of primary equipment, this paper determines the equipment maintenance and test methods with computer technology as the core, so as to provide an effective basis for improving the construction level of electric power industry.

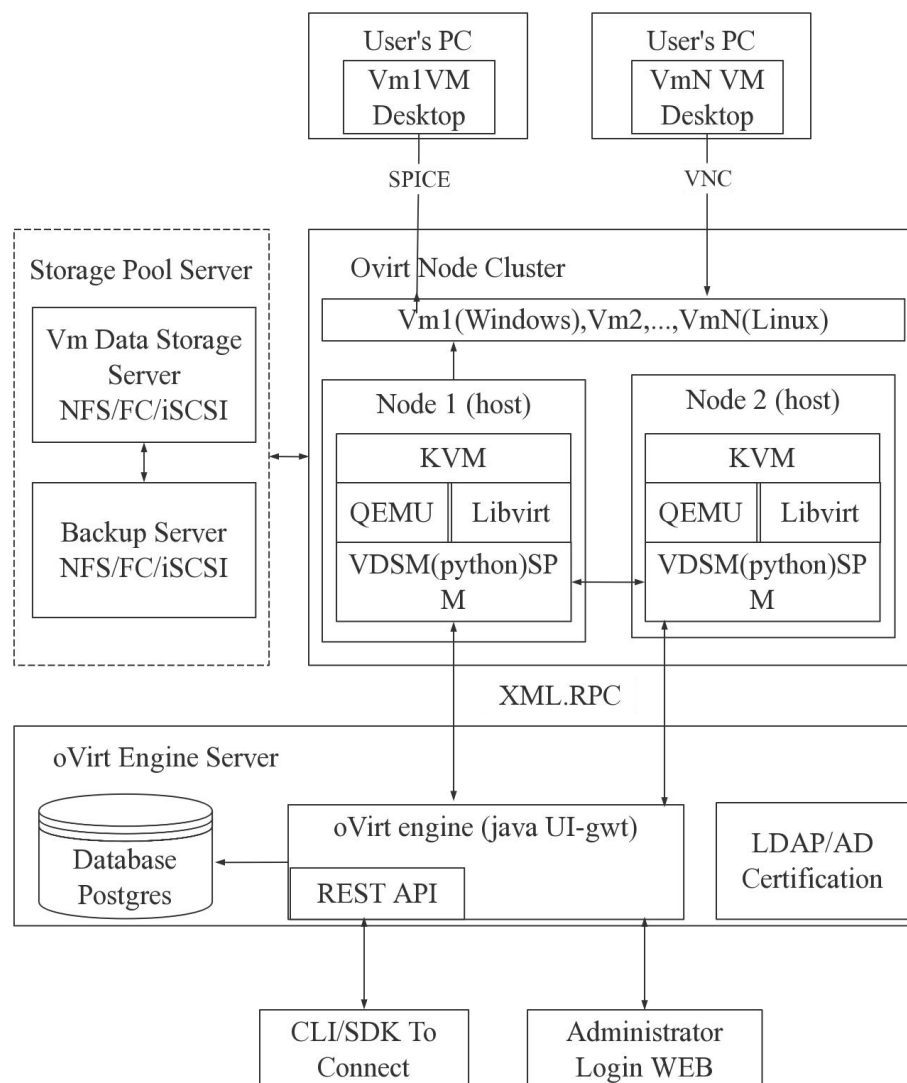


Figure 2 Computer technology platform

## 2. Method

### 2.1 Computer technology platform

In the process of substation operation, in the traditional sense an equipment maintenance and test analysis, mainly manual operation, but in the development of modern technology innovation, have scientific research scholars put forward to use computer technology platform for equipment maintenance and test analysis, both to reduce the data amount of calculation, reduce the pressure of the calculation of staff, It can also ensure that the power industry resources will not be excessive loss, according to the simulation experiment for accurate judgment, in order to develop effective solutions. Taking substation insulation detection as an example, the specific detection module is shown in Figure 3 below:[8.9]

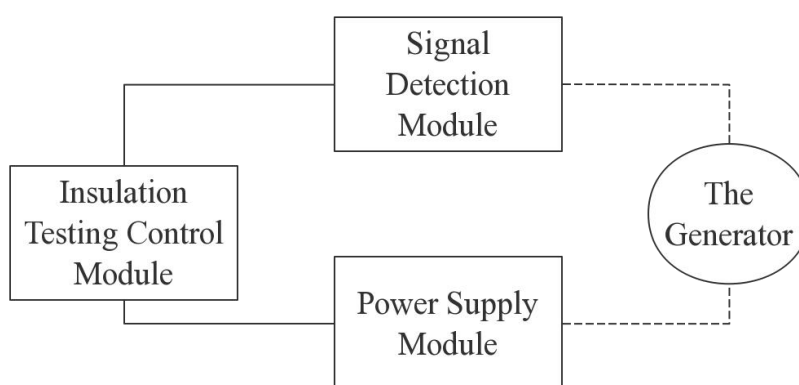


FIG. 3 Module design of insulation detection

### 2.2 Equipment Maintenance

First, transformers. As the basic content of the construction and operation of modern substation, this equipment directly affects the operation quality of power transmission and other equipment. The most common faults are: first, the sound is abnormal. According to the structure analysis of the power transformer, the sound has a certain rhythm under normal working conditions. However, if there is an internal fault, such as line grounding, circuit short-circuit and parts loosening, it is likely to change the sound and lead to noise inside the equipment. Second, the lead position is faulty. If the binding post is loose and the lead is loose, it is likely to lead to excessive temperature and poor contact in some parts of the equipment. If the workers do not deal with these problems in a timely manner, then it is likely to cause more serious safety accidents, such as transformer burning, hindering the normal operation of the power system and so on. Third, the transformer works in a humid environment. Appear the phenomenon is likely to lead to moisture directly into the device, make parts appear aging, so the staff according to the following test flow chart shown in figure 4, based on computer technology platform check transformer parts conform to the requirements of the work, to conduct a comprehensive assessment and design experiment, so as to avoid the impact of power grid operation stability.[9.10]

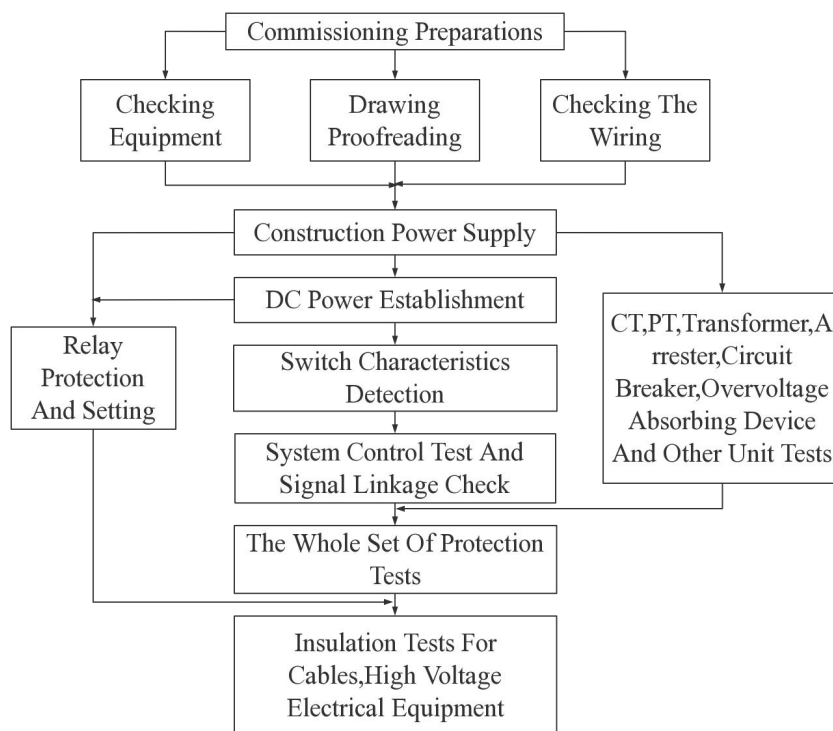


FIG. 4 Detection flow chart based on computer technology

Second, the isolator. This equipment needs to work with the circuit breaker to achieve a block connection in a modern substation. In the process of using the switch, it is likely that the fault is the contact loosening, which leads to the poor contact of the equipment, the temperature of some parts is too high, or the corrosion of the surface of the parts affected by moisture, which reduces the bearing pressure of the spring, and the oxidation phenomenon occurs in the contact area. In modern substations, when the isolation switch is used for partition, assuming that the applied force is small or too large, it is likely to lead to the deviation of the take-off and landing position and the temperature of pile head area will rise. Therefore, when checking this kind of equipment, the staff should focus on observing the color change and melting size of the contact position, and accurately judge the specific situation, so as to provide an effective basis for the follow-up test analysis and solution. The structure of the isolator is shown in Figure 5 below:

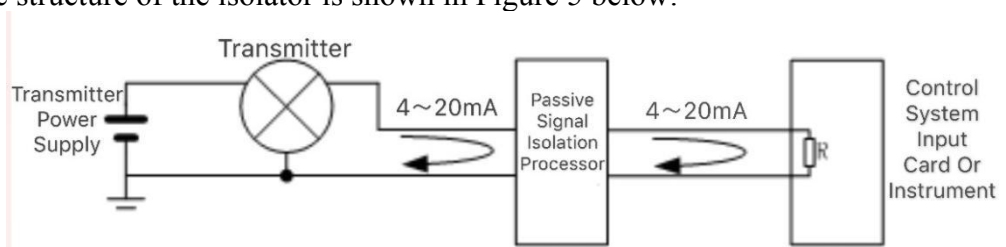


Figure 5. Structure diagram of isolator

Finally, the circuit breaker. This kind of equipment is used together with the disconnecter to ensure the stability of the overall operation of the line equipment. Common faults are reflected in the following points: first, due to mechanical failure can not be closed, the need for staff to manually open the gate, and in the remote control problems, the mechanical and electrical protection of the equipment will also be affected. Second, the energy storage of the circuit breaker fails to function. If the energy storage function of the circuit breaker is lost, then the corresponding travel switch will automatically fail, and the energy storage motor can not run intermittently, which leads to the failure of the on-off operation. Third, the closing coil is burned out. In the working state of the circuit breaker, assuming that there is a problem in the spring operation, it is likely to lead to a decline in the efficiency of energy storage. Finally, the spring operation will lose its effect, the

energy transfer of the closing can not be carried out, and the energy storage motor can not run intermittently. The structure of circuit breaker is shown in Figure 6 below:

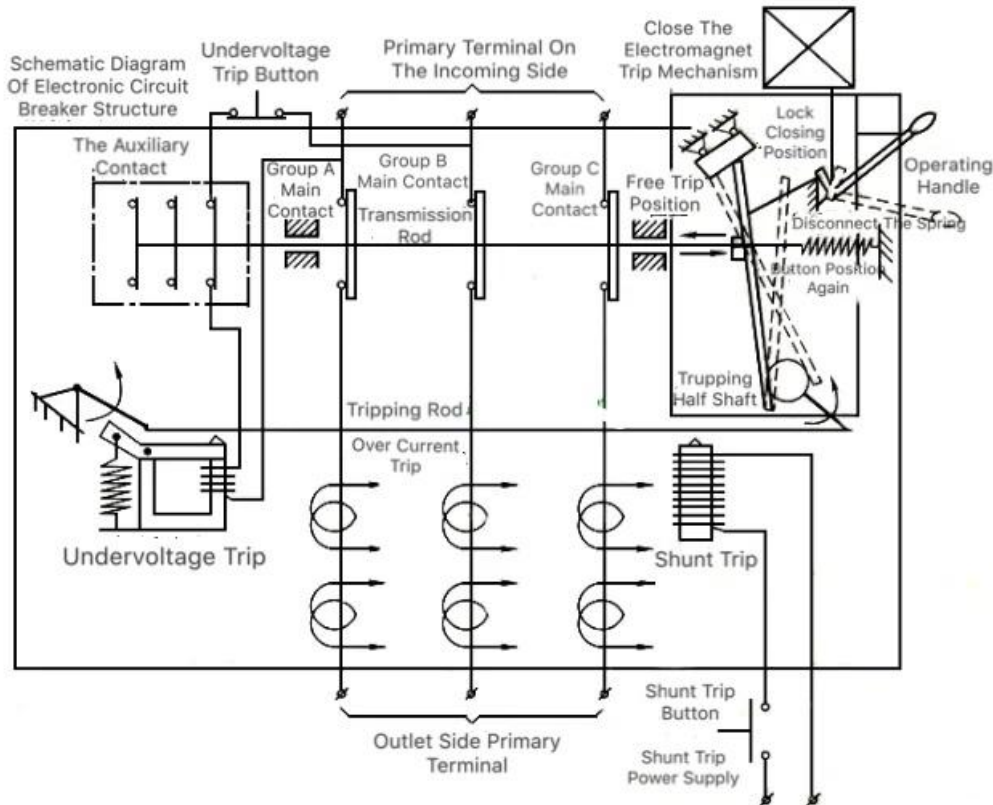


Figure 6 Structure diagram of circuit breaker

### 2.3 Equipment test

In this paper studies three at a time, in equipment repair work due to the high voltage power distribution device has the characteristics of safety performance is high, the operation requirements higher, so the test experiment is given priority to with insulation test, despite the related test equipment before the formal factory, and to the manufacturer to provide the quality meets the requirements document, but it's difficult to really understand the structure of the security from all file. Therefore, all parts of the equipment should be regarded as test objects, and a variety of methods should be combined to deal with. Combined with the analysis of the operation structure of the modern transformer grid system as shown in FIG. 7 below, it can be seen that after the fusion of local and high voltage detection, the obtained results are better, but the operation difficulty of the experimental method is likely to be increased due to the increase of the range and volume. In addition to the above three primary equipment maintenance test work, but also to carry out routine test, closing resistance value, main circuit resistance, infrared thermal imaging instrument and other aspects of detection and analysis, in order to judge whether the performance of all kinds of equipment is good.[10]

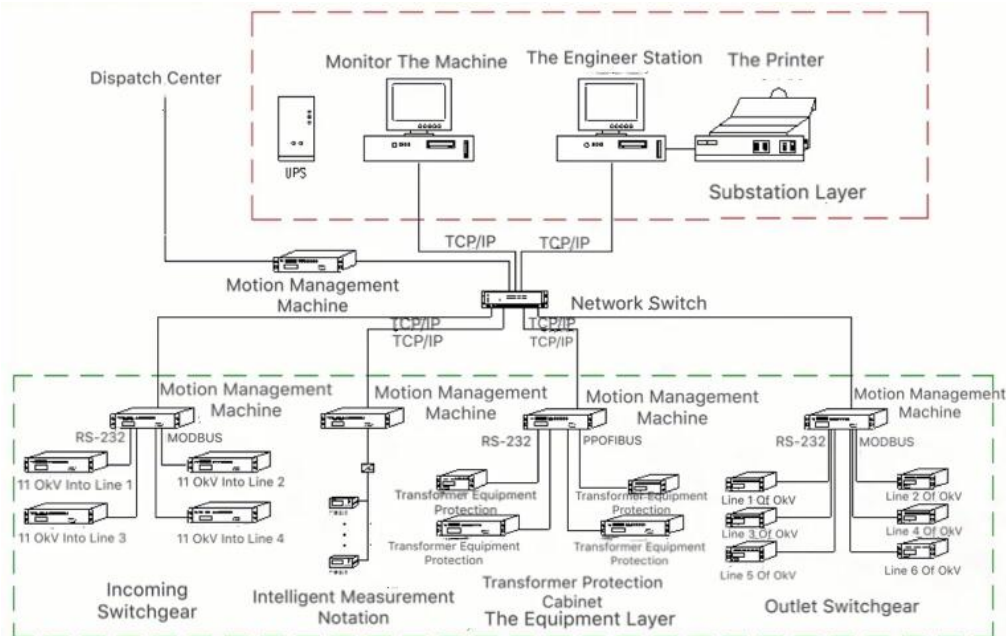


FIG. 7 Operation structure diagram of modern transformer grid system

### 3. Result analysis

Under the guidance of modern information technology, the reform pace of substation design in China is getting faster and faster, and scientific researchers begin to focus on whether the development direction of substation and the whole power system is consistent. Therefore, the overhaul and test method of a device should be transformed to the following two aspects: on the one hand, digitalization. Digital substation equipment technology has a positive influence on the operation of automation system. In the digital substation system, it is necessary to ensure that the primary equipment has intelligent characteristics and the secondary equipment has network characteristics. Assembly, on the other hand. In the process of substation equipment operation, the selection and analysis of the building form of full-time assembly structure should be combined, and the on-site assembly and installation method should be used to shorten the construction cycle of substation and gradually optimize the application quality of primary equipment. Especially after the State Grid put forward the development trend of "two types and one transformation", the assembly substation design scheme can better meet the development needs of power enterprises in the new era and conform to the goal of modern sustainable development.[11.12]

### 4. Conclusion

In summary, on the basis of understanding the design goals and technical scheme of modern substation in China, there are many problems in the study of the overhaul and test method of equipment, and the actual mastery of technical method and professional personnel is not in line with the development needs. Therefore, our country electric power industry in the integration on the basis of accumulated experience, based on a proposed new repair and test method, pay attention to learn from foreign advanced technology theory, actively cultivate high quality high level talents, pay attention to thinking from the long-term operation of power system, so after make effective solution, Improve the running environment of power system in our country, guarantee the application quality of all kinds of equipment parts, and finally provide effective basis for the practical development of power industry in the future.[13.14]

## Reference

- [1] Huan Cheng, Zimeng Tang. Overheat problem of primary electrical equipment in substation and maintenance countermeasures [J]. Electric Power Engineering Technology Innovation, 2022, 4(3):87-89.
- [2] Chunbo Cao, Yan Chen. Development and application of combined tool for live operation of primary equipment in substation [J]. Inner Mongolia Electric Power Technology, 2020, 38(4):4.
- [3] Lin Liu, Heng Qiao. Research on Primary Equipment maintenance and test method of substation [J]. Power Equipment Management, 2022(5):3.
- [4] Zhun Zhao. Maintenance Technology Analysis of Electric Equipment in Power System [J]. China Petroleum and Chemical Standards and Quality, 2022(016):042.
- [5] Bo Wei. Practical exploration of technical measures to prolong the maintenance cycle of blast furnace equipment [J]. Metallurgy and Materials, 2022, 42(4):3.
- [6] Zhijie Jia, Songhai Fan, Zhichuan Wang, et al. Mechanical Characteristics Protection and Maintenance of PD Detection Equipment for High Voltage switchgear [J]. Casting, 2022, 71(8):1.
- [7] Xuebao Xia, Zhimao Ming, Yunjia Yu, et al. Research on Simulation analysis method of ship equipment double-wave impact test [J]. Environmental Technology, 2022, 40(4):5.
- [8] Xijun Zhang. Analysis of Installation and maintenance method of mechanical and electrical Equipment in hydraulic pumping Station [J]. Integrated Circuit Application, 2022, 39(4):2.
- [9] Meng Xie. Research on Maintenance Equipment Automation of Hook and Slow Device of Railway Freight Car [J]. China New Technology and New Products, 2022(12):3.
- [10] Fang Yang, Xiaobo Luo, Chengxiu Zhou, et al. Main Equipment maintenance method based on AR technology [J]. Electrical Automation, 2022, 44(3):4.
- [11] Cheng Biao Zhang, Ya Xin Li, Wei Zhu, et al. Emergency remote maintenance method of power supply equipment under public health emergencies [J]. Electrical Automation, 2022, 44(2):85-87.
- [12] Zhiyong Chen. Analysis of the whole life cycle cost control method of thermal power plant equipment Fault maintenance [J]. China Equipment Engineering, 2022(4):2.
- [13] Yongli Zhang. Analysis of management and maintenance method of mining transportation equipment [J]. China Metals Bulletin, 2022(1):3.
- [14] Yu Ren. Welding Maintenance Safety Management of Large Open mining Equipment [J]. China Equipment Engineering, 2022(14):3.