Analysis and Research on Factors Affecting the Reliability of Medium Voltage Power Supply

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Abstract. With the continuous development of social economy, the demand for electricity is increasing day by day. Power users have higher and higher requirements on the reliability of power supply. In case of grid failure, the impact on businesses and individuals is also growing. The reliability of medium voltage power supply system has been paid more and more attention. The reliability of medium voltage power supply has a direct impact on users' satisfaction with electricity consumption. Power supply reliability has become an important index to reflect the continuous power supply capacity of enterprises. Power supply enterprises pay more attention to power supply reliability year by year. Improving the reliability of power supply for medium voltage users has become an important part of reliability management. The author summarizes the work experience, the main factors affecting the reliability of medium voltage supply are analyzed. The measures and methods to improve the reliability of medium voltage power supply are put forward.

Keywords: reliability, continuous supply of electricity, measures.

1. Factors affecting the reliability of medium voltage power supply

1.1. Influence of management mechanism on reliability of medium voltage supply

With the continuous development of national economy and society, National energy regulation has been strengthened in recent years, the demand of users for the reliability of power supply is constantly improving. Power supply enterprises pay more attention to reliability management, the management mechanism has been gradually improved, forming a hierarchical control and implementation mechanism. However, some units continue to use the old management ideas, pay insufficient attention to the reliability management of medium-voltage power supply, and fail to establish a multi-level responsibility control mechanism. Some enterprises believe that as long as the main network does not have a large-scale power failure, in the distribution network construction process, the power failure control of distribution network project is not strict. For example, in the early stage of construction, relevant power failure plans were not carefully prepared, the number of households during power failure was not calculated, and some power failure plans were even without power failure plans.
1.2. Influence of characteristics of medium voltage power grid on power supply reliability
Medium voltage distribution network is characterized by numerous lines and wide distribution range. Some areas are affected by natural geographical conditions, leading to large power supply radius and some areas suffer from poor natural conditions. Combined with these factors, it is difficult for medium voltage distribution network to have fault maintenance. In addition, there is uncertainty in the connection between medium-voltage distribution network cables and overhead lines, and some signs are not clear. Especially in the case of cable failure, it is impossible to locate the fault point in a short time, resulting in longer blackout time. If a distribution failure occurs in a complex wiring, the load may not be transferred smoothly. Limited by economic cost, geographical environment, natural climate and other reasons, the line cannot meet the N-1, failure cannot be diverted. In some areas, there are many overlapped and staggered medium-voltage distribution networks. These factors all lead to great difficulty in maintenance and management of distribution network operation. When power distribution accidents occur, it is likely to cause large-scale blackout accidents.

1.3. Influence of power equipment defects on power supply reliability
At present, many electric power enterprises in China generally have problems such as slow updating speed of electric power equipment. There are two reasons for this phenomenon. On the one hand, the renewal of power equipment requires a large amount of capital investment, and many power enterprises often choose not to renew power equipment in order to reduce costs, which seriously restricts the new development of power system. On the other hand, due to the lack of corresponding professional talents in many power enterprises, their overhaul personnel in the process of equipment overhaul and maintenance, often can not find the fault of power equipment or fault diagnosis misjudgment and other situations, resulting in the failure of power equipment to play its due role, leading to a lot of problems in the process of power supply, seriously affecting the stable operation of the power grid and the economic benefits of power enterprises.

1.4. Analysis of the main cause of power failure

![Figure 1](image-url)

*Figure 1.* Classification of major liability causes for power failure of urban users by a provincial power company in 2019
The average outage time of a provincial power company in 2019 is classified according to the cause of responsibility. The influence of network equipment maintenance and network engineering construction in the pre-arranged power failure is relatively large.

Taking a provincial power company as an example, we can see that the distribution network is pre-arranged for power failure, and the distribution network fault power failure accounts for far more than the average power failure time of the main network, so it is important and meaningful to deeply study the reliability of medium-voltage power supply.

2. Countermeasure analysis of improving the reliability of medium voltage power supply

2.1. Improving the management operation and maintenance ability of medium voltage power supply reliability

In order to strengthen the management and maintenance of distribution network, the distribution network management staff should first be required to standardize the management of the distribution network system according to rules and regulations, form a clear management mechanism and assessment mechanism, and timely handle and improve the distribution network system in case of failure according to the corresponding provisions. The distribution network management personnel should be organized to carry out regular maintenance work on the distribution system, so as to reduce the occurrence of distribution system failure and improve the reliability of power supply system. Distribution network management personnel need to check the obstacles of distribution lines regularly to avoid the damage of distribution lines due to obstacles. In terms of technical management, the most important thing is to strengthen comprehensive power failure control, hold regular power supply reliability analysis meetings, conduct in-depth discussion and analysis on the factors affecting reliability, make detailed power failure plans, strictly and conscientiously implement power failure plans, implement index control measures in the whole process of power failure planning, and form effective closed-loop management.

2.2. Perfect the design of distribution network and optimize the structure of network frame

In order to ensure the safety of power network operation, improve the reliability of power supply, and make the planning of power distribution network structure scientific and reasonable, it is necessary to perfect the design of power distribution network. Specifically, we can start from the following three aspects: First, According to the overall planning of urban development and the development status of the industry, and in combination with the future development trend, the electric power distribution network is designed scientifically and rationally, so as to better ensure the power supply reliability of the electric power distribution network. Second, The grid structure of double circuit power supply, ring circuit power supply, multi-partition and multi-connection is established, and the loop network power supply is gradually realized hand in hand. The power supply radius should be reasonable and the power supply load should meet the technical standard. Third, it should speed up the distribution network automation transformation, should replace the old equipment.

2.3. Pay attention to the introduction of advanced technology and personnel training

Great progress has been made in the development of science and technology in China. The application of science and technology has promoted the improvement of work quality and efficiency in many industries. Faced with this situation, electric power enterprises can also constantly introduce new technology or new equipment to improve the reliability of power distribution network operation. However, in the process of the introduction of advanced equipment, power enterprises must pay attention to the following aspects of the problem. First of all, the choice of equipment must be consistent with or slightly higher than the development status of power enterprises, so as to give play to its due effect. Second, power companies must train their employees on new equipment. In this way, when the equipment failure, the fault in a timely manner, to avoid its impact on the normal work of power enterprises. Finally, the electric power enterprises should also enhance the communication
methods. It can promote the learning and communication among employees, so as to improve their professional skills.

2.4. Optimize the operation process of distribution network
In the process of distribution network operation, attention should be paid to the whole process of management and fault maintenance. First of all, enterprises should carry out regular inspection of distribution network lines to eliminate obstacles around the lines and ensure their safety. Operators should focus on the operation of insulated wires, buried cables and overhead cables to reduce the probability of distribution network failure. To avoid the collective power failure caused by a single station configuration or a user line failure, the location of the fault should be determined as far as possible, the scope of power failure should be narrowed, and the impact on other users should be reduced. Power enterprises need to make reasonable planning of power distribution network according to the actual situation of enterprises, the actual power consumption of users and the future development of the region. Before the construction of distribution network, the power design department should be organized to make a reasonable layout of distribution network. Comprehensive consideration is given to regional grid structure, belt transfer capacity, regional power load, single line and single variation.

Through the new line, the power supply radius of 10kV line can be shortened, the load can be reasonably allocated, and the load transfer capacity can be improved in the case of substation main transformer failure. To reduce the inter-district power supply and circuitous power supply as much as possible, improve the line connection rate, improve the load transfer capacity, so as to improve the reliability of power supply.

2.5. Reasonable planning and construction of distribution network
Power enterprises need to make reasonable planning of power distribution network according to the actual situation of enterprises, the actual power consumption of users and the future development of the region. Before the construction of distribution network, the power design department should be organized to make a reasonable layout of distribution network. Comprehensive consideration is given to regional grid structure, belt transfer capacity, regional power load, single line and single variation. Through the new line, the power supply radius of 10kV line can be shortened, the load can be reasonably allocated, and the load transfer capacity can be improved in the case of substation main transformer failure. To reduce the inter-district power supply and circuitous power supply as much as possible, improve the line connection rate, improve the load transfer capacity, so as to improve the reliability of power supply.

3. Conclusion
With the continuous progress of science and technology, the level of social development is constantly improving. The requirement of electric power reliability is gradually raised. The power distribution network has realized the effective connection between the enterprise and the user. The reliability of medium voltage supply is increasingly important. In the actual process of power supply, If the reliability of power distribution network is a problem, it will seriously affect the power supply situation of power enterprises. Therefore, at present, how to improve the reliability of power distribution network, how to improve grid operation efficiency, how to arrange the blackout plan reasonably, how to reduce repeated blackouts, how to shorten the time of emergency repair as an important research target of electric power production.

This paper combines the actual production situation of power supply enterprises. The main factors affecting the reliability of medium voltage supply are listed. In view of these factors, this paper analyzes and studies the improvement of the reliability of medium voltage power supply. This paper is of practical significance to improve the reliability of medium voltage power supply.
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