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# APPLICATION OF RELAY PROTECTION AUTOMATION TECHNOLOGY IN POWER SYSTEM

Rujiroj Vanfretti
*KTH Royal Institute of Technology, Stockholm, Sweden.*

**Abstract:** The demand for electric power resources in various fields of society continues to increase, making this resource an indispensable part of people's daily lives and production processes. This not only promotes the development of electric power enterprises, but also brings greater challenges to them. The reason is that high demand will inevitably affect the stability and safe operation of the system. Therefore, it currently needs to be dealt with through relay protection. This article introduces relay automation technology and its application in many aspects such as busbar and grounding protection applications are discussed in detail.
**Keywords:** Power system; Relay protection; Automation technology; Application

## 1 RELAY PROTECTION DEVICE

The power system must be continuously adjusted according to the power demand, otherwise it will cause safety accidents due to faults and cause immeasurable losses to the enterprise. The solution to this problem must be achieved through relay protection devices, which can promptly respond to system failures[1-2].

### 1.1 Operating Characteristics

The relay protection device can transmit signals in time when the power system fails and control other equipment, limiting the impact of the fault to a certain range, and can also remove the fault. In addition, relay devices can also have problems during operation, mainly in two forms[3]: (1) Refusal to act, that is, failure to send a signal in time and cut off the fault when a problem occurs in the system; (2) Misoperation fault mainly refers to the phenomenon of signal or action error of the protection device. This mainly refers to traditional protection devices. The currently developed relay devices have automation characteristics and can realize comprehensive monitoring of the power system, obtain the most time-sensitive information, and master the parameters of various types of equipment during operation, and Ability to remotely monitor and control equipment[4-6].

### 1.2 Basic Requirements

In order to ensure that the power system is always in a stable operation state, the relay device must meet the following requirements:

***1.2.1 Selectivity***

That is, when the system is abnormal, the fault location must be accurately determined and selectively removed to avoid affecting other parts.

***1.2.2 Sensitivity***

That is to say, it is clear about the scope of protection it covers, and only reflects the areas it is responsible for, ensuring that it can act in a timely manner.

***1.2.3 Quickness***

That is, the fault must be responded to and removed immediately to prevent the fault from being left unhandled and evolving into a larger problem that affects other parts of the system.

***1.2.4 Reliability***

This is the most basic requirement. Otherwise, it will be difficult for the protection device to respond to system faults, which will cause the scope of the fault to continue to expand and eventually lead to problems in the entire system. In this case, it will inevitably cause immeasurable damage loss.

## 2 RELAY PROTECTION STRATEGY

The application of relay protection technology began in the 1960s, and then the protection functions became more and more perfect driven by science and technology. The emergence of automation technology began in the 1990s and mainly includes three contents:

### 2.1 Microcomputer

It has extremely strong computing and logic processing capabilities, and can monitor the operating status of the equipment at all times and accurately detect various parameters.

### 2.2 Client

Installed in substations, it can protect the interface of the wave recorder and obtain the most timely information; detect the operating status of the power system, generate fault reports, and receive accident reports; can monitor the working status of technicians and upload various abnormalities in a timely manner information.

### 2.3 Network and Scheduling Support

Relay protection requires network connection and scheduling support so that resources can be shared and the system will not be affected by faults.

## 3 TECHNICAL APPLICATIONS

### 3.1 Line Ground Protection

The system circuit is extremely complex and the grounding methods vary greatly. It can be mainly divided into two different types: large current and small current. For the former grounding method, the way to deal with the fault is to cut off the power supply, while for the latter, it is judged based on the alarm signal sent by the relay device, and the system is processed as soon as possible within the limited time that the system can operate. When the current grounding system is single-phase grounded, the line can be regarded as phase A grounding. The grounding point flows through phase B and phase C capacitance and zero sequence current. After analysis by relevant personnel, phase A is in a voltage-free state, and the fault current voltage drop is UR0. , according to the B-phase voltage, it can be concluded that UB =V3EAe - j1502 - URO, UC = √-3EAe -j1502 -URO. The small resistance voltage in this state is extremely small and can be ignored directly. The line voltage value of the three-phase voltage is symmetrical, larger than the phase voltage value, about V-3 times of the latter. In the specific calculation process, the symmetrical component method can be selected, and it can be inferred that the current direction of each phase is the same. Therefore, phase A is grounded during a fault, causing both line and ground fault types to trip simultaneously.

Appropriate protection measures should be selected based on the type of ground fault, which mainly include the following points:

(1) Zero-sequence power. When a ground fault occurs, the power direction will change. The current will be relatively stable and the fluctuation will not be too violent. This can not only predict the fault, but also protect the system.

(2) Zero-sequence current will increase sharply in a short period of time when the system line fails. At this time, the relay protection can cut off the power supply in time.

(3) Zero sequence voltage, which is mainly generated during the occurrence of system ground faults and needs to be processed according to the alarm signal of the relay device.

Maintenance personnel must observe the voltmeter in detail and make judgments based on the displayed values to understand the fault characteristics. Normally, voltage values below normal indicate a ground fault and should be addressed as soon as possible.

### 3.2 Transformer Relay Protection

Transformer protection mainly includes the following points:

#### *3.2.1 Short circuit protection*

It can be divided into two different forms: impedance and overcurrent. The former is mainly the impedance component. The component will decide whether to cut off the power supply based on the length of running time, so as to achieve the purpose of protecting the voltage regulator. The latter mainly refers to installing a relay device in the current component. The current component will decide whether to cut off the power supply based on the running time.

#### *3.2.2 Gas Protection*

If the temperature of the transformer oil tank deviates greatly from the normal state, it will cause the insulating material and oil and gas to decompose. At this time, toxic and more harmful gases will be produced. Therefore, it is necessary to activate the protection device through gas protection, cut off the power supply in time, and Send out an alarm signal, prompting maintenance personnel to find faults and deal with them as soon as possible.

#### *3.2.3 Ground Protection*

Targeted processing needs to be carried out according to whether the transformer is grounded. Zero sequence voltage should be selected when it is not grounded, and zero sequence current should be selected when it is grounded.

### 3.3 Generator Relay Protection

Generators are closely related to the operating quality of the power system, so it is very necessary to carry out relay protection for generators. Specifically, the relay protection of this equipment mainly includes two key points:

#### *3.3.1 Key protection*

When the generator is short-circuited, the temperature of the faulty part will be higher than the normal value, causing the insulation layer to be damaged. Therefore, it is necessary to install a relay device between the turns to ensure that the stator turns can always be in a stable operating state and reduce the probability of failure. In addition, if the single-phase ground current deviates, it is necessary to combine the center point and phase through a relay device to achieve the purpose of longitudinal differential protection.

#### *3.3.2 Backup protection*

The main form of protection is overvoltage, which prevents equipment breakdown, especially when the load is low. This protection method can prevent short-circuit faults from damaging the engine, and can automatically cut off the power supply under low load conditions and provide feedback to maintenance personnel in the form of alarms, allowing personnel to handle faults in a timely manner.

### 3.4 Busbar Relay Protection

There are two different types of busbar protection.

(1) Phase contrast protection, this method can make the bus more reliable.

(2) Differential protection is operated by setting a transformer on the busbar component. After connecting the terminals and windings, a relay device can be installed. The installation location is the differential part of the busbar.

For the two different grounding methods of large current and small current, the three-phase and two-phase methods are adopted respectively during the connection process.

The operator of a substation resumed operation of the 220kV transformer after the test. During the specific operation, he first closed the isolation switch, but when he closed the main switch, it tripped directly, causing the 220kV protection that was in operation to have no voltage. , after inspection, it was found that only the 220kV auxiliary bus had voltage, while the bus switch and the secondary circuit were disconnected and out of contact. However, the results measured by the relevant personnel with a multimeter showed that there was voltage on the positive bus A phase, and it was connected to the auxiliary bus A. The phases are completely consistent, so it can be inferred that the positive bus A-phase voltage is connected by the switching contact. After confirmation, it is determined that the cut-off contact is connected, thereby realizing the connection of the positive bus voltage, causing the auxiliary bus to be reversely charged to the positive bus side. This is The direct cause was that the main switch tripped, and then returned to normal operation after replacing the switching plug-in.

## 4 CONCLUSION

All in all, the current demand for electric energy from all walks of life is relatively high, resulting in the continued expansion of the scale of electric power companies, and the number of electric power companies in the market is also continuing to increase. Under this situation, the management difficulty of enterprises is also relatively higher, so it is necessary to reasonably Apply relay automation technology and master the principles and application standards of this technology, so that various faults can be dealt with in a short time.

## COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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