

## Research on Remote Diagnosis and Analysis of Transmission Faults in High-voltage Transmission Lines

Chao Yang, Chang Su, Cong Tian

Heilongjiang University of Technology, Heilongjiang, Jixi, 158100

**Keywords:** Remote Diagnosis, Analysis, Transmission Faults, High-voltage Transmission Lines

**Abstract:** The fault prevention and control of high-voltage transmission line is the key link in the development of the entire circuit system. During the operation of high-voltage transmission lines, due to the influences of connection methods, environmental factors, and climatic factors, there is a high possibility of faults occurring during operation. Line faults directly affect the safe operation of high-voltage transmission lines, and electricity is used by residents. Safety and the economic development of the country have brought adverse effects. Therefore, it is necessary to strengthen research on the prevention and control of failures of high-voltage transmission lines. This paper analyzes the main causes of the failure of high-voltage transmission lines, and proposes corresponding prevention and control measures for the faults, so as to provide help for the development of future fault prevention and control technologies.

### 1. Introduction

High-voltage transmission line is one of the important components of the power system. The operation safety of the high-voltage transmission line is related to the effective operation of the entire power grid system. It is of great practical significance to strengthen the research on the fault of the high-voltage transmission line to ensure the safe operation of the power system. Because the high-voltage transmission line is set up outdoors, there is a high possibility of failure during operation. In order to ensure the stable and efficient operation of our country's power system, we must strengthen the research on line fault prevention and control technology, and further improve the stability and reliability of our country's power system, and provide reliable support for national production and residential life.

### 2. Main Factors Leading to Failure of High Voltage Transmission Line Operation

The main factors leading to the fault of the high-voltage transmission line are: First, the problem of the equipment itself. As the power equipment will have various problems such as aging of the fuselage and damage of the line during operation, the operation of the high voltage transmission line will occur. The second is the external force and is influenced by human factors, such as intentional damage to the line, external impact, etc. Fault; again, accidental factors lead to failure of the high voltage transmission line. For example, under the influence of weather such as windy and rainy weather, the power transmission lines vibrate. Such vibrations can easily lead to flashovers between lines, resulting in power outages. At the same time, the design is irrational and the lines pass through the tall trees, which makes it difficult to clean the lines when a fault occurs.

The continuous development of the power system has greatly improved the protection technology of the power system. The operation of high-voltage transmission lines is also the same. The power system has taken various protective measures. Although these measures and technologies have played a significant role to a certain extent, these technologies cannot protect the power failures caused by external forces and the failures caused by the equipment's own problems. At the same time, they are caused by these two aspects. Faults are highly unpredictable. In this paper, a 35kv-330kv high-voltage transmission line is taken as an example to study and it is found that the cause of the high-voltage transmission line is mainly due to two reasons. On the one hand, it is due to environmental reasons, such as line oscillations caused by strong winds, thunderstorms, etc.

Strong influence; on the other hand, artificial reasons, such as the construction process, or large-scale vehicles, etc., can cause short circuit and open circuit faults of high-voltage transmission lines. The above are just a few of the measures that led to the failure of the operation of high-voltage transmission lines, and in fact, there are many reasons. Therefore, the relevant personnel of China's high-voltage transmission lines should strengthen the study of the causes of the line faults, so as to determine the type of failure based on specific reasons.

In the adjustment of the causes of faults in high-voltage transmission lines, it is found that there are many causes of faults. Therefore, troubleshooting and prevention of faults must be combined with the actual operation of high-voltage transmission lines to achieve targeted prevention and control.

### **3. Analysis of Operation Failure of High Voltage Transmission Lines**

After analyzing the fault cases of high-voltage transmission lines, we found that the types of faults can be subdivided into the following types:

The probability of a short-circuit fault on a high-voltage transmission line is much higher than that of other faults. The main cause of the fault is the breakdown of the interphase insulator between the conductor and the high-voltage transmission line. In the operation of high-voltage transmission lines, the probability of occurrence of short-circuit faults is 8%, which accounts for about 30% of power system failures. Short-circuit faults in high-voltage power grids may lead to grid collapse, and sparks due to short circuits may cause fires. Seriously affected the safety of power system operation, and threatened the power service quality of the power companies and the good operation of the company [1].

In the operation of high-voltage transmission lines, single-phase ground faults are also one of the most common types of faults and have a direct impact on the stability of high-voltage transmission lines. The main cause of single-phase earth faults in high-voltage power transmission lines is due to faults caused by precipitation and humid environment. Single-phase earth faults can lead to a sharp increase in line temperature and cause equipment to burn out. If the circuit is running, the phase voltage becomes zero, and at the same time, the normal operating phase voltage will rise to the level of the line voltage, causing the voltage span to increase, causing a single-phase ground fault [2].

The erection of high-voltage transmission lines has a great influence on the quality of the circuit transmission. The different operating environments of the line are different, and the faults that are easily generated are also different. In the fault of the high-voltage transmission line, the fault of the wire breakage is more common, and the impact on the operation of the power system is also greater. In addition, in the course of the operation of the high-voltage transmission line, if the motor of the three-phase power supply is defective, it will cause a single-phase breaking fault of the three-phase motor, thus causing failure of the high-voltage transmission line [3].

Due to the large environmental changes in recent years, the high-voltage transmission lines caused by thunder and lightning have more and more failures. After analyzing and summarizing the lightning accidents, the main types of lightning caused by bypass tripping accidents and counterattack tripping accidents. The impact of transmission lines on different locations and areas is different, and it is often the case that a lightning strike accident dominates a certain area. Lightning accidents can lead to equipment damage and lead to large-scale power outages.

### **4. Prevention and Control Measures for Operation Failure of High-voltage Transmission Lines**

For the cause of pipeline faults, the main measures to be taken in the prevention and control of circuit short-circuit faults in the transmission of high-voltage transmission lines are: First, the fault interval of the high-voltage transmission line is predicted in conjunction with protection ranging, so the protection of ranging Accuracy has become the main factor affecting the results. In order to ensure the effectiveness of the protection ranging, in the process of determining the data information of the protection ranging, it is necessary to analyze the partial parameters provided by

the scheduling. In addition, the determination of the protection zone can be determined by the relevant design drawings. During the process of placing the short-circuit fault on the line, modern advanced detection means can also be used to monitor the operating status of the high-voltage transmission line in real time. When a fault occurs, an automatic alarm can be provided to help the maintenance personnel quickly determine the fault location and improve the high-pressure transportation.

To improve the management of the operating environment of high voltage transmission lines is an important guarantee for ensuring the safety of the operation of high voltage transmission lines. At the same time, in combination with different environmental conditions, the span of the high-voltage transmission line can be properly adjusted to avoid the occurrence of transmission line operation failure due to excessive span. Single-phase ground faults are also affected by the weather conditions. Line maintenance personnel are required to have a certain degree of understanding of the local climate characteristics. The experience is summarized in the work and attention is paid to the analysis of faults. At the same time, we must do a good job in maintenance and statistical records of line faults to check whether there is any problem with outgoing line equipment from the bus line to the transformer substation fence, determine the cause of the fault, and take effective measures [4].

Due to the complexity of the erection environment of the high-voltage transmission line, there are many reasons for power failure of the line. Therefore, the maintenance of the wire breakage fault also has certain complexity, including wire breakage, flashover burns, and wire damage. To harm the safe operation of high-voltage transmission lines, the main methods to strengthen the prevention and control of line disconnection faults are: (1) to strengthen the investigation of the safe operation of high-voltage transmission lines, and pay special attention to the environment where wind power is large or wind and rain is transmitted. Once the phenomenon of slack in the transmission line is found, the line shall be investigated in time. At the same time, according to the actual situation in different regions, the erection of the book visible roads will be adjusted. If the conditions permit, the sparse density between the circuit struts will be appropriately increased to improve the operating efficiency of the wire. (2) Strengthen the prevention and control of lightning damage. In order to reduce the damage caused by lightning strikes on high-voltage transmission lines, it is necessary to constantly improve the defense level of the power system against lightning, constantly update the technology, and strengthen the defense against tripping accidents caused by lightning disasters. The specific measures that can be adopted include: perfecting and reconstructing the grounding of the transmission line, adjusting the insulation level of the line, and paying attention to installing lightning arresters during the erection of the high-voltage transmission line. Continuously improving the insulation level of the line is the basis of lightning protection work, which can effectively improve the lightning resistance of the line and reduce the impact of lightning on high-voltage transmission lines, thus ensuring the complete stability of circuit transportation [5].

With the increase of voltage levels and the increase in the number and length of lines, in order to increase the efficiency of operation and maintenance, the inspection, monitoring, detection, and overhaul technologies and equipment of transmission lines need to be further developed in the direction of automation, mechanization, and intelligence. In terms of condition monitoring and detection of transmission lines, online monitoring and inspection platforms are used to enhance the state awareness capabilities of transmission lines, and intelligent transmission grids are built using information, communication and computer technologies. On-line monitoring is an important technical means to realize the state awareness of transmission lines. Currently, online monitoring of 11 types of projects has been carried out on transmission lines. However, the monitoring device has many faults in practical applications, which are mostly reflected in the reliability, power supply, etc. of electronic devices. In the future, it is necessary to further develop on-line monitoring devices with stable status, reliable performance, long operating life, and good weather resistance. In terms of inspection platforms, the research and application of UAV patrol line technology should be increased. Utilizing visible light detectors, infrared imagers, UV imagers, airborne laser radars, etc., on the line to conduct inspections on the line, in order to meet the practical needs of the site It is

required to develop a long-distance drone inspection system with a remote control distance of 30 km or more, and flight control functions such as flight stability control, GPS autonomous line navigation control, geographic matching automatic control, and automatic tracking of towers.

In respect of overhauling equipment, helicopters and insulated arm-armed vehicles are used as a portable work platform. Because of their high safety and ease of use, they are used on the UHV AC-DC transmission lines in Europe and the United States and other countries. Next, China should develop insulation. Application of Bucket Wheels in Inspection and Repair of 500 kV AC and DC Transmission Lines and Helicopters in Maintenance of UHV AC / DC Power Transmission.

## **5. Conclusion**

The prevention and control of faults in high voltage transmission lines is an important guarantee for the development of power systems. The article discusses the causes of faults in high-voltage power transmission lines and finds solutions to the problems, so that future power system development can be more stable. During the management of high-voltage transmission lines, attention should be paid to strengthening the management and monitoring of high-voltage transmission lines, using modern management techniques to manage high-voltage transmission lines, and improving the operating efficiency of transmission lines, and ultimately enabling the power companies to obtain economic benefits. At the same time reduce the loss of electrical energy, to provide safe and efficient power energy for the country.

## **References**

- [1] Liu Xueshan. Research on Automatic Battery Detection System Based on Machine Vision [J]. Microcomputer and Applications. 2009 (23)
- [2] Ou Xiyang, Hou Xingzhe, Zhou Kongjun, Zheng Ke, Wu Hua, Liang Yanyang. Research on smart meter recognition and precise positioning based on machine vision[J]. Microcomputer Information. 2012 (10)
- [3] Li Rui, Zhai Wei, Cheng Wushan. Nut positioning system based on machine vision [J]. Machine Tool & Hydraulics. 2013 (23)
- [4] Sun Haijie, Lin Junqiang, Li Yutao, Li Tao, Ouyang Gaofer. Research on Color Sorting Technology of Polycrystalline Silicon Solar Cells Based on Color Machine Vision [J]. Manufacturing Automation. 2012 (21)
- [5] Ju Ling. Solar cell position error detection based on machine vision [J]. Machinery Manufacturing and Automation. 2012 (05)