Analysis of Power Cable Fault Diagnosis and Electric Field Detection Technology Based on Computer Control System

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Abstract. With the continuous improvement of China's power system requirements, a good and stable power supply is particularly important. Among them, the operation of power cable equipment is closely related to the quality of power system. Therefore, continuous improvement and reform of power cable equipment fault analysis and electric field detection technology can improve the quality and timeliness of power system. Based on the analysis of power cable fault and electric field detection technology by computer control system, this paper summarizes the related fault problems and electric field detection technology, so as to improve the quality of China's power system.

Keywords: Power Cable, Electric Field Detection Technology, Fault Diagnosis, Computer Control System

Electric power facilities are an indispensable part of today's social life. In people's daily life, there are countless instruments and equipment that use electrical energy to operate. People's daily work, life and learning are closely related to electrical energy. Therefore, as a power company, providing a stable power is an important and arduous task. As power cables can better transfer power resources and gradually replace the traditional overhead routes, they are widely used in urban construction planning. When power cable equipment fails, it is necessary to locate the fault point at the first time, then quickly find the cause of the fault to solve the problem in time and shorten the time of power supply interruption. It increases the stability of power supply system, and strives to reduce the negative impact of power cable equipment failure to The lowest\[1\].

1. Power cable fault diagnosis method

(1) Insulation medium aging deterioration
Because the power cable is laid underground, under the influence of uncontrollable factors such as soil and small animals, the physical and chemical properties of the external insulation material of the power cable can be changed, thereby changing the insulation capability of the power cable\(^2\).

(2) Insulation medium damp

The quality of the power cable itself and the technical problems in the installation of the power cable can affect the tightness of the power cable interface. If the sealing effect at the power cable interface is poor, the cable interface is prone to moisture, which in turn causes the cable insulation medium to be damp and affects the insulation capacity of the insulating medium.

(3) Power cable overheating

When the power cable is laid underground, a small free gap may appear in the insulating medium of the cable. When the power cable is put into use, the gas in the insulating dielectric gap will increase the resistance value of the local cable, resulting in a large amount of heat generated by the cable. In some buried cables, the cable overheating is even more serious. The cable heating can speed up the aging process of insulation materials outside the power cable, thus changing the insulation capacity\(^3\).

(4) Mechanical damage

During the operation of power cable after laying successfully, it is often affected by uncontrollable external forces, which will cause mechanical damage to power cable. To damage the integrity of insulation is to damage the structure of power cable interface, and to affect the normal function of power cable. In the past power cable mechanical damage events, the causes of mechanical damage can be divided into the following three categories. First of all, in the construction of other projects, no understanding the distribution of power cables will result in injury. In addition, in the construction process of power cables, due to mistakes in the operation of constructors, it damages power cable insulation outer layer and internal protective layer. Besides, due to the ground displacement caused power cable interface, the mechanical condition is changed, resulting in mechanical damage\(^4\).

(5) Material defects

Defective or unqualified products will inevitably occur in the process of power cable processing. If the latter acceptance inspection is not careful enough, it will lead to unqualified power cables into actual production and use. Unqualified cable connections at the interface or other components will make the interconnected cable contact is not strict, greatly reducing the sealing between cables. As the basis of protecting the stability of power cables, the material quality, management, protection and other factors of external insulators will aging under the influence of environmental factors, reducing the quality of cable interface.

(6) Fault location

Firstly, when the fault occurs, the distance of the fault place should be quickly judged to provide direction for the future troubleshooting work. After choosing the high-efficient and accurate test method, select the professional tester with rich relevant test experience to test, and quickly get the rigorous and reliable test results\(^5\). According to the rough measured distance results and the laying path and distance of the power cable, the accurate location of the fault point is finally completed.
However, power cables are often deposited underground. Therefore, the detection path will be formed to make the real fault point shift. In the determination of the fault point, the specific conditions and the surrounding environment should be taken into account, with the appropriate use of audio current, current and other signals to locate.

2. Electric field detection technology for power cable faults

(1) High pressure pulse method

The high pressure pulse method is the inevitable outcome of the continuous innovation and reform of the power system. With the rapid development of China's power transmission industry, the transmission voltage is getting higher and higher, the traditional ranging method exposes many problems in the high-voltage ranging work, and the high-voltage pulse method has gradually become the mainstream ranging method. The high-voltage pulse impulse method is improved and innovated in the traditional method of fault location, which greatly improves the effect of fault detection. In the process of high voltage pulse, a higher voltage pulse at breakdown point will be breakdown and discharge. In addition, the resistance of the fault point is higher. When the bidirectional high voltage and high resistance meet quickly, it will discharge and send short circuit phenomenon. In the actual fault location, the fault location can be determined according to the short circuit location.

In practical ranging work, extra attention should be paid to the magnitude of the applied voltage. According to the parameters such as the inverse pulse and pulse formed after discharge, the equation related to the band induction between the lines should be fitted out, and the distance between the fault points can be determined by combining the known data. This method has been verified and affirmed by many countries and regions all over the world. It is the most ideal and fast fault location method for power cable at present.

(2) Classical bridge method

Classical bridge method is the most classical fault location method. Since the birth of this method, along with the reform and innovation of power system, it has been playing an important role in the long-term practical operation of power cable fault location. Classical bridge method is more commonly used in single phase fault detection. In the detection, the non-fault conductor is connected with the fault conductor to form a small bridge structure, which is balanced by slowly adjusting the resistance and other states. After the bridge is balanced, the resistance and the arm of the bridge are measured, and the resistance ratio at the arm of the bridge is calculated by analyzing the measured results. Finally, the fault point distance is determined. The classical bridge method has been used for a long time and is very classic. Therefore, in the past power system failure, it is the first choice to become the fault point and measure the distance. However, with the continuous progress of science and technology, power supply system updating, the classical bridge method gradually can not keep up with the pace of the times. It will be forgotten in today's power cable fault location work.

(3) Low voltage pulse method

At present, the low voltage pulse method is a common method in power cable fault detection in China. It can realize the fault location of power cable by analyzing the transmission and reception mode of microwave pulse wave. When the pulse wave is transmitted to the fault location, the
corresponding rebound warning will be generated, and the pre-set automatic device can be analyzed according to the difference between the transmission process and the rebound length. After careful calculation and analysis, the process length of the pulse wave is the fault distance of the power cable. However, the low voltage pulse method is only suitable for fault location of power cable with low resistance and open circuit fault location because of its low transmission voltage signal.

(4) Secondary pulse measurement method

Under the background of power consumption in production and people's daily life in China, the method of fault location distance measurement by secondary pulse arises at the historic moment. Secondary pulse measurement method not only breaks through the problems of large resistance and grounding of power cable, but also makes up for the drawbacks of traditional voltage detection, and continuously improves and systematizes the technology of electric field detection for power cable fault in China. Secondary pulse measurement method is to apply low-voltage pulse wave to power cable. When low-voltage pulse wave is transmitted to the fault point with high resistance value, it will return automatically and release high-voltage pulse wave to the fault point. When the breakdown of high voltage pulse and high voltage resistor occurs, a low voltage pulse wave will form. This low voltage pulse wave will return at the fault location. Secondary pulse measurement equipment will receive and save the above pulse wave process, through the later analysis can accurately and efficiently locate the fault point.

3. Conclusion

With the increasing demand and requirement for power system, when power cable failures occur, it should be the first time to eliminate the fault, and strive to minimize the negative impact of power cable equipment failures to improve the stability of the power system. The power cable fault diagnosis and electric field detection technology are the basis of power cable troubleshooting. When power cable failures occur, the optimal detection technology is selected at the first time, and the possible causes of the fault are eliminated one by one according to the actual situation of power cable obstacle sites to promote the development of China's power industry.

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