

# Research on Application and Development of Power System Relay Protection Technology

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**Abstract**—People demand for electricity is growing with the development of society. To make the power system can operate safely and reliably, relay technology in China has been very good development. With the development of technology department for the development of relay technology has injected new vitality, but also to relay technology continues to put forward new demands. How effective containment protection technology failure, so that the efficiency and quality of power system operation are effectively protected, electricity technician technical issues need to be addressed. This paper analyzes the concept and principle of protection technology, aims to relay technology development and its application to improve the quality of the power system, reduce power consumption and other aspects to explain their role, to study the technical characteristics of protection and analyze its importance, illustrate the application and development trend of power protection systems.

*Keywords*—power systems; relay protection; applications; development

## I. INTRODUCTION

In recent years, with the continuous development of China's social and economic life of the people in the industry has been rapid infrastructure development. In these people's livelihood industries, the pace of development of the power industry is particularly fast. With the continuous improvement and continuous development of society and the improvement of people's living standards, electrical equipment has become an indispensable part of our lives, but what good foundation, a growing number of power system to enhance and improve our lives At the same time, there are many attendant problems, China's various regions have experienced varying degrees of power shortage problem, in order to alleviate the power shortage situation in the country and even less in some areas have taken brownouts and blackouts solutions. The relay technology has just the right solution to this thorny problem, the principle of protection technology, when the power system for some reason there is a problem, relay technology can automatically be repaired, so that the power system can stable and secure operation, which has a strong automation features. The protection of these power systems, the protection technology is a very important measure[1].

Modern power systems in a hundred years, has evolved into a complex large system, large capacity long-distance

transmission and large grid interconnection power system will be the main issues to be addressed the next 10-20 years. Undoubtedly, the complexity of the system will make the safety of the power grid becomes more prominent. Currently, the power supply system has developed into a wide area, large capacity, high voltage level of power system[2-3]. As a source for national economic development, the scale of China's electric power system is expanding rapidly. The rapid development of the power system in terms of capacity, size, voltage level to the protection aspect brought new demands[4]. From a historical perspective of the development of protection, new theories, new technologies, new materials, and constantly improve the protection techniques have emerged to provide a technical basis, and promote the development of relay technology for the past century[5-6]. As a protection technique how to effectively curb the failure, so that the efficiency and quality of power system operation are effectively protected, protection work is technical issues need to be addressed technician. This article will explain the power system protection technology related content to enhance research on mechanical and electrical protection technology people, contribute to the safe operation of the power system.

## II. RELAY PROTECTION TECHNOLOGY AND FEATURE

Relay technology is a process in electricity, timely signal transmission circuit failure to effectively prevent electrical accidents resulting technology. With protection devices from traditional electromechanical rectifier shift to integrated computer processing style, the effective use of advanced computer technology, to some extent, led to the development of relay protection technology.

### A. Relay protection works

Because of the type of power system protection devices range, depending on its composition and functions can be divided into electromechanical relay technology, static protection devices and protection devices rectifier three categories. Its working principle is divided into the following steps: 1) the operation of the power system, electrical protection devices take advantage of the protected object measurement module fault signal acquisition; 2) the signal information will be collected with the standard value, delivered to the logic module; 3) analyze and calculate through the logic modules, such as the results of a calculation, the computer will

automatically transfer operation of the signal to the execution module, and then carry out protection work[7].

### B. Development stage relay protection

1) electromechanical relay stage. Since 1949, China's power industry gradually realized the importance of, and thus in the 1950s, a large number of electrical engineering personnel and protection technology-related knowledge and learning, and then, through the tireless efforts of engineers, and finally established with rich power system protection relay team of technical theoretical knowledge and experience for the normal operation of the national power system made a greater contribution[8].

2) relay stage transistors. In phase electromechanical relay, China's electric power system circuit protection technology entirely from abroad, after the 1960s, advances in technology make our power system has created its own line protection technology, and the technology lead in power system protection technology to the relay stage transistors, the most obvious sign of this stage is the application of the Gezhouba transistor relay technology.

3) integrated circuit protection stage. After the 1970s, the transistor relay there are more questions, to which the power system engineering researchers slowly to produce a strong interest in the protection of integrated circuits, integrated circuit protection ultimately makes access to extension, not only to make the transistor relay protection of defects, but also reduces the cost of power system relay protection.

4) relay stage computer. With the rapid economic development, economic development has been rapid, in order to conform to the trend of the times, the power system engineering researchers began working on computer protection, the main transmission line marked by the successful development of microprocessor-based protection device. The relay technology makes more perfect stage for our protection devices has opened up new markets, and fully ensure the safe operation of the power system.

### C. Features of relay protection technology

Relay technology technology as a key factor in the power system is essential, which is characterized as follows:

1) strong compatibility. Relay technology in the manufacturing process of the protection device, using a common practice, it has strong compatibility. This practice helps protect standardized operation of the device, while reducing the number of disk spaces, and enhance the protection of a number of auxiliary functions.

2) monitoring of the strong. Relay technology makes the core components of the protection device is no longer affected by the external environment, and enhance the effectiveness of their use, reducing the cost. At the same time, its role in the network information system, to achieve a strong monitoring function.

3) increase the autonomy of operating efficiency. Protection technology in data processing technology to enhance the memory function relay device, the device fault component

protection, improved protection devices running the correct rate.

### D. The importance of relay protection

The short circuit is a major common factor in the normal operation of electrical equipment can cause, their consequences are very serious, not only will damage components will shorten the life of components and even a threat to the lives and property of the people. To minimize the damage this kind of relay protection technology can be the perfect solution to this problem, it is divided into the following sections: measurement, implementation, logic. If electrical equipment accidents (such as short circuit), the relay can mask out of the power system the faulty components, this process is quick and accurate. This prevents electrical equipment due to failure by the more damage, and can ensure the safety of the work of other normal components.

## III. EASE OF USE

With the continuous development of information technology, protection techniques are becoming increasingly automated, and its application in power system has also been strengthened to some extent.

### A. Line of ground protection

Grounding protection work is very prominent, broadly divided into the following two points: first, to protect the screen of each device barriers chassis grounding problems in the screen must be connected to copper rafts, general manufacturers have done a better job just check carefully. The most important thing is to protect the inside of the copper screen whether reliable access to the network, you should use a larger cross-section of copper wire whip or reliable fastening of the grounding line, and by measuring the insulation resistance meter meets code requirements.

According to the power system wiring lines to the way different sections, the grounding protection is also divided into two large current-Grounding and small current type. Large current-ground protection for the case of the main power system fails, you can immediately cut off the power supply, so as to effectively protect the entire power system; small current grounding fault protection is mainly responsible for conveying signals, that is, when the power system ground fault thick lines, power system normal operation. Given the small current grounding protection of particularity, which mainly consists of the following situations:

1) zero-sequence voltage. Normal operation of the power system is zero-sequence voltage is not present, the formation of mutual relations with symmetrical three-phase voltage, and the three independent displays voltage voltmeter can. When the power system ground fault occurs, the power system will produce zero-sequence voltage protection device automation immediately issued a warning signal, and then to determine the location of a failure by numerical voltmeter shown. Under normal circumstances, its value will decline.

2) zero-sequence current. When the power system failure, zero-sequence current overall upward phenomenon, protection

devices are relatively quick action and timely quickly cut off power to protect the overall power system.

3) the zero sequence power. Zero sequence current at the time of the grounding system failure rendered less volatility, which was a huge change in direction will occur. Under this situation, the timely prevention and protection of power systems is essential.

#### B. Transformer protection

Transformer is one of the important elements indispensable power system, which is to protect the power system security and stability is very important to have a protective effect. Therefore, to strengthen the protection of the transformer is a crucial task.

1) Gas protection. This is mainly aimed at protecting the transformer tank failure. When a fault occurs, the oil and insulating means under the action of arc fault gradually decompose to form larger hazardous gases. Protect the transformer off the gas supply in the event of failure, while protecting the transformer, issued a warning signal.

2) ground protection. Its main earthing transformer directly responsible for the protection device. Usually zero sequence current protection measures, the zero-sequence protection action is set in position on both sides of the transformer, using a current transformer to produce zero-sequence current.

3) short-circuit protection. The main by impedance protection and overcurrent protection in two ways. Impedance protection protective effect through the transformer impedance element, when its running for some time, it will automatically cut off the power supply to the trip in order to effectively protect the voltage device. The overcurrent protection is on both sides of the transformer and the time element, the current protection devices installed, it automatically trip when the current element is run a certain time, and cut off the power supply.

#### C. Transmission line of protection

High voltage transmission lines are generally considered by both sides have the power, the power to take large current grounding system, circuit breakers generally use the split-phase operation, usually integrated reclosing. In the form of failures include: three-phase fault, two-phase fault, two phase to ground fault, single-phase ground fault with anything else there were ten different fault types, taking into account the issue of non-full-phase operation, with the pole double circuit line Cross line failure problems. High voltage transmission lines occupies a very important position in the power system, there is a higher demand for its protection, computer protection, the line sets are designed to protect the general protection, a protection that is completed and all primary protection backup protection functions on the principle, in order to achieve the reserve on the device, usually of double configuration or multiple configurations.

Distance protection by reflecting fault protection device to protect the installation at a distance and movement, usually applied voltage level of 110kV and above transmission lines, the principle can also be applied to 35kV distribution line

voltage level. Constitute the core of the distance protection is to measure the distance to fault protection installed at that, and with a pre-tuning the distance compared to the distance measuring protective action distances less than tuning. The method includes measuring the distance to fault impedance method, the traveling wave method and the radar method, which is the most widely impedance method.

At this stage, the bus relay including two phase contrast and differential protection protection. Phase contrast to protect the effectiveness of the power system in order to improve the protection of the bus as the goal, the use of the applicable phase contrast mode. Small current grounding busbar protection system should be set up in phase short circuit, and the two are connected. When the high-current ground, which is connected by way of a three-phase to achieve protection. Differential protection is interconnected system after the bus terminal and the secondary winding on both sides between the protection device is installed in up to achieve the protective effect of the differential location of the system bus.

#### D. Generator protection

Backup generator protection relay can be divided into two categories and key protection. (1) backup protection. When the low-load power generation stator winding device, protection device will automatically trip and cut off the power supply. This phenomenon should be used overcurrent protection, to prevent the occurrence of insulation breakdown, thus avoiding damage to the generator. (2) protection. The main fault for the loss of excitation conditions. The effective combination of current protection, generator phase and neutral, forming longitudinal differential protection mode. In this process, the individual should pay attention to the generator ground current is too large, ground fault protection device should be installed. On this basis, protection should be installed between turns in the stator windings, in order to avoid short-circuiting the stator winding insulation damage leads to the phenomenon.

### IV. PREPARE YOUR PAPER BEFORE STYLING

The rapid development of computer technology and computer widely used in the fields of Power System Protection, the new control theory and methods are constantly used in computer protection in order to achieve better results, so that the computer protection research to a higher level of development, there have been some dramatic new trend.

1) Network. Computer networks and data communication tools as information technology has become a pillar of the information age, the production of human social life and outlook has changed fundamentally. It is a profound impact on all industrial sectors, but also provides a powerful means of communication for various industrial fields. The basic conditions for realization of such a system is to protect the whole system protection devices to link up all the major computer networks, namely networked computer protection device.

2) Computerization. With the rapid development of computer hardware, computer hardware protection is constantly evolving. Power systems for computer protection requirements continue to increase, in addition to the basic

functions of protection, should also have a long-term storage space capacity fault information and data, fast data processing capabilities, powerful communication capabilities. And other protection, control devices and scheduling system-wide network to share data, information, and the ability to network resources, high-level language programming.

3) Integration technology. Any integration of technology in the final analysis, is to achieve integrated protection devices in the data processing process, always put a single protection devices as a terminal device entire power grid system, which can be obtained from the power system operation and failure online Information and several dig, and it can get any information and data that it is transmitted to the protection element network control center or any terminal.

4) Substation automation technology. Modern computer technology, communications technology and network technology to change the current substation monitoring, control, protection and fault recording, equipment and metering devices and systems division of the state of emergency control provides the technical foundation for optimal combination and system integration. HV, EHV substation is facing a technological innovation. Closely integrated protection and integrated automation has become possible, it is manifested in the integration and sharing of resources, well control and information sharing.

5) Intelligent. Because artificial intelligence logical thinking and fast processing capabilities, artificial intelligence has become an important tool for online condition assessment, are increasingly used in many aspects of the power system, in particular aspects of protection, and its control, management and planning and other areas also plays an important role.

6) Adaptive control technology. The concept of adaptive relay began in the 1980s, it can be defined as the way according to changes in power system operation and fault conditions and changed in real time protection performance, the new protection features or given value. The basic idea is to make the protection of Adaptive Protection can adapt to various changes in the power system as much as possible, to further improve the protection of property. Adaptive Protection has the advantage of improving the response of the system to enhance the reliability and economic efficiency, etc., within the distance of transmission line protection, transformer protection,

generator protection, automatic reclosing and other fields have broad application prospects.

## V. CONCLUSION

People demand for electricity is growing with the development of society. To make the power system can operate safely and reliably, relay technology in China has been very good development. Power system protection can be quickly and effectively removed the faulty device, ensure non-faulty equipment to ensure safe operation, the ability to selectively issued fault alarm signal, maintaining the smooth flow of power systems. Development of power systems for electrical and mechanical protection also put forward higher requirements, protection devices prone to failure, and only regular inspection and maintenance of protection devices, to detect faults and treatment to ensure the normal operation of the power system, to ensure a reliable power supply.

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