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Digital Differential Protection of Power Transformer using MATLAB

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Abstract - *The two major items of equipment in a power system are the generators and transformers. Chances of fault occurrence on them are very rare as compared to on lines, but the damaged caused by the fault usually takes much more time and money to repair then are required to repair the damage caused by the fault on the lines. Current transformer secondary current for the winding of a power transformer are used to produce a differential current. An operating current value is obtained from the differential current value. A restraining current value is obtained from processed winding current values. Second and fourth harmonic values of the differential current are obtained and are summed with a restraining current quantity which is a result of the restraining current multiplied by a slope characteristic factor. If the operating current value is greater than the second and fourth harmonic values, an output signal is produced which may be used as a trip signal unless it is blocked by selected blocking signals generated by another portion of the system.*

Key Words: MatLab Simulation, MatLab Modeling, Differential protection relay.

I. INTRODUCTION

The two major items of equipment in a power system are the generators and transformers. Chances of fault occurrence on them are very rare as compared to on lines, but the damaged caused by the fault usually takes much more time and money to repair then are required to repair the damage caused by the fault on the lines. Rapid reclosing of circuit breaker is feasible on lines and it helps in saving the amount of damage while a fault in a transformer always required some attention of the supervisor staff. Fast clearing of faults, however assists in reducing the damage to the equipment and also reduces the interruption in power service caused by drop in voltage and from instability [1] .

Small distribution transformer are usually connected to the supply system through series fuses instead of circuit breakers. Consequently no automatic protective relay equipment is required. However the probability of faults on power transformer undoubtedly more and hence protection is absolutely necessary.

The transformer is major and very important equipment in power system. It requires highly reliable protective devices. The protection scheme depends on the size of the transformer. The rating of transformer used in transmission and distribution system ranges from a few KVA to a several MVA. For small transformer of medium size over current relays are used. For large size transformer differential protection is used.

Types of faults in transformer

- Internals fault
- Transformer overload
- Insulation breakdown
- Oil contimination and leakage
- Phase to phase fault
- Phase to earth fault

2. SYSTEM ANALYSIS

2.1 Differential protection scheme

This scheme is based on the principal that the input power to the power transformer under normal condition is equal to the output power. Under normal condition, no current will flow into the differential relay current coil. Whenever a fault occurs, within the protected zone, the current balance will no longer exist, and relay contacts will close and release a trip signal to cause the certain circuit breaker (CBs) to operate in order to disconnect the faulty equipment/part. The differential relay

compares the primary and secondary side currents of the power transformer. Current transformer (CTs) are used to reduce the amount of currents in such a way their secondary side currents are equal. Fig. 1 shows the differential relay in its simplest form. The polarity of CTs is such as to make the current circulate normally without going through the relay, during normal load condition and external faults.

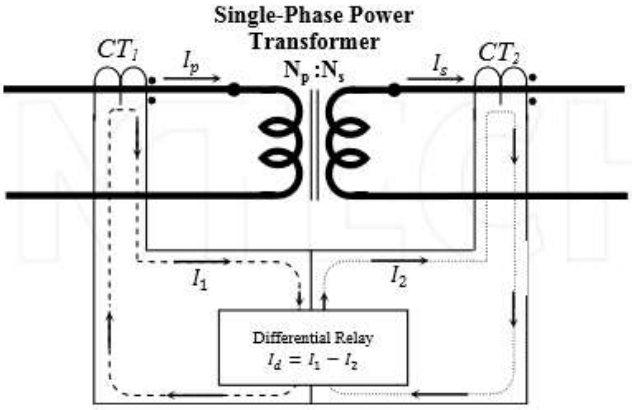


Fig 1 Differential Protection Scheme

3 Working of Differential

3.1 Normal condition

Differential protection relies on the Kirchhoff principal that states that the sum of currents entering a node equals the sum of current leaving a node. Applied to differential protection, it means that the sum of current entering a bus equals the sum of those leaving. If the sum of these currents is not zero, then it must be due to a short circuit either by an earth fault or a phase to phase fault,

Differential relays take a variety of forms, depending on the equipment they protect, the definition of such a relay is "one that operates when the vector difference of two or more similar electrical quantities exceeds a predetermined amount"

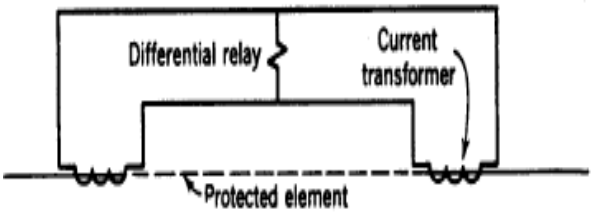


Fig 2 Protection under normal condition

Figure 1illustates the implementation of a simple differential protection application. The dashed portion of the line indicates the protected zone. CTs are installed at either end of the segment and the secondary winding of the CTs are interconnected with a differential relay in parallel.

3.2 Under fault condition

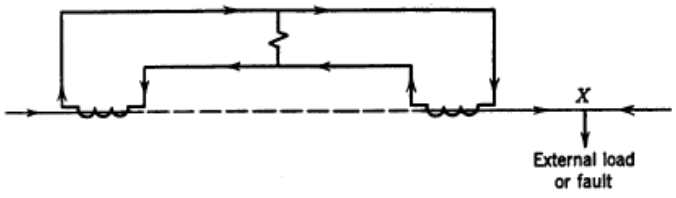


Fig 3 Protection under external fault

If there is current flow through the line to a load or external fault at X the differential protection should not trip. Provided that the 2 CTs are of the same ratio and property connected, the secondary currents of the CTs should only circulate as shown by the arrows in figure. There, no current should flow through the differential relay.

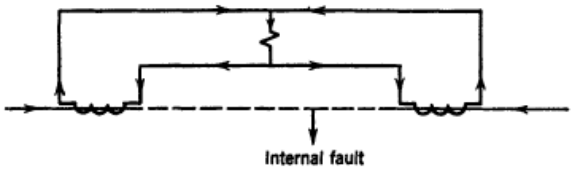


Fig 4 Protection under internal fault

Figure illustrates the occurrence of an internal fault. In this case, the sum of currents entering the protected segment does not equal the current leaving. This results in current flowing through the differential relay, which then initiates a trip.

4. SYSTEM DESIGN

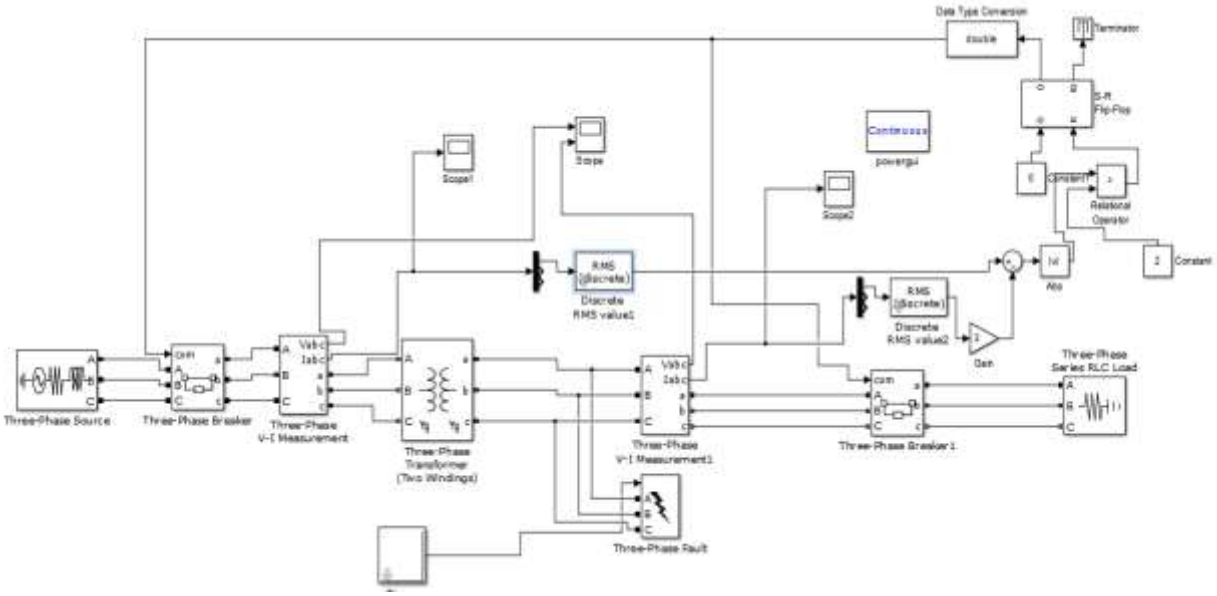
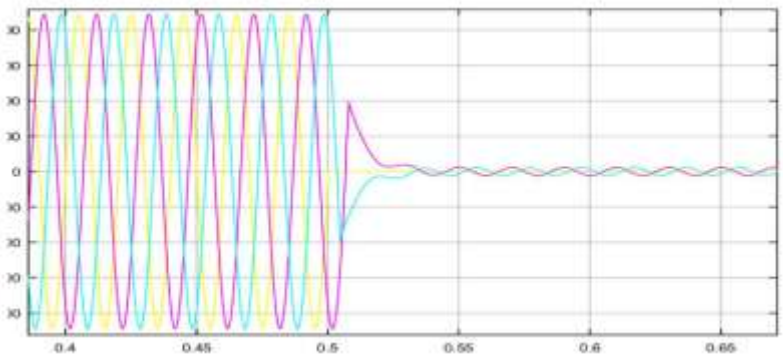
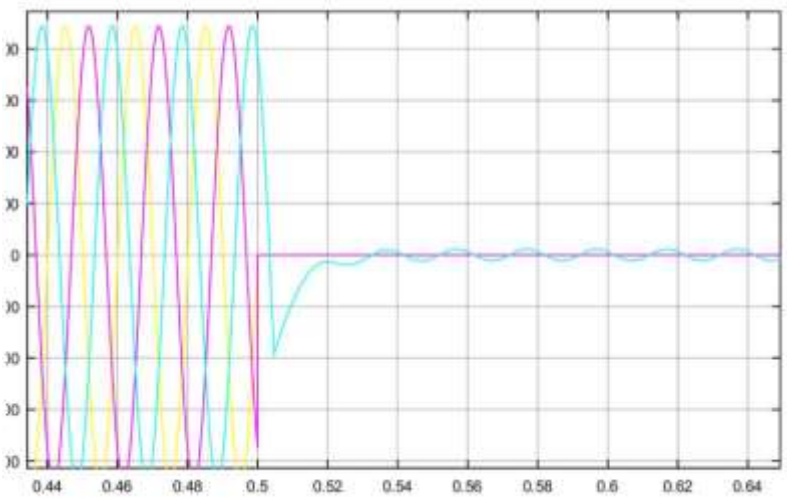


Fig 5 MATLAB SIMULATION Model

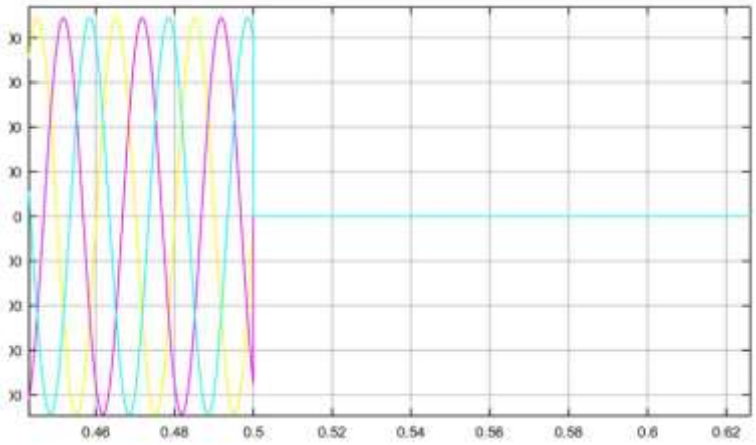
4.1 L-G fault



4.2 L-L-G fault



4.3 L-L-L fault



5. Advantages

- It is used to protect a specific piece of equipment i. e. transformer, Generator, Bus section etc.
- It operation time is very fast and easily coordinated with other types of relaying, fusing system,
- Required less power for control operation.
- No fire hazards.

6. Conclusion

It can be conclude that differential protection technique can be applied to the protection of any device in power system. It can be useful for protection of generator, bus bar protection, transformers protection etc. the technology of differential protection is not new but it is very useful for the unit protection. The equipment's like transformer and generators are very coasty so protection of them is very important. The disadvantage of this technique is that it cannot operate when an external fault is in the power system. This technology can be made better with the use of microcontroller. With the use of controller the technique becomes very accurate and all relay are operated with the use of microcontroller. And also due to use of microcontroller all parameters can be controlled.

REFERENCE

[1] "Adel Akataibi & M.Azizur Rahman", Digital Differential Protection of Power Transformer.

[2] "M. A. Rahman", Software Design Technique for Differential Protection of Power Transformer**.**

[3] "M. Azizur Rahman", Digital Differential Protection of Power Transformer using MATLAB.

[4] "Nikhil Paliwal & Dr. A. Trivedi", Analysis of Modern Digital Differential Protection for Power Transformer.