Scientific Journal of Impact Factor(SJIF): 3.134

e-ISSN(O): 2348-4470
p-ISSN(P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2,Issue 6, June -2015

ANALYSIS OF INTERNAL AND EXTERNAL FAULT FOR STAR – DELTA TRANSFORMER USING PSCAD

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Abstract: - *The differential protection is a unit protection scheme. This paper described about performance of differential relay in transformer using PSCAD software. The differential protective scheme of transformer should operate only for the internal fault. So that this protection scheme should not operate for any external fault and the magnetizing inrush current due to energization of the transformer under no load condition. This Protective scheme is analyzed using Fast Fourier Transform (FFT) technique to provide the dual slope differential relay operating characteristics.*

Keywords: - *Power transformer, Current transformer, Differential protection, Fast Fourier transforms*

I. INTRODUCTION

Differential protection is a unit-type protection for a specified zone or piece of equipment. It is based on the fact that it is only in the case of internal fault and when differential current (difference between input and output currents) will be high. 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. Over-current protection, differential protection and gas accumulator are three types of protection that are normally applied to protect power transformers.

II. BASICS OF DIFFERENTIAL PROTECTION

The basic operating principle of differential protection is to calculate the difference between the current entering and leaving the protected zone. There is a phenomenon that occurred during removal of external through fault or due to energization of the transformer under no load condition named magnetizing inrush current. The differential protection scheme should remain insensitive for such magnetizing inrush current. The differential relay should not operate for the external/through fault. The protective scheme should operate only for the internal fault and it must be insensitive for any fault outside the zone of protection.

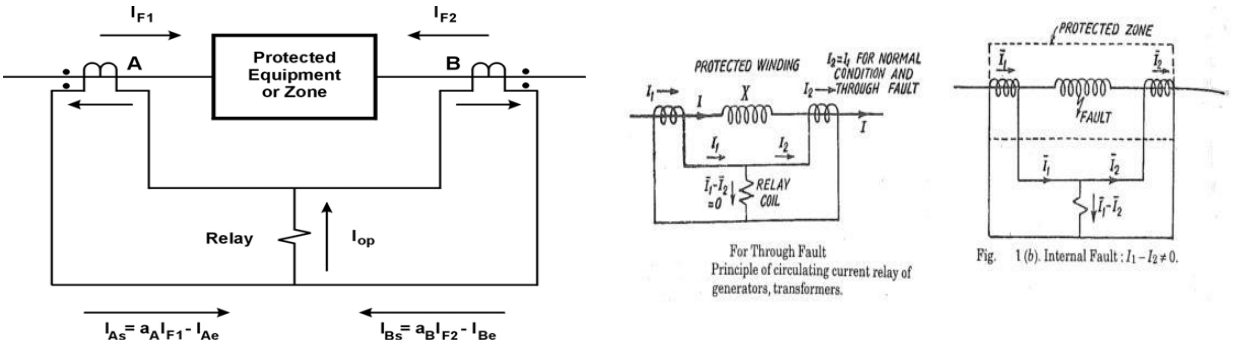

Figure 2.1: Differential relay current during normal situation, internal fault and external fault [5]

The protection operates when the differential current exceed the set bias threshold value. For external faults, the differential current should be zero, but error caused by the CT saturation and CT ration error leads to non-zero value. To prevent mal-operation the operating threshold is raised by increasing the relay setting. Mal-operation of the differential protection of power transformer may occur due to magnetizing inrush current, CT saturation and through fault inrush. Among all these three; magnetizing inrush results during excitation of Transformer under no load condition. It can also consider during the energization of parallel connected power transformer.

For this setting of four relay parameter is very important.

IS1: The basic differential current setting

K1: The lower percentage bias setting

IS2: The bias current threshold setting

K2: The higher percentage bias setting

The tripping criteria can be formulated as:

Case 1

I bias< Is2 (1)

Idiff > K1 * I bias + Is1 THEN TRIP

Case 2

I bias> = Is2 (2)

Idiff > K2 * I bias – (K2 – K1) * Is2 + Is1 THEN TRIP

Fast Fourier Transform technique is used for preventing the mal-operation. The secondary current signals from the CTs are sampled at a regular interval. This is an online Fast Fourier Transform (FFT), which can determine the harmonic magnitude and phase of the input signal as a function of time. The input signals first sampled before they are decomposed into harmonic constituents. FFT technique is use to block the 2nd and 5th harmonics of the differential current and to avoid mal-operation of differential relay due to inrush current.

III. Problems of differential protection applied to power transformers

- Two current transformers do not identical, even when they are from the same manufacturer and have the same ratio and type.
- The saturation characteristics of two current transformers and their excitation currents are not identical.
- Saturation of the current transformers affects the waveform and reduces the output of the transformer current. The difference of the outputs of the two current transformers is represented as relay operating current.
- Difference in the value of resistances of the pilot wires is affecting the symmetry of signals. This difficulty is solved by connecting adjustable resistors to pilot wires.
- The incoming and outgoing sides of a transformer have different voltage levels and currents. For this reason, the ratio of current transformers used on the two sides of a differential protection is different. This increases the mismatch of the current transformers. This difference is corrected in numerical relay by scaling used in their software.
- The power transformer connection produces a phase displacement in the primary and secondary side's voltages and currents.
- Tap changing alters the ratio of voltages and currents on the high voltage and low-voltage sides. The variation in secondary currents due to tap changing does not produce relay operation so that enough bias should be provided.

IV Simulation Model and Result Analysis

Simulations is done for internal fault and external fault condition.

A. Simulation Model for Star-Delta connection of transformer to Internal Fault

- This model is used only for to test differential protection in 3 Phase Transformer.
- Star – Delta connection of transformer is connected between to two sources and two breakers. Phase to ground internal fault is created in this system.

- Parameters:
  - Source: 100 MVA
  - Transformer 13.8/230 kV, 100MVA
  - CT Rating: 1/1000, 1/300
  - Fault: Phase – Ground (0.2 sec)
  - Fast Fourier Transformation

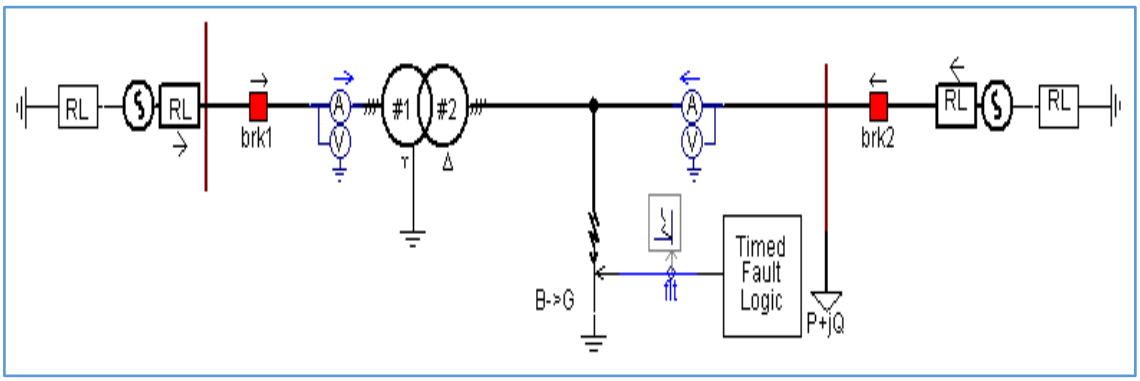

Figure 4.2: Simulation model of transformer differential protective scheme for Internal fault (Phase - Ground)

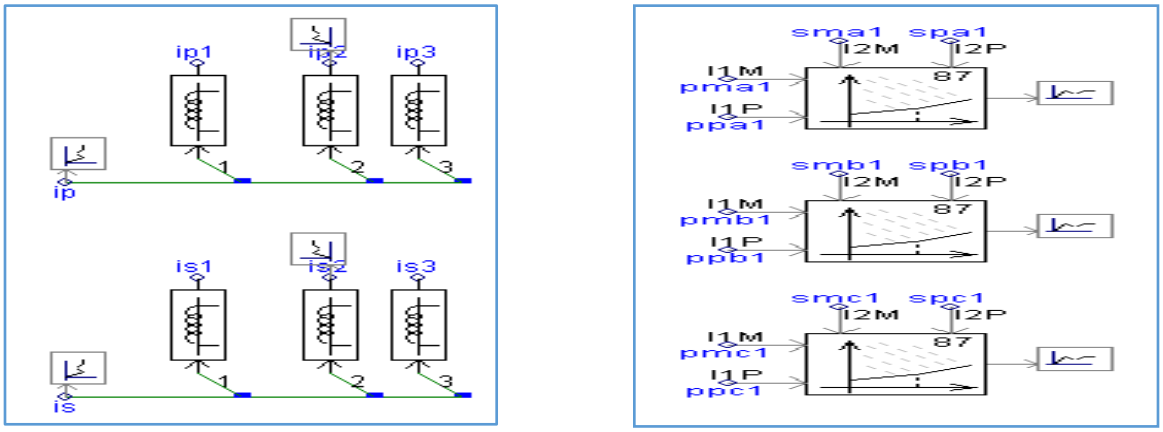

Figure 4.3: Current Transformer and Differential Relay connections

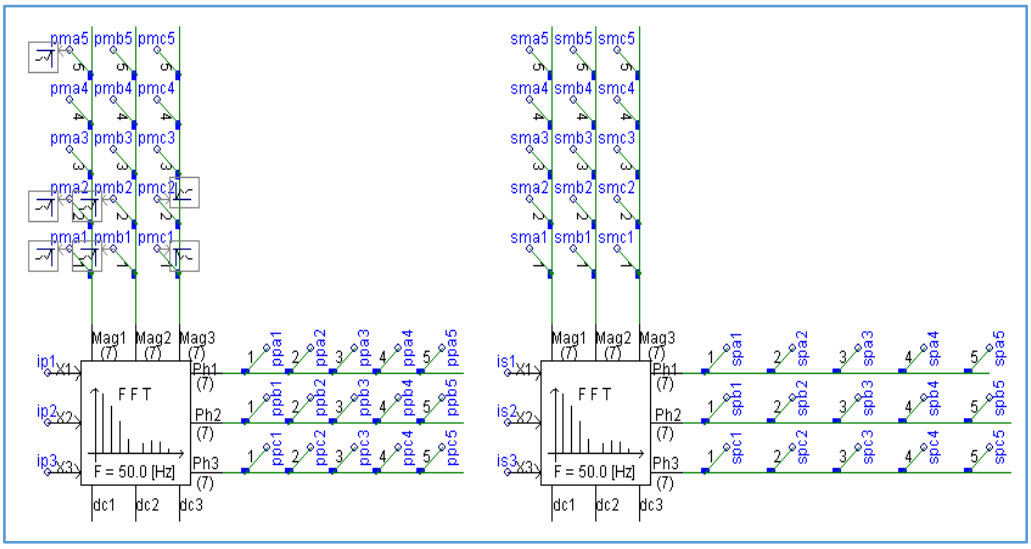

Figure 4.4: Fast Fourier Transform Extractions block

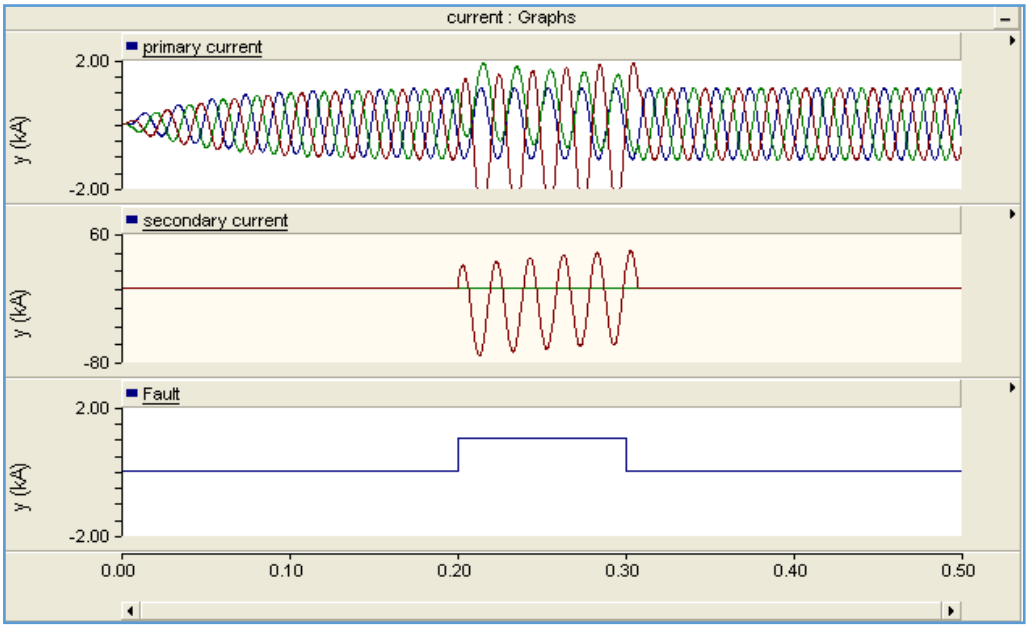

Figure 4.5: Primary and Secondary CT current for Internal Fault

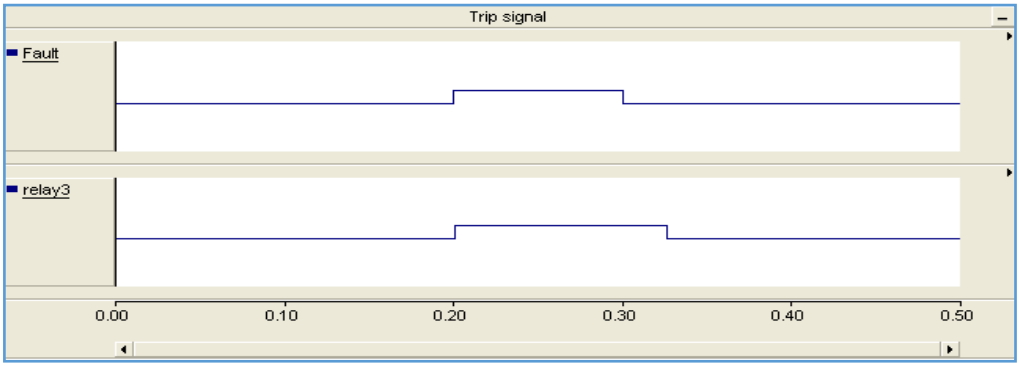

Figure 4.6: Relay Trip Signal and Breaker Signal

B. Simulation Model for Star-Delta connection of transformer to External Fault

- For 3- phase transformer simulation designed below.
- Star – Delta connection of transformer is connected between to two sources and two breakers. Phase to ground External fault is created in this system.

Observed the result and proved that differential relay is not operate in external fault condition

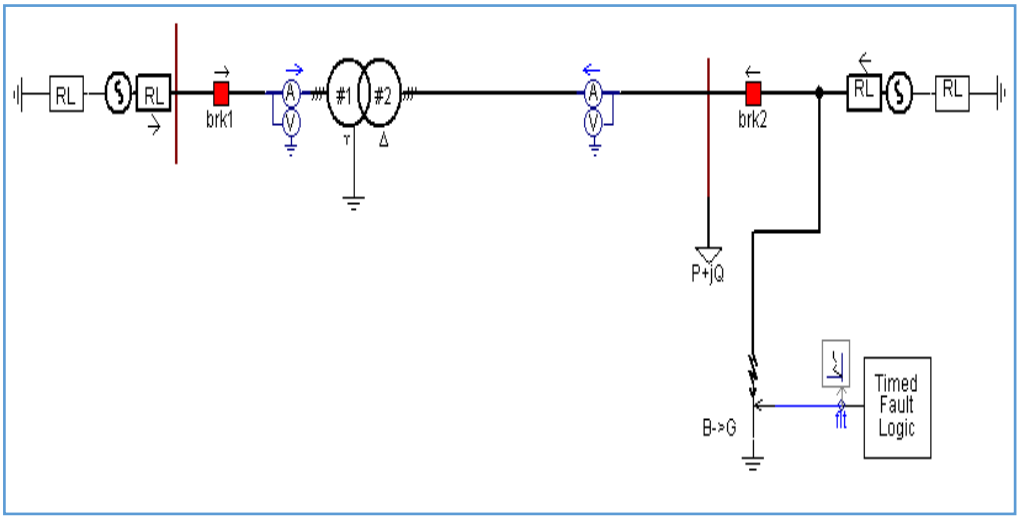

Figure 4.7: Simulation Model of External Fault for Star- Delta Transformer

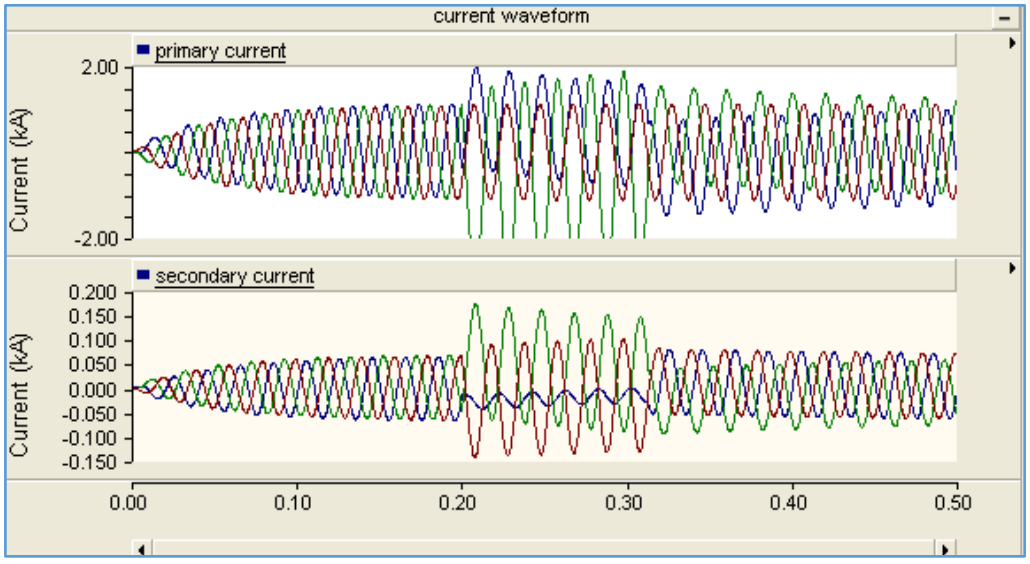

Figure 4.8: Primary and Secondary CT current for External Fault

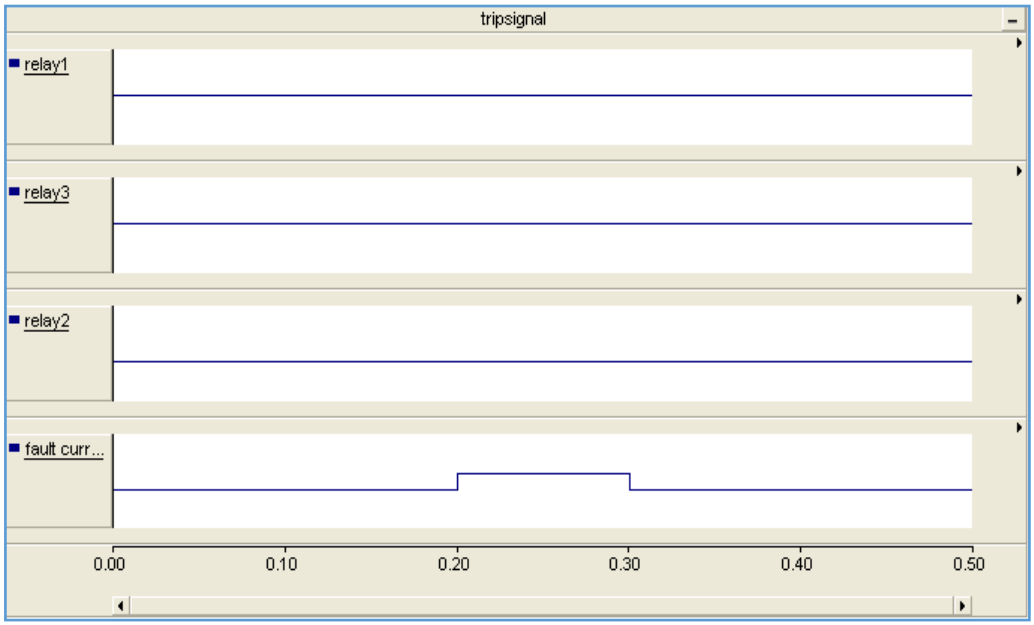

Figure 4.9: Relay Signal and Trip Signal for External Fault+

V. CONCLUSION

The PSCAD/EMTDC software can be successfully used to modelling the different fault schemes with transformers and differential relays protecting transformer from effects of faults such as internal and external faults. In this paper stated that the inrush current has a second harmonic component of the differential current which is much larger in the case of inrush than for a fault and the over excitation current has a larger fifth- harmonic component. Using FFT harmonics components are differentiate and differential protection scheme is used for fault discrimination.

REFERENCES

1. L.Madhan Kumar, "Modeling Of Power Transformer For Differential Protection Using Pscad.","*International Journal Of Advanced Research In Electrical,Electronics And Instrumentation Engineering*, Vol. 3, No. 2, P. 9, April 2014.
2. B. h. Zoran Gajic Ivo Brancic, "sensitive turn to turn fault for power transformer," *cigre*, p. 11, 2005.
3. Z. Gajic, "Use of standard 87T differential protection for special three phase power transformer," *IEEE*, vol. 27, no. 3, p. 6, 2012.
4. a. s. e. bartosiwicz, "reserch on differential protection algorithms of power transformer using PSCAD/EMTDC software," *recent advances in systems science*, p. 6.
5. Bhavesh bhalja,(2011) "Protection and Switchgear" First Edition, OXFORD Publication.
6. Bhuvanesh A Oza, (2012) "Power System Protection and Switchgear" Fourth Edition, McGraw Hill Publication.

