

Reliability Evaluation of Relay Protection in Power System

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Abstract: Relay protection system is an important part of eliminating influencing factors and ensuring the normal operation of power system. On this basis, the intelligent relay protection system of substation is analyzed, and several methods to improve its reliability are discussed. Its purpose is to make the relay protection system of intelligent substation play a more stable role, ensure the normal operation of power system, and provide help for the stable and effective development of human power life.

1. The Importance of Reliability of Relay Protection System in Intelligent Substation

Reliability refers to the failure-free power of a component system within a certain range of environment and time. When problems occur in power system operation, relay protection system can realize isolation function according to the time and place of fault occurrence, avoid the harm of current and voltage, and ensure the stable operation of power system. Therefore, to ensure the reliability of the relay protection system of intelligent substation is very important for the operation of the whole power system. It is imperative to improve the reliability of the relay protection system of intelligent substation.

2. Reliability Evaluation and Analysis of Relay Protection

2.1 Evaluation Indicators

In order to ensure the integrity of the power system, the reliability of equipment and the reliability of function, the reliability index can be expressed by probability. Essentially, it refers to the probability of the power system, facilities and components to complete rated functions within a specified time range or within a specified time. In addition, when formulating reliability index of relay protection, besides fully considering the function of relay protection device itself, special use and environmental conditions of relay protection device should also be taken into account.

2.2 Composition of Relay Protection System in Intelligent Substation

Intelligent substation relay protection system is mainly composed of electronic transformer, combined electrical appliances, switches and intelligent terminals. (1) Compared with the traditional transformer, the electronic transformer in the relay protection system can ensure the accuracy of fault detection and promote the safe and stable operation of the power system. At the same time, the replacement of traditional cables makes the economic benefits of the system more considerable. In addition, electronic transformer has the advantage of data transmission, which is of great significance to the intelligent development of substation. (2) The combined device is the intermediate link of information and data transmission from electronic transformer to protective device, and plays an irreplaceable important role. It eliminates the need of complex wiring between transformer and protection device, effectively guarantees the effective sharing of secondary equipment data, and saves money. (3) Switch is the core part of substation intelligent relay protection system, which realizes the purpose of data transmission through communication channels. (4) Intelligent terminals can greatly improve the ability of fault prevention and monitoring of power system, which is of great significance to the repair of power system faults.

3. Measures to Improve Reliability of Relay Protection

3.1 Setting relay device fixed value to improve protection device maintenance

It is necessary to set reasonable values during the operation of relay protection devices in power system. Therefore, in relay protection, the accuracy of setting value has a great influence on improving the reliability of power system operation. The failure of fixed value calculation also needs the personnel with higher professional and technical level to calculate, and needs a higher sense of responsibility and responsibility. Before calculating the set value, in order to ensure the accuracy of the basic data, the impedance network diagram of the system should be drawn first. Different equipment should have different protection settings. Therefore, it is necessary to calculate the parameters of electrical equipment in order to ensure the scientific calculation data of relay protection setting value. At the same time, in order to avoid tripping problems caused by incompatible upper and lower protection settings, it is necessary to check the coordination of upper and lower protection settings regularly and timely.

3.2 Optimizing the configuration of line protection and reasonably carrying out inspection work

The following measures can be taken to optimize the configuration of line protection and conduct reasonable inspection: (1) For the configuration of line protection, centralized and backup modes can be adopted. Relevant personnel can be found on a computer through the protection and communication monitoring system of voltage interval unit. In order to improve the security of smart grid and the reliability of system operation, (2) With the development of intellectualization, the demand for human resources is becoming smaller and smaller, but it is still an indispensable factor for power system operation. In order to improve the reliability of the relay protection system of intelligent substation, attention should be paid to the development of inspection and inspection work, and a working group with professional skills and professional level should be established. At the same time, a sound inspection system and measures should be formulated to improve the reliability of the relay protection system of intelligent substation. Put the inspection work into practice and clarify the responsibilities of the inspectors. Through the comprehensive inspection of substation intelligent relay protection system by inspectors, the problems and faults that may occur in the system can be found and solved in time to ensure the reliable operation of the relay protection system.

3.3 Enhancing the Application of High-tech

Promoted by the development of high and new technology, the power industry has developed rapidly, especially in hardware facilities. Its update frequency is getting higher and higher, which lays a solid foundation for ensuring the reliability of relay protection. China's research on relay protection devices is also thorough, absorbing the essence of foreign advanced concepts and technologies, and expanding the network technology, computer technology and information technology, and the kinetic energy of the system to a number of aspects. For example, remote terminal detection devices inherit and monitor system integration functions. High technology not only promotes the development of hardware, but also enlarges the application scope of software. For example, relay connection not only realizes multipath, but also transforms the complex logic relationship into simple operation relationship, which improves the reliability of power system.

3.4 Reliability of Transformer Protection

Power system has certain requirements for voltage quota, so ensuring the accuracy of voltage quota can ensure the normal operation of power system supply and distribution. In the process of realizing effective voltage control, the application of transformer system plays a decisive role, so improving the reliability of transformer protection plays an important role in ensuring the operation of power system. Based on the important role of transformer system in the reliability of substation relay protection system, in the process of transformer configuration in substation, transformer can be distributed, which can disperse the pressure of transformer system and avoid the problem caused

by excessive transformer pressure. In the follow-up configuration of the relay protection system, it is necessary to combine decentralized configuration with centralized configuration to reduce the complexity of the system, realize transformer protection of the relay protection system and improve the reliability of the relay protection system.

3.5 Relay Protection of Process Layer

Process layer relay protection is mainly to reduce the risk of power system operation by protecting buses, transformers and distribution lines in power system, and to implement necessary protection for power dispatching system, so as to ensure the safe operation of power system. Generally speaking, the stability of the relay protection system ensures the stability of the protection value when the power system fluctuates, thus ensuring the stable operation of the power system. However, primary equipment is widely used in smart substation. In this process, switches and hardware should be separated to ensure the relative independence of switches and hardware, thus protecting substation buses and transmission lines. In the practical work of relay protection, bus and transformer protection of intelligent substation can be defined by multi-segment line protection. In order to ensure the applicability and reliability of sampling data, the sampling data are adjusted in real time while sampling in the main substation.

3.6 Improvement of Interval Layer Relay Protection

It is an effective measure to improve the reliability of relay protection system to apply dual equipment to substation relay protection system and centralize backup protection. The backup protection system can provide protection for substation backup equipment, switch faults, adjacent lines and buses, thus accurately diagnosing the faults and problems in the operation of power grid system and providing timely and effective solutions. In addition, the voltage level of smart substation can be centralized allocation to adapt to the specific conditions of power grid operation when the technical means permit. At the same time, through the analysis of the specific situation of the power grid system, several reasonable operation schemes can be set in advance. Through analysis, the most appropriate and effective scheme is selected to maximize the function of the relay protection system in intelligent substation.

3.7 Redundancy Design of Optimized System

In the process of relay protection, the optimization of system redundancy can largely avoid the problem of system misoperation and rejection, thus improving the reliability of the system. Redundancy enhancement of relay protection system can be started from the following two aspects: (1) real-time monitoring of substation automation by using data link layer technology of Ethernet switch; (2) reasonable selection and application according to different requirements of substation network structure. Based on the characteristics of bus structure, ring structure and star structure. Bus architecture can effectively reduce wiring, but at the same time it needs to improve redundancy. Because any point on the ring can provide redundancy, the ring structure has good redundancy, but the convergence time is long, which has a great impact on system reconfiguration. Star structure has the characteristics of short waiting time, no redundancy and low reliability. The reliability of substation relay protection system can be improved only by reasonably selecting three kinds of structures according to their different characteristics and respective needs. In addition, when optimizing the redundancy design of the system, the investment rate of the system should be reasonably analyzed. While improving the reliability of the system, the realization of economic benefits should be emphasized.

4. Conclusion

In power system, relay protection is the main component. Strengthening the reliability management of relay protection can improve the reliability and security of power system. However, there are many factors affecting the reliability of relay protection. It is necessary to reasonably analyze the reliability evaluation results of relay protection and improve the accuracy of the

evaluation results. In addition, in terms of management and technology, it is necessary to strengthen security protection to ensure the reliable and safe operation of the relay protection system.

References

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