Research on Relay Protection Design of Power Transformer

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Abstract: With the rapid development of society, people's living standards are gradually improved, and the application of power protection devices in life is gradually improved. In order to ensure the safe and normal operation of the power system, it can be adjusted in time when problems occur in the power transformer protection system. Thereby ensuring the normal operation of the power system. After long-term research, it is found that it is easy to produce related problems in the power transformer relay protection system, including secondary circuit problems and current mutual inductance faults. This paper studies the design of power transformer relay protection.

1. Introduction

With the continuous development of the society, the level of our national power industry is also running at a rapid rate. The form of the power grid is increasing day by day, and the network density of the society is also increasing. In the entire electrical system, the electrical and mechanical equipment of the power transformer is a very Important power equipment facilities are responsible for the very important conversion work of the power system. Therefore, the power transformer is easily affected by some external natural conditions. During the working period, a large number of transformers are easily damaged, in order to ensure the safety and reliability of power consumption. It is necessary to do the relay protection device for the power transformer according to the actual working conditions.

2. Principle and basic composition of power transformer relay protection system

2.1. Principle of power transformer relay protection system

After long-term research, it is known that in the power system for the relay protection device of the transformer, the main working principle of the system is to self-regulate the pressure transformation capability by the actual numerical fluctuation of the power during the operation of the electric power. An important prerequisite for the normal operation of the power system is the need for the relay protection device to operate normally, thus laying a solid foundation for the transformer relay protection device. The relay protection system will have different protection effects in the actual operation process according to the actual situation. Their principle will also be different. In the process of operation, according to the specific situation, the operation process In the specific analysis of the specific parameters, the data of the obtained parameters are different. According to the data, it is judged whether the relay protection system is in the normal working state. Different data can be used as the data of different operation of the relay protection system, forming different The principle of the content. When the relay protection system is in a normal state or in an abnormal state, a specific analysis is performed. When he is in a normal state, the working principle is to measure and then execute; let the abnormal working state, relay The physical parameters obtained in the event of a system failure in the protection system are compared with the actual parameters.

2.2. Power transformer relay protection system

With the continuous development of science and technology in China, research on power

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transformer relay protection devices in power systems has also been recognized, and the development of microcomputer-based relay protection systems has been developed. At present, the following three aspects of the microcomputer-based relay protection device system have been successfully studied. Firstly, by introducing the current information collection of the entire power system in detail, it provides specific support for the data collected by the transformer, so that the operation of the power value in the power system can be clearly understood, and the detailed currents collected can be collected. The operation is effectively transmitted to the relay protection device of the final power transformer. Secondly[1], for the signal processing aspect of the entire power system, the data of the entire power system is effectively analyzed through comprehensive data collection and sorting, and the cause of the problem is effectively processed according to the relative law. Finally, for the output part of the power system, we also need to transmit the effective output signal to ensure a good regulation in the relay protection device.

3. Design of power transformer relay protection monitoring system

3.1. System structure

The power transformer relay protection terminal monitor includes lightning overvoltage, induced overvoltage, ground current, current direction judgment detection module. The main structure is Rogowski coil, integrator circuit, data collector, CPLD, memory, CPU processor, RS485 data transmission department. Grounding resistance detection module: Includes built-in non-contact sensor, excitation pulse signal generation unit, current detection unit, voltage detection unit, data processor, RS485 data transmission unit. Since the signals being monitored are analog signals, these signals cannot be directly analyzed and processed by the processor. Therefore, the ADC is required to convert the analog signals into digital signals and finally transmit them to the processor. Power transformer relay protection terminal online wireless monitor, including lightning overvoltage, induced overvoltage, ground current, current direction judgment detection module: including Rogowski coil, integrator circuit, data collector, CPLD, memory, CPU processor, Wireless data transmission department. Grounding resistance detection module: including built-in non-contact sensor, excitation pulse signal generation unit, current detection unit, voltage detection unit, data processor[2], and wireless data transmission unit. Power transformer relay protection terminal wired communication management unit, including RS485 interface to SDH 2M, wireless communication management unit, including wireless to RS485 interface, RS485 interface to SDH 2M, communication management unit including SDH 2M to RS485 interface, RS485 interface Transfer USB interface, server program, including real-time display of lightning overvoltage, induced overvoltage, grounding resistance, ground current, current direction, alarm information, graph, data record, topology map, historical data export.

3.2. System function

The power transformer relay protection online monitoring system can realize lightning overvoltage, induced overvoltage, grounding resistance, grounding current and current direction judgment. Lightning overvoltage: The front end adopts Rogowski coil, integral circuit, data acquisition and storage, data processing, adjustable current value, and program capture data unit pulse time 1.2μs~50μs for lightning overvoltage. Inductive overvoltage: The front end adopts Rogowski coil, integral circuit, data acquisition and storage, data processing, adjustable current value, and the program capture data unit pulse time is 250μs~2500μs for lightning overvoltage. Grounding resistance: including built-in non-contact sensor, excitation pulse signal generation unit, current detection unit, voltage detection unit, data processor, RS485 data transmission unit, detection range 0~200 ohms, alarm full range can be set. Grounding current: The front end adopts Rogowski coil, integral circuit, data acquisition and storage, data processing, detection range 0~400A, alarm current value is adjustable. Current direction judgment: The phase detection process of the CPLD is controlled by the high-speed ARM processor through the power transformer relay protection ground wire passing through the Rogowski coil and passing through the integrator to the

complex programmable logic device CPLD. Control process: system power-on, high-speed ARM processor work reset CPLD phase detection[3], waiting time is greater than 2s, high-speed ARM processor enables CPLD phase detection, waiting time is greater than 1s, CPLD phase lock completion notification high-speed ARM processor, high-speed ARM processing The phase data is read and stored; the high speed ARM processor resets the CPLD phase detection, the waiting time is greater than 1 s, the high speed ARM processor enables CPLD phase detection, the waiting time is greater than 1 s, the CPLD phase completion informs the high speed ARM processor, the high speed ARM processor The read phase data is compared with the stored data and is greater than 180 degrees when compared.

3.3. Working methods

The power transformer relay protection grounding wire passes through the Rogowski coil, the Rogowski coil output is connected to the integrator module, the integrator module output is connected to the 10M acquisition/8-bit module, the acquisition module output is connected to the data processing unit, and the data processing unit pairs the collected data. The processing is performed to distinguish whether there is lightning overvoltage and induced overvoltage, and whether it is lightning overvoltage or induced overvoltage, and the data processing unit processes the data output to the display unit and the output interface (RS485 or 433M). In order to maintain the accuracy of the acquired signal, a sample/hold circuit needs to be added between the signal source and the A/D converter to ensure the reliability of the signal source. In order to improve the accuracy of the system, the sampling time of the sample/hold circuit is as short as possible, and the longer the retention time, the better. There are many types of A/D converters, and a successive approximation type A/D converter is generally used. The power transformer relay protection grounding wire passes through the Rogowski coil, the Rogowski coil output is connected to the integrator module, the integrator module output is connected to the 10k/24-bit acquisition module, the acquisition module output is connected to the data processing unit, and the data processing unit pairs the collected data. Processing and calculating the ground current value and calculating the phase value, the data processing unit processes the data output to the display unit and the output interface (RS485 or 433M). The power transformer relay protection grounding wire passes through the sensor, the data processing unit triggers the pulse generation module, the pulse generation module output is connected to the sensor,[4] the sensor outputs a current signal to the data acquisition module, the data acquisition module outputs to the data processing unit, and the data processing unit pairs The collected data is processed to calculate the grounding resistance value, and the data processing unit processes the data output to the display unit and the output interface (RS485 or 433M). The output interface (RS485 or 433M) output is connected to the monitor communication management unit. The monitor communication management unit converts the data into the SDM module 2M output. The monitor communication management unit remotely outputs the data to the server communication management unit. The server communication management unit will The SDH module 2M signal is converted to a USB interface, and the server communication management unit output is connected to the server.

4. Fault type of power transformer relay protection system

Under normal circumstances, we simply divide the fault types of power transformer protection devices into two types, namely, internal tank failure and external tank failure. In general, the main cause of internal faults in the fuel tank is caused by problems such as internal phase-to-phase short-circuit, short-circuit to ground, and short-circuit of the core. Since the probability of occurrence of internal faults in the power transformer device system is very high, and the risk factor of internal faults is large, when an internal fault occurs, a large arc generated will not only burn the insulation part of the transformer[5], but also make the transformer Most of the internal insulators generate a large amount of toxic gases under severe heat conditions, which may cause explosions in the fuel tank inside the transformer to cause serious personal safety accidents. Therefore, the internal faults of the transformer need to be promptly applied to the relay protection device. Check

to avoid serious accidents. The main cause of the failure of the external fuel tank is the phenomenon that the resistance line of the transformer itself is related to the circuit or grounding disconnection of the insulator. In addition, for the power transformer relay protection can not operate normally, we need to summarize from the following aspects. First, the current caused by the short circuit of the external line of the power transformer is too large, or the actual transformer load is overloaded. Secondly, the oil leakage of the transformer's own tank will cause the oil level to drop, which will result in the inability to cool in time when the transformer fails, and the temperature is too high. These phenomena will undoubtedly cause serious damage to the internal metal facilities of the transformer itself, resulting in damage to the transformer insulation, which will cause subsequent accidents to occur continuously.

5. Design measures

5.1. Differential protection design

If there is a problem such as short circuit, oil leakage, insulation failure, core burning and oil level drop inside the transformer, then the application of the differential protection design is not ideal and will be limited. In this case, the best application Gas protection design. Mainly to put the gas relay device into the oil guiding pipe of the transformer[6], so as to achieve the effect of gas protection. We can divide the gas protection into two kinds, one is the light gas protection device, which mainly judges the nature of the failure and the cause of the failure of the color and quantity of the gas. The other is to protect heavy gas, monitor the speed of gas generation, analyze the main components of the gas, and finally find out the main problems and the extent of the failure. There are two main types of gas protection: 1 First, the light gas protection acts on the signal, and then according to the properties of the gas, including: color, flammability, quantity and chemical composition, the reason for the protection and the nature of the failure of the power transformer relay protection device. According to this, the relevant staff can detect the occurrence of the fault in time and deal with the fault in a targeted manner. 2 Firstly, the heavy gas protection action is tripped to the circuit breaker, and then the speed of gas generation is determined by monitoring, and the different characteristics of the gas and related components are analyzed, thereby indirectly estimating and judging the cause of the failure and the occurrence of the fault according to the relevant analysis. The location and the severity of the fault.

5.2. Transformer Relay Protection Design Principles

First, if it is to be operated under normal conditions, it is necessary to loop the transformers on both sides of the transformer, and follow the secondary current of the current transformer under normal operation of the transformer protection current[7]. When the operating state of the transformer is normal, the current in the differential relay generates a secondary current. At this time, the secondary current value of the current transformer is zero. If the differential relay does not produce an action, its protection will not move. If the current transformer occurs in the secondary circuit, the transformer at this time will be in a large state, and the differential protection will have no other action. In recent years, the performance of computer chips has been greatly improved. Therefore, in the protection device of the transformer, all the backups are mainly protected, and the protection device of the main transformer is fully developed. The application results are very extensive. It is also applied to power engineering[8]. Therefore, if a double differential protection is installed in the high-voltage transformer, it will react to the casing and internal faults of the transformer, and realize the differential protection of the short circuit between the winding of the transformer and the winding. In addition, the most important protection is the current quick-break protection, which achieves the effect of breaking the circuit breaker instantaneously.

5.3. Overcurrent protection device

Under normal circumstances, if the three-phase transformer is applied mainly on the low-voltage side of the transformer, once the short-circuit occurs on the pressure side, or if the impedance

protection is not exerted, then the protection will not be achieved. Therefore, the backup of all adjacent components must achieve the protection. If this problem occurs, a composite voltage blocking overcurrent protection can be designed on the low voltage side, or a composite voltage blocking overcurrent protection can be installed on the high and medium voltage sides[9]. In addition, when designing the high-voltage transformer protection device, when the high-voltage side current protection of the transformer will have a certain sensitivity to the low-voltage side busbar, it is possible to install a protection device for the high-voltage side short-circuit of the transformer and the low-voltage side circuit breaker. Once the low-voltage side of the transformer has a shutdown problem and a fault occurs, an abnormal situation occurs between the switch and the TA. At this time, the protection device is used as a backup protection design for the low-voltage side bus of the transformer, and can also be used as a main protection design application. [10]. One thing we can neglect is that when a non-metallic short circuit occurs, there will be impedance protection with insufficient sensitivity, or a delay and timeout problem. In the process of solving the above problems, the best solution is to design a protection device on the high voltage side of the transformer to install a protection transformer, that is, a thermally stable inverse time overcurrent device. And the setting value of this setting must be adapted to the thermal stability of the transformer. In addition, the low-voltage side of the transformer must be protected accordingly, and a current protection device is installed.

6. Conclusion

The electromechanical protection device is very important in the operation process. When the electromechanical protection device of the whole power transformer is in the running state, to some extent, the transformer's own relay protection device plays an important protective role, so the transformer is In-depth research on relay protection devices should be taken seriously.

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