New Method Research and Systematic Analysis of High Voltage Electrical Test in Power System

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Abstract. In the power system, the generator set is an important core equipment, and the state of operation of the generator set directly affects the reliability operation of the power system. The detection and research of high-voltage electrical test in power system can detect potential fault problems and deal with them in time, effectively ensuring the reliable operation of the power system. This paper summarizes the types and principles of high-voltage electrical tests, proposes improvement measures for the problems in high-voltage electrical test schemes, improves the accuracy and efficiency of high-voltage electrical test schemes, and effectively ensures the smooth operation of power systems.

1. Introduction
High-voltage electrical test technology is critical in the stability and safety assurance of power systems. Improvement strategies for high-voltage testing include establishing databases, handling lead problems, and applying online monitoring techniques to ensure the accuracy of the test and promote the safe operation of the power system. Under the theoretical study of the high-voltage electrical test in the power system, it can promote the good operation of the actual power system.

2. The necessity of high voltage electrical test in power system
The high-voltage electrical test is mainly used to detect the insulation performance of power equipment in the power system, and to ensure that the power equipment in the power system meets high-quality standards. Under normal circumstances, transformers, transformers and other equipment in the power system must pass the high-voltage electrical test to verify the basic performance of each power equipment, and promote the stable and efficient operation of the power equipment in the power grid. However, in the actual high-voltage electrical test, it will be affected by many factors and interfere with the final result of the high-voltage electrical test. Therefore, it is necessary to standardize the operation of high-voltage electrical test in combination with the requirements of the power system, and accurately evaluate the performance of various electrical equipment to ensure the high quality of electrical equipment and meet the operational requirements of the power system. There are many equipments in the power system. The high-voltage electrical test is used to test the insulation performance of electrical equipment, to ensure the safety and stability of electrical equipment in the power system, and to actively eliminate the hidden troubles of electrical equipment, so as not to affect the operation of the power system. The high-voltage electrical test provides the data basis for adjustment and optimization of the
power system equipment, prompting the equipment management personnel to grasp the operational status of the equipment, and regularly organize equipment maintenance and inspection work, gradually improve the efficiency of the electrical equipment, and strengthen the stability of the power system. Sexuality to prevent equipment failure during operation of the power system.

![Diagram](https://via.placeholder.com/150)

**Figure 1.** Theoretical study on the principle of high voltage electrical test

3. Overview of high voltage electrical test of power system

3.1. Test types

In the power system, if you want to ensure that the electrical equipment works well, you can use the high-voltage electrical test to carry out the parameters of the electrical equipment, and has many advantages, such as high safety, can resist more interference factors, and does not require too much manual operation. The equipment has a small space and there is a lot of room for development in the future. In the high-voltage electrical test of the power system, it mainly includes three aspects of the test: First, the electrical characteristics test of the line air gap. In order to avoid the negative impact of the adjacent tower on the test process, it is necessary to ensure a certain distance between two adjacent towers to ensure the smooth operation of the high-voltage transmission line. Under the premise that the ratio of the rod-plate is reasonable, it is necessary to ensure the whole the test process is safe, and the specific conditions of the test data are optimized to take into account the surrounding environmental factors and the actual operational problems of the personnel. The second is the series resonant withstand voltage test. The main purpose is to prevent the device from consuming more power without actually playing a role. Carrying out this test is beneficial to improve the reliability of the power output power, effectively improve the power output power, and ensure the stability of the entire electrical equipment under scientific adjustment.

3.2. Test principle

The principle of high-voltage electrical test is mainly introduced as follows: In order to accurately judge whether the characteristics and insulation of electrical equipment can meet the specifications for the operation of power systems, the staff should first apply high voltage to the electrical equipment to be tested, or use some Other incentives, so that you can know whether this electrical equipment can withstand the high voltage load, whether it will affect the normal operation of electrical equipment. The short-circuit point can be used for effective test. The short-circuit discharge is placed at the switch of the transformer group to ensure that current flows at both ends of the current transformer. Differential protection is used to ensure that the load of the generator set does not exceed the normal
range. The phase difference of the secondary current amplitude is maintained at 180 degrees, which reduces the difference between the range of the primary current value and the braking current, thereby facilitating the determination of the accuracy of the protection loop direction. The specific principle of the short-circuit test is as shown in the figure below. In the state of maintaining the short-circuit, the data of each transformer is recorded and analyzed. In the figure below, A, B, and C are three transformers, and a switches are placed at the maximum tap, B. The tap changer is placed at the rated tap and the C tap changer is placed at the minimum tap for the short circuit test. The main use of the electrical equipment to increase the current method to verify the equipment in the case of short-circuit faults, how to ensure performance, and then verify the correctness of the secondary circuit wiring to complete the test. The traditional genset protection device has a big drawback in performing the short circuit test. In the traditional generator set short-circuit test, it will consume a lot of manpower, material resources, and a lot of time, but it cannot guarantee the safety of the test process, and there may be a problem of CT secondary open circuit. With the rapid development of technology, more and more new protection devices are used in the short-circuit test, which makes the test show the characteristics of autonomy, integrity and safety. It can be used in the short-circuit test by utilizing the characteristics of protecting the secondary circuit wiring. The acquired data is analyzed to obtain the correct conclusion about the short circuit problem.

Figure 2. Short circuit test wiring principle

4. Analysis of current status of high voltage electrical test

4.1. Static test technology analysis
The static test technology of the high-voltage electrical test of the power system is to test the main protection logic function through logic test under the normal operation of the power system equipment, and effectively test the logic function. The logic test is to test the circuit in the power system in a logical manner through the grid relay electric protection test instrument. The static test technology can also use the loop test method to perform the pressurization operation from the far end of the generator to boost and test the voltage and current transformer, so that the safety and reliability of the voltage and current transformer can be operated. Authenticating.
4.2. Electrical start test technical analysis
Commonly used technical methods for electrical start-up tests include conventional test methods such as grid-connected loads. In practical engineering applications, the electrical start-up test technology can effectively guide the setting of the short-circuit point, but it is difficult to solve the difficulty of setting the short-circuit row at the switch. The electrical test in China is mainly carried out by simulation, and the secondary circuit in the system is tested in a dynamic manner. However, the evaluation of each protection performance can only pass the static test. The test method adopted in China has less time and economical savings. Fuel.

5. Power system high voltage electrical test problem solving measures

5.1. How to deal with grounding problems
When solving the grounding problem of high-voltage electrical test, the first thing to do is that the test staff should understand the cause of the grounding problem. At the same time, we must pay attention to the solution of the secondary winding problem of high voltage TV and TA. Dealing with this problem can be started from the safety and accuracy of measurement. Specifically, it is necessary to know the grounding of the port to ensure that there are no loopholes and mistakes. In addition, when conducting the AC withstand voltage test, the intensity of the capacitor current must be carefully tested to determine the specific voltage.

5.2. Lead problem
In the high-voltage electrical test, the electrical tester may not work objectively due to the absence of the insulating tape, which may result in conflicts between the obtained data and the specific data. In addition, the operation of the maintenance personnel is not in place, and the lightning rods are not completely disconnected, which affects the processing effect of the lead connectors, and thus malfunctions. Therefore, the electrical test personnel should thoroughly analyze the root cause of the lead problem, thoroughly remove the insulating tape according to the test specification, and reduce the probability of increase of the dielectric resistance to ensure the normal operation of the electrical test.

5.3. How to deal with voltage problems
First, the role of the voltage during the measurement of the DC resistance is guaranteed to function normally. If the voltage of the double-arm bridge is low, the resistance is large, the oxide film will not be broken down, and vice versa. The second is to ensure the normal effect of the voltage in the dielectric loss measurement, such as when performing the pressure test switching wiring. To adjust the regulator to the zero position, pull the knife of the test power supply and test it to prevent the danger.

5.4. Online Monitoring Technology
In the development of modernization, there has been an online monitoring technology for insulation of electrical equipment. This technology is more effective in ensuring the detection of equipment. For example, the technique of small-signal dielectric loss $\tan \delta$ measurement adopts the blind element separation technique and the denoising algorithm of orthogonal cancellation vector technology in the strong electromagnetic interference environment; the new soft magnetic material is used to successfully develop the angular difference and the variable ratio highly linear micro current sensor. After laboratory and on-site application testing, these new technologies have achieved higher performance and performance in similar studies in terms of accuracy and stability of dielectric loss factor $\tan \delta$ measurements.
6. Research on high voltage electrical test and detection in power system

6.1. Experimental study on short-circuit point setting
Feasibility analysis, in the method of short circuit row at the switch of the transformer group, the differential protection can be effectively verified. When this method is used, the two ends of the current transformer are simultaneously added to ensure that the load of the generator set is running normally, and the phase difference between the amplitudes of the secondary currents of the circuit is guaranteed to be 180 degrees, so that the magnitude of the braking current is The current values are similar, which can effectively infer the correctness of the direction of the protection loop. The short-circuit test records the short-circuit characteristics of the generator set. If the current flowing through the generator rises to the rated current, it is easy to cause the main transformer current to be large. Therefore, the design only gives the system a few minutes of power. In this paper, a new short-circuit point is set at the connection between the GIS and the high-voltage position of the main transformer, and the grounding knife is used as a short-circuit point by connecting the grounding knife. This design method integrates the current transformer of the main transformer internally, which causes the normal transformer to be charged. However, the current transformer is not charged, which will not affect the short circuit recording of the generator set. Therefore, the short-circuit point setting study is feasible.

![Figure 3. Analysis of test results of short circuit point setting in high voltage electrical test](image)

6.2. Loop protection test method research
The loop protection test method can effectively compensate for the deficiency of the static test for the differential protection direction verification. When the isolation switch between the main transformer and the busbar is guaranteed to be disconnected, the 380V three-phase AC power supply can be introduced, which can effectively power the power supply. Tested by connecting to the neutral point of the main transformer engine. In the whole process of the test, in order to ensure that the unit can withstand the test conditions, the current flowing through the current transformer and the neutral point
of the generator outlet is designed to ensure that the current is not too large. On the high voltage side of the main transformer, a test power supply of 380V three-phase AC is placed. The current flows from the current transformer on the high voltage side of the main transformer to the current transformer in the center of the motor.

6.3. Study on the test method for shortening the electrical start test time
Under the conditions of guaranteeing the test quality and target requirements, the idling time of the unit should reduce the fuel consumption, reduce the expenditure of the electrical test input, improve the test efficiency and ensure the safety of the unit. The electrical start test sequence diagram is shown in Figure 1. The design of shortening the electrical start test time, effectively utilizing the system running time, and improving the efficiency of the test work. When the short-circuit test is performed, the empty busbar is prepared, and after the busbar is reset, the busbar is operated correspondingly at the end of the short-circuit test. Through the method designed in this paper, the engine is subjected to the no-load test and then the subsequent tests are carried out in an orderly manner. During the test, the empty busbar was recharged. After the test, the busbar was charged, and then the parallel test was carried out. It was verified by theoretical and practical test that the design can greatly shorten the total test time.

![Figure 4. Analysis of test data at different temperatures](image)

6.4. Set the short circuit point at the exit switch of the generator unit
In combination with the above-mentioned short-circuit point field setting constant problem, if the installation position of the short-circuit row is changed, the problem can be effectively optimized and improved, and the shortcoming that the correct protection direction cannot be judged can be compensated. Install the short circuit row at the outlet switch of the generator unit to ensure that there is current at both ends of the current transformer, so that the generator unit is in a load state, and the brake current value is much higher than the differential current value. The test line is wound around the clamp ammeter to ensure the The accuracy of the differential protection test data.

6.5. Electrical start test time shortened design
Shortening the electrical start-up test time can effectively reduce the cost of capital invested in electrical testing. Because in the same test, the idle time of the unit will consume lower energy, shorten the test time, and further improve the safety of the test. The short-circuit test process, the first step is to carry out the no-load test, and after charging with the empty busbar, it is incorporated into the test; the second step is to use the excitation regulator for the test, and then with the busbar zero-boost and nuclear phase test; The grid is connected with a load test. Operating in the above sequence can greatly shorten the time for the electrical start-up test.

7. Conclusion
The core of the power system is the generator unit, but in the actual production process of power, it often faces short-circuit problems. The current high-voltage electrical test optimizes the solution to solve the
bottleneck problem that hinders safety and efficiency, and improves the accuracy of the high-voltage electrical test program. And efficiency, effectively ensuring the smooth operation of the power system.

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