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Protection of Transformer by Using Differential Protection Scheme

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***Abstract*: Differential protection is provided in the electrical power transformer which are higher rated. This type of protection can detect internal faults in the transformer. However, it cannot prevent external faults from occurring in the transformer. If a short circuit is detected in the bushings, then the Buchholz relay cannot effectively cover it. In addition to detecting internal faults in a transformer, Buchholz relays can also be utilized to detect other types of faults. But, the differential protection scheme is faster than the Buchholz relay. This ensures that the relays can respond to the faults that occur in the side of the transformer that's in differential protection zone.**

***Keywords*: Differential, Protection, Transformer, Relay.**

1. Introduction

The function of protective relaying is to initiate the prompt removal of the faulty element from service in order to minimize the damage to the system [1]. Power transformers are very expensive and vital components in electric Power systems. They occasionally Experience faults resulting from insulation failures caused by atmospheric disturbances and switching surges. These transformer faults can be divided into two main classes. The first class is internal faults the second class is external [2].

Transformer faults can be divided into two main classes. Differential protection is a unit-type protection for a specified zone. It is based on the fact that it is only in the case of faults internal to the zone that the differential current (difference between input and output currents) will be high. The function of protective relaying is to initiate the prompt removal of the faulty element from service in order to minimize the damage to the system [3]. However, the differential current can sometimes be substantial even without an internal fault.

This is due to certain characteristics of current transformers (different saturation levels, nonlinearities) measuring the input and output currents, and of the power transformer being protected. with the exception of the inrush and over excitation currents, most of the other problems, can be solved by means of the percentage of differential relay, which adds to the normal differential relay two restraining coils fed by the zone-through current, by proper choice of the resulting percent differential characteristic, and by proper connection of the current.

On each side of the power transformer. The power transformer is star connected on one side and delta connected on the other side. The CTs on the star connected side are delta-connected and those on delta-connected side are star-connected. The neutral of the current transformer star connection and power transformer star connections are grounded.

To overcome this problem the kick fuse is placed across the relay coil. These fuses are of the time-limit type with an inverse characteristic and do not operate in short duration of the switch in the surge. When the fault occurs the fuses blow out and the fault current flows through the relay coils and operate the protection system. This problem can also be overcome by using a relay with an inverse and definite minimum type characteristic instead of an instantaneous type.

The relay whose operation depends on the phase difference of two or more electrical quantities is known as the differential protection relay. It works on the principle of comparison between the phase angle and the magnitude of the same electrical quantities. Differential current relay is exercising to protect power transformer in condition of internal fault. It is Mostly two types Differential Relay and Percentage Differential Relay [4].

A. Transformer Protection Using Differential Relay

A differential relay is a state that the relay working whiles the phase angular of two or extra identical electric, values Exceeds a set value. The differential relay function on the Concept of differentiating with the phase angle and value of Two or extra similar electrical values. Differentiate two Electric values in a circuit by utilizing differential relays is Easy in utility and high quality in action.

Perhaps the best technique for protection to protect transformers is the Differential protection approach with the aid of the use of differential relay circuits. This method is primarily based on the standard that the power fed to the transformer under typical conditions is equivalent to the power out. By legitimate association of the secondaries of current transformers (CT), under typical conditions, no current will stream into the relay coil. Whenever a fault takes place, the current equilibrium will not exist and relay contacts will close and fed a trip signal to Circuit Breakers (CB) to work to isolate the faulty equipment [5].

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2. Methodology

A. Block Diagram

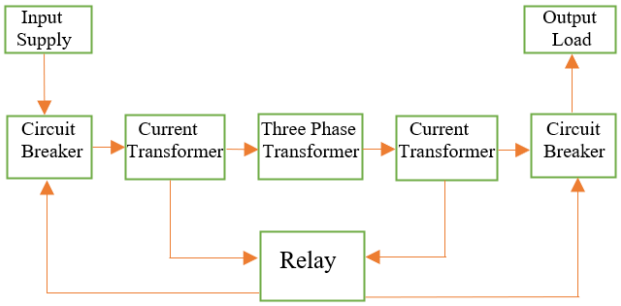

Fig. 1. Block diagram of differential Protection system

The above diagram shows the arrangement of Differential Protection Transformer are used for large rated transformer. It consists of six identical current transformer for sensing unbalance current relay for sense faulty current. And circuit breaker for tripping. The secondary of current transformer are connected in star through the pilot wires the relay operating coil R1, R2, R3 are connected across natural point wire end. The relay is connected between pilot wires of current transformer secondary side. First we measuring the three phase current on both sides of transformer [6]. During normal working conditions the currents in pilot wires fed from CT connection are equal. The differential current like the differential between primary side and secondary side is zero current are same and no current flow relay coil is equal. When line to line fault or line to ground fault occurs the current through current transformer secondary is different the different current is produced. Which flow though pilot wires and relay coil. The respective relay coil is thus energies and send trip to circuit breaker after circuit breaker operation transformer is disconnected from system. Under Normal conditions, ideally no current will flow into the relay coil, i.e .the deferential current is equal to zero. Whenever a fault occurs, within the protection zone, the current balance will no longer exist and the relay contacts will close and release a trip signal to cause a certain circuit breakers (CB) to activate in order to disconnect the faulty transformer [7].

B. Circuit diagram

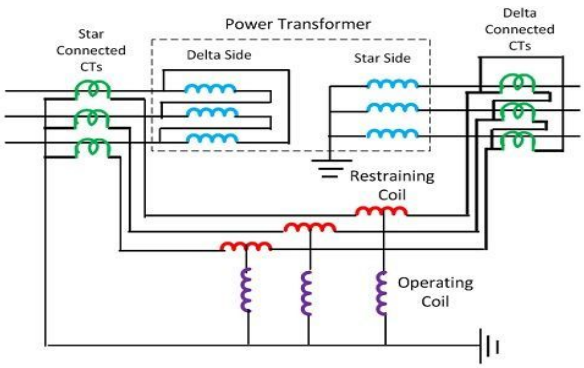

Fig. 2. Circuit diagram of differential protection system

The circuit diagram of differential protection transformers used for big rated transformers is shown in the diagram above. It is made up of six identical current transformers that detect unbalanced current and defective current using relays and a trip-safe circuit breaker. The relay operating coils are connected across the natural point wire end, and the secondary of the current transformer is connected in a star pattern through the pilot wires. The relay is attached to the secondary side pilot wires of the current transformer. The currents in pilot wires fed

From the CT connection are equal when everything is operating normally. The differential current is equal to zero and no current flows through the relay coil when the disparity between the primary side and secondary side is zero.

3. Differential Connection Using Time Overcurrent Relays

Overcurrent relays without restraint are seldom used in present-day Applications due to their susceptibility to false Operation from the following causes:

1) Inrush magnetizing current when energizing Transformer.
2) Saturation errors or mismatch of current transformers.
3) Excessive excitation current when transformer is overexcited.

The term “differential” relaying refers to any relay that uses the total of all currents entering and eating the protected zone [9].

4. Differential Connections Using Percentage

Differential Relays. To avoid undesired tripping due to a mismatch, restraint may be added for through (external) faults. This permits a more sensitive setting, and somewhat faster operation at low fault currents There is also some benefit in case of saturation errors. The restraining force disappears or is a much smaller percentage of the operating force, when the fault is internal. These relays are particularly applicable to power transformers of moderate size located at some Distance from major sources of generation [8]. Basis of the conventional percentage differential relay is that the differential current is more than a predetermined percentage of the restraint current. Magnitude of the fundamental component of the difference between the sampled values of the primary and secondary currents in per unit of each phase of the transformer, as measured by CTs’ secondary, is obtained using one cycle Discrete Fourier Transform [10].

5. Conclusion

The protection of transformer is very important because the transformer is a very important link in the power system. This protective device does not prevent their cause of fault or occurrence of fault it is used after the occurrence of fault for quick action to remove those fault section for further normal operation. The differential protection scheme is a quite reliable method used to protect transformers from external faults.

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