

Research on Application of Optical Fiber Composite Overhead Phase Line in Medium and Low Voltage Overhead Transmission Line

Enshan Chang

Yulin Vocational and Technical College, Yulin, Shaanxi, 719000, China

Abstract: *Optical fiber communication has large transmission capacity and small overall loss. It has the advantages of anti-electromagnetic interference, light weight, small outer diameter and high speed. Therefore, it is used as a core in traditional communication cables. The optical fiber composite overhead phase line can make full use of the line resources of the power system, and can effectively reduce the frequency resources, electromagnetic compatibility and other contradictions with the outside world. It plays a positive role in the use of power communication, and is a type of new power optical cable. Applying the optical fiber composite overhead phase line to the medium and low voltage overhead transmission lines can achieve the efficiency of communication and power transmission. This paper introduces the optical fiber composite overhead phase line and analyzes its specific application in medium and low voltage overhead transmission lines.*

Keywords: *Optical Fiber Composite Overhead Phase Line; Medium and Low Voltage Overhead Transmission Lines; Application*

1. Overview of optical fiber composite overhead phase line

Optical fiber composite overhead phase line is a new type of power special optical cable which is widely used in transmission lines at present. It contains optical units. In this type of overhead phase line, replacing one or more steel wires in the conductor with stainless steel tube optical units can ensure that it can achieve two functions of communication and transmission. The optical fiber composite overhead phase line can be used to replace one phase of the three-phase transmission line, so that the three-phase power line composed of two conductors and one optical fiber composite overhead phase line can be constructed, and there is no need to set up a communication line to solve the problem of optical fiber communication for related businesses [1]. Especially in the medium-low power transmission network, the use of optical fiber composite overhead phase lines has significant advantages, which can prevent electromagnetic compatibility, routing coordination and other contradictions.

In terms of the characteristics of optical fiber composite overhead phase line, it mainly includes the following points:

The application of optical fiber composite overhead phase line to medium and low voltage overhead transmission lines can promote the effective solution of transmission of electric energy and optical fiber communication. This optical fiber composite overhead phase line is also an optical cable that can provide signal transmission. The corresponding mechanical characteristics, electrical characteristics and optical fiber transmission characteristics are critical [2].

Secondly, the optical fiber composite overhead phase line can be effectively applied through the tower resources of the transmission line itself. In the erection of medium and low voltage transmission lines, the ground wire hanging point is not taken into account, so it is impossible to select the OPGW optical cable that matches the characteristics of the ground wire, or it is difficult to erect the OPGW optical cable through the same tower when the ground wire in the icing area needs to melt ice. ADSS optical cable will be limited in the ground safety distance control and cannot meet the safety distance control requirements between the cable and the conductor [3]. If ADSS optical cables are erected in medium and low voltage lines, problems such as crossing and crossing are often encountered, and it is also impossible to realize the same pole erection. However, if ordinary optical cables are erected with self-supporting poles, it is easy to be stolen and not conducive to maintenance. With the help of optical fiber composite overhead phase lines, the problem of optical cable erection can be effectively solved, the defects faced in the ordinary optical cable erection can be made up, and the existing transmission

line poles and towers can play a good role.

2. Technical requirements for structure selection of optical fiber composite overhead phase line

2.1 Structural analysis

The guiding similarity between optical fiber composite overhead phase line and adjacent ground wire is higher than that between optical fiber composite overhead phase line and adjacent ground wire. The stainless steel structure in the optical fiber composite overhead phase line is roughly the same as the traditional wire structure. The metal single wire in the traditional optical cable stranding layer is replaced with stainless steel pipe containing optical fiber, which is easier to meet the design requirements. The optical fiber composite overhead phase line should conduct the permanent current in the three-phase system. This type of phase line can keep the temperature constant for a long time. The corresponding structure also has a good protection effect on the optical fiber. To ensure the consistency with the sag tension and creep characteristics of adjacent conductors, the optical fiber composite overhead phase line is close to the adjacent conductors in many parameters, such as diameter, metal sectional area and weight. To prevent the voltage change at the remote position and ensure three-phase balance, the DC resistance and impedance corresponding to the optical fiber composite overhead phase line should also be as close as possible to the adjacent conductors.

From the current research and development of optical fiber composite overhead phase lines in China, there are no perfect standards and regulations yet. In the standard GB/T1179-1999 Round Wire Concentric Stranded Overhead Conductors, there are relevant provisions for optical fiber composite overhead phase lines.

2.2 Technical requirements for installation

The optical fiber composite overhead phase line is the line installed in the high-voltage system, and the corresponding installation metal needs to be well insulated.

First, install the fittings of the optical fiber composite overhead phase line. The fittings are mostly pre-twisted power mode, which is more suitable for high-voltage overhead transmission lines and can effectively replace the new products of traditional power fittings, including pre-twisted suspension clamp, pre-twisted connector strip, etc. The optical fiber composite overhead phase line is installed with optical fiber bundle tube structure inside the conductor, and the installation is mainly based on pre-twisted wire fittings to achieve effective protection of optical fiber.

Secondly, the connection operation of optical fiber composite overhead phase line. The optical cable room erected in the corresponding tower, as well as the optical cable room and the guide optical cable room, need to use the joint box to connect. The connection operation of the optical fiber composite overhead phase line is a crucial step for the overall project. Compared with the optical cables in other stores, the corresponding connection method of this optical cable is also different. The installation and connection of the corresponding junction box are different. The relevant requirements are also higher than other power optical cables. This requires the relevant successor to have certain technical experience. The optical cable is usually not live, so the high voltage and signal can be effectively separated after the communication signal in the junction box is horizontally connected with the zero potential to ensure the safety of the line. The connection of optical fiber composite overhead phase line needs to separate the optical fiber unit from the operating phase line, and the connection technology and insulation requirements are relatively high. The optical fiber composite overhead phase line joint box also includes the intermediate joint box and the terminal joint box. The intermediate joint box is mainly used for connection between lines on the tower. Generally, composite silicone rubber and insulating secondary materials can be used as fusion materials. The intermediate joint box can also be divided into several types according to its prevention form on the tower. The terminal junction box is generally connected by two times of welding up and down, and can be connected by conventional methods. The procedure for using this kind of connecting material is simpler, and the joint box can also be formed in one time in production, which is very simple and convenient for construction. It can also ensure the safe transmission of communication signals. The requirements for the intermediate joint box and the heavy end joint box of the optical fiber composite overhead phase line are different. In addition to the necessary characteristics of the general joint box, it also has the characteristics of waterproof, moisture-proof and easy to fix, which can reduce the adverse impact on the power transmission guidance and ensure reliable transmission efficiency. In the use of optical fiber composite overhead

phase line, the corresponding current transmission and optical signal transmission are in the same cable, so the optical signal can be connected to the zero potential level, which can improve the safety of isolation voltage and ensure the safety of the overall transmission of the line.

3. Application examples of optical fiber composite overhead phase lines in medium and low voltage transmission lines

In a 35KV line transmission project of a wind farm, a 35KV line needs to be erected to the 35KV station on the opposite side. The area to be crossed by this project has a high altitude, and the fog weather in the corresponding building environment is very common. If the carrier communication technology is applied, it will be vulnerable to the impact of the meteorological environment, resulting in unstable communication quality, unable to ensure the effectiveness of communication, and the corresponding communication capacity under this transmission mode is also small. Considering that the opposite station is the cable incoming line, the wave arrester cannot be deployed in the substation enclosure, the coupling capacitor and other outdoor carrier combining equipment cannot be installed, and the outdoor carrier combining equipment at the terminal post outside the enclosure needs to deal with the problems of land acquisition cultivation and anti-theft, so the use of carrier communication technology is not the most ideal.

In this way, the application of optical fiber communication technology can achieve more ideal transmission communication effect. During the line erection of the 35KV line project, there is no need to carry out the ground wire support. The area it passes through is mainly the heavy icing area. During the icing period, it is necessary to do a good job of ice melting, so OPGW optical cable cannot be erected. In addition, there are many crossing and crossing situations of the line, and the ice cover is thick. The use of ADSS line erection scheme requires more costs, and the reliability cannot be guaranteed. The use of optical fiber composite overhead phase line optical cable can effectively utilize the line phase line resources, make up for the deficiencies and defects of ordinary optical cable, effectively meet the communication requirements from the wind farm to the corresponding dispatching end, and ensure the safe and effective operation of the power grid.

4. Application advantages and precautions of optical fiber composite overhead phase line technology

4.1 Application advantages

The development of optical fiber composite overhead phase line can realize effective application in medium and low voltage overhead lines of 35KV and below. This type of optical cable can replace the all-dielectric self-supporting optical cable. In terms of technical application advantages and economic benefits of optical fiber composite overhead phase line, it is mainly reflected in the following aspects:

First, the optical fiber composite overhead phase line is an all-metal structure, and the corrosion resistance of the optical cable is strong, which can effectively extend the service life of the optical cable.

Second, the optical fiber composite overhead phase line optical cable is erected on the overhead phase line, which can meet the dual functions of electric energy transmission and optical fiber communication. After the optical fiber composite overhead phase line optical cable is erected, it is not necessary to install another ADSS optical cable, and it can code group communication and transmission needs.

Third, optical fiber composite overhead phase line and cable are applicable to 35KV and below medium and low voltage overhead phase lines. The voltage level is high during operation, so its anti-theft performance can be improved to a certain extent, so that the theft of the corresponding optical fiber composite overhead phase line and connector box and other accessories is also significantly reduced.

Fourth, generally, the overhead optical cable or ADSS is erected on the same pole as the transmission line, which will cause additional mechanical load on the tower, which is unfavorable for the safety and reliability of the tower, while the use of optical fiber composite overhead phase lines will not cause such problems.

Fifthly, the tower height of the traditional 35KV and below medium and low voltage overhead lines

is designed according to the conventional tradition, and the need to add ADSS at that time is not fully considered. These will lead to certain design problems, and the use of optical fiber composite overhead phase line technology can solve these problems.

4.2 Precautions

In the use of optical fiber composite overhead phase line technology, the optical fiber composite overhead phase line should be consistent with the tension sag of adjacent conductors, and the relevant parameters should be as close as possible. Secondly, the optical fiber in the optical unit of the optical fiber composite overhead phase line should be left with a certain length to ensure that the optical fiber is not subject to tensile stress during erection and operation. The corresponding optical unit shall maintain certain mechanical protection performance to avoid extrusion deformation. To avoid moisture affecting the service life of optical fiber, it is necessary to prevent the optical fiber from being placed in a confined space and do a good job of moisture-proof treatment. In addition, the joint box of optical fiber composite overhead phase line shall be combined with composite insulators to ensure the effect of optical fiber connection and photoelectric separation. The optical fiber composite overhead phase line is one of the three-phase conductors. It is necessary to conduct the constant current in the three-phase system, so it is necessary to maintain a certain temperature condition to ensure that the optical cable has a certain thermal stability and ensure the effective implementation of optical communication.

5. Conclusion

At this stage, China's overhead transmission lines and optical communications are developing and applying rapidly in the power system. The new optical fiber composite overhead phase line has obvious advantages in the application of medium and low voltage overhead transmission lines of 35KV and below. The optical fiber composite overhead phase line technology has outstanding security and reliability, can achieve certain cost-saving benefits, and has broad application prospects.

Acknowledgment

Scientific research plan project of Shaanxi Provincial Department of Education, project number: 21JK1020.

References

- [1] Chen X, Qi L, Feng X, et al. *Development and engineering application of key technologies for safe operation and maintenance of optical fiber composite overhead ground wire (OPGW)* [Z]. China Electric Power Research Institute 2016;
- [2] Zhu Z. *Assumption of using OPPC technology to realize real-time online temperature measurement of overhead lines* [C]// *Proceedings of the 3rd (2012) National Overhead Transmission Line Technical Seminar 2012*; 1434-1440.
- [3] Zhai Q, Liu L, Miao J. *Development of 110 kV optical fiber composite overhead phase line (OPPC) junction box* [C]// *Proceedings of the 2009 Optical Fiber and Cable Academic Annual Conference of the China Communications Society 2009*; 296-302.