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Modeling of Digital Differential Over-Current Relay for Power Transformer

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***Abstract*—**This paper present the proposed scheme related to modeling of digital differential over current relay, in which the modeling based of differential scheme is used, where the values of power transformer current taken as primary and secondary current and then compare the data and if the secondary current is more than the estimated current then the relay will send trip signal to the circuit breaker. This paper presents the new differential scheme.

Keywords—Differential method, Relay, Circuit Breaker, Power Transformer

1. INTRODUCTION

A protective power system designed and persist controlled and measured flow of current and cleared fault within a fraction of a second into every section of the system. It includes circuit breaker, transducer (CTs & VTs), and protective relays to isolate the faulty section of the power system from the healthy sections. A circuit breaker can detach the faulty essence of the system when relay send signal. Transducers (CTs &VTs) are used to reduce currents and voltage to lowers values and to isolate protective relay is to detect and locate a fault and issue a command to the circuit breaker to detach the faulty essence. It is a tactic which comprehension abnormal circumstances on a power system by constantly invigilate electrical quantities of systems, which distinguish under normal and abnormal circumstances. The basal electrical quantities which are eventually to change during abnormal circumstances are current, voltage, phase- angle (direction) and frequency. Protective relays ply one or more of these quantities to unearth abnormal circumstances on a power system. Every protection system which isolates a faulty element is required to satisfy four basic requirements reliability, selectively, sensitivity, and speed of operation. Without reliability and selectivity the protection would be rendered largely ineffective and could even become liability.

2. OVER-CURRENT RELAY

Protection against excess current was naturally the earliest protection system to involve the graded over current system, a discriminative fault protection, has been developed. This should not be flurried with over-load protection, which commonly makes use of relays that serve in a time respective in slight degree to the thermal capacitating of the plant to be conserved. Over current protection, on the other hand, is directed entirely to the clearance of faults, an appropriate time setting is given to each of the relays controlling the circuit breakers in a power system to ascertain that the breaker proximate to the fault opens sooner. Over current is, at the in feed end of each section of the power system. Denominator protection unit reckon on a definite-time delay over current relay in which the manipulation of the current sentient element merely undertakes the time delay element. Provided the setting of the current element is below the fault current value, this element plays no part in the accomplishment of partisanship. The current/time tripping indications of IDMT relays may needfulness to be diverse pursuance to the tripping time required and the indications of other protection tactics used in the network.

2.1 Working Principle Of Over Current Relay

In an over current relay or o/c relay encourage quantity is solely current. There is solely one current conducted element in the relay, no voltage coil etc. are expected to fabricate this protective relay. In an over current relay, there would be virtually a current coil. When mediocre current flows via this coil, the magnetic effect procreate by the coil is not adequate to gait the dynamic element of the relay, as in this prerequisite the restraining force is greater than deflecting force. However when the current through the coil enhanced, the magnetic effect enhances, and after scant level of current, the deflecting force procreated by the magnetic effect of the coil, crosses the restraining force, as a consequences, the dynamic element starts moving to change the contact position in the relay.

3. MODELING OF DIGITAL OVER CURRENT RELAY IN MATLAB

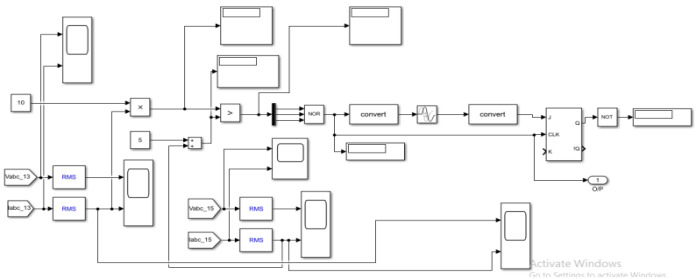

Fig. 1 Modeling of Differential Over-Current Relay in Matlab

In over current relay simulation, I am taking values of V_{abc_13}, V_{abc_15}, I_{abc_13}, I_{abc_15}. Here for differentiation purpose I am

using the RMS values of these quantities. For comparison comparator blocks are used, there different types of converter used for converting the values. This over current relay 1 connected with LVCB1 circuit breaker which is placed near point 13.

3.1 Over Current Relay 1 without Fault

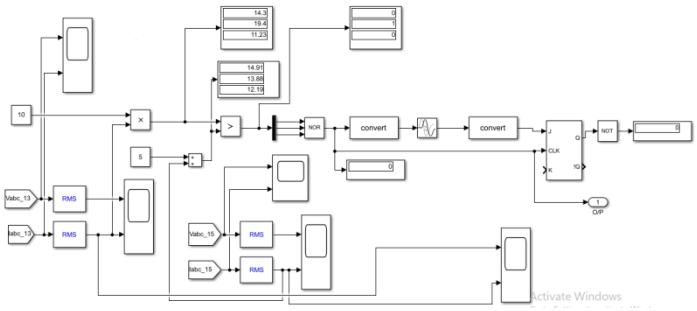

Fig. 2 Over current relay with fault

In Over-Current Relay1 Iabc_13RMS and Iabc_15 RMS without fault are used for comparison. Constant 10 value used for Iabc_13RMS and constant 05 value used for Iabc_15RMS. In this relay V_{rms}= 38e3 Volt. Iabc_13RMS values are 14.3, 19.4, 11.23 and Iabc_15RMS values are 14.91, 13.88, 12.19

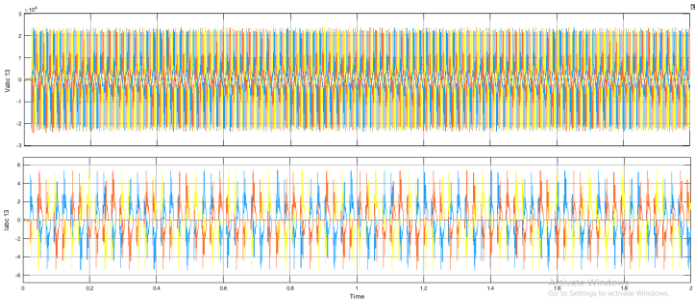

Fig- :3 Waveform of Vabc_13 and Iabc_13 without fault

Above waveforms are Vabc_13 and Iabc_13 without fault. Here maximum values of graph are Vabc_13= -30391.10401 to 30363.36244 and Iabc_13= -6.80431 to 6.79544

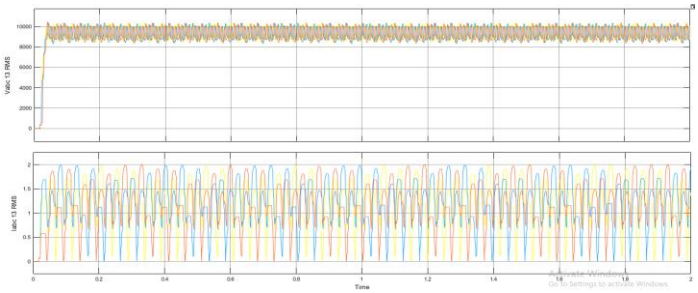

Fig-4: Waveform of Vabc_13 RMS and Iabc_13 RMS without fault

Above waveforms are Vabc_13RMS and Iabc_13RMS without fault. Here maximum values of graph are Vabc_13RMS= -1307.11289 to 11764.01604 and Iabc_13RMS= -0.2495 to 2.24553

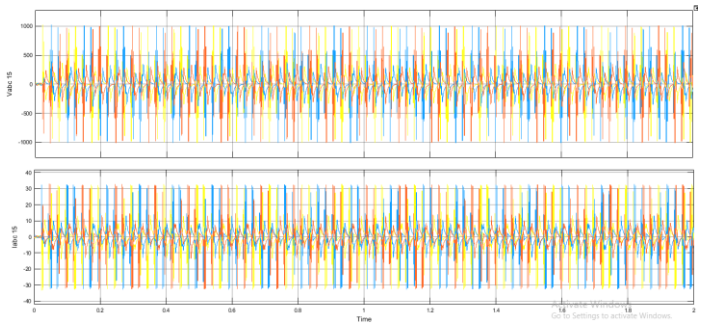

Fig-5: Waveform of Vabc_15 and Iabc_15 without fault

Above waveforms are Vabc_15 and Iabc_15 without fault. Here maximum values of graph are Vabc_15= -1269.1857 to 1276.27994 and Iabc_15= --41.85733 to 41.5259

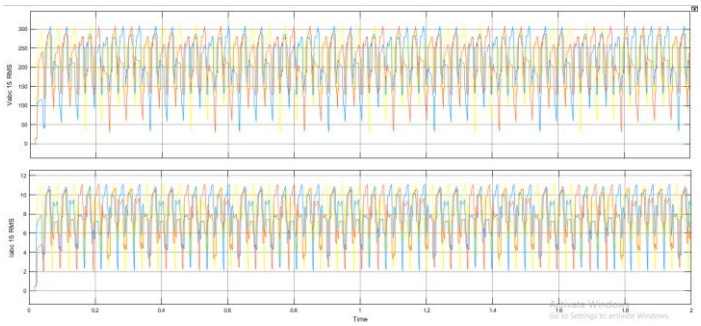

Fig-6: Waveform of Vabc_15RMS and Iabc_15RMS without fault

Above waveforms are Vabc_15RMS and Iabc_15RMS without fault. Here maximum values of graph are Vabc_15RMS= -38.53172 to 346.78545 and Iabc_15RMS= -1.39165 to 12.52485

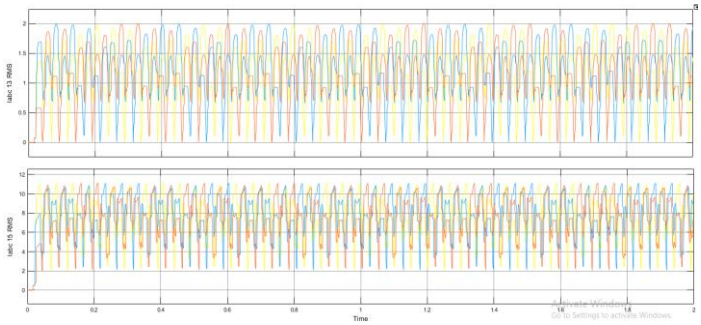

Fig-7: Comparison Waveform of Iabc_13RMS and Iabc_15RMS without fault

Above waveforms are Iabc_13RMS and Iabc_15RMS without fault. Here maximum values of graph are Iabc_13RMS= -0.2495 to 2.24553 and Iabc_15RMS= -1.39165 to 12.52485

3.2 Over Current Relay with Fault

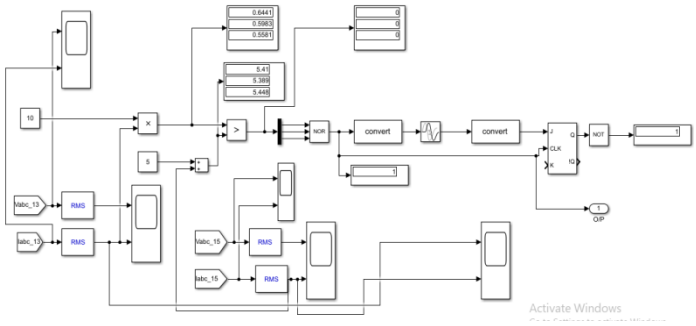

Fig-8: Over current relay with fault

In Over-Current Relay Iabc_13RMS and Iabc_15 RMS with fault are used for comparison. Constant 10 value used for Iabc_13RMS and constant 05 value used for Iabc_15RMS. In this relay V_{rms}= 38e3 Volt. Iabc_13RMS values are 0.6441, 0.5983, 0.5581 and Iabc_15RMS values are 5.41, 5.389, 5.448

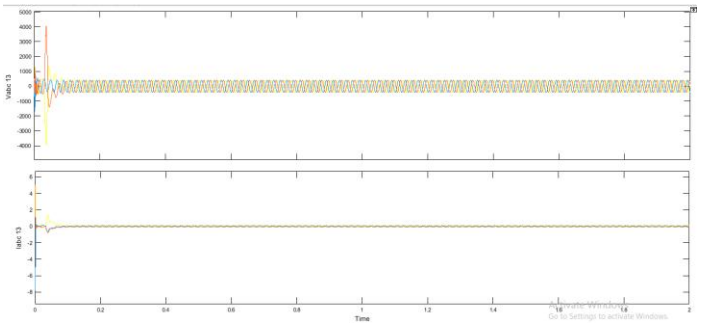

Fig-9: Waveform of Vabc_13 and Iabc_13 with fault

Above waveforms are Vabc_13 and Iabc_13 with fault. Here maximum values of graph are Vabc_13= -4955.53756 to 5056.08687 and Iabc_13= -9.40925 to 6.64794

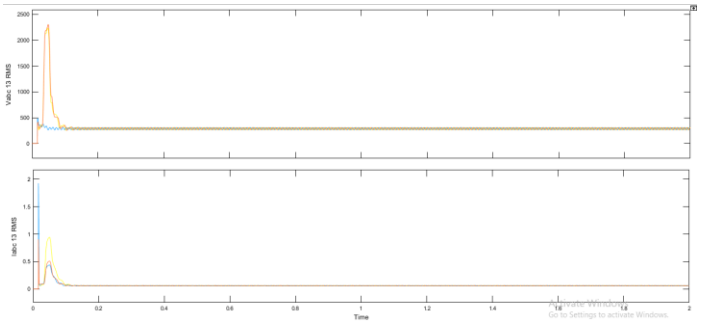

Fig-10: Waveform of Vabc_13RMS and Iabc_13RMS with fault

Above waveforms are Vabc_13RMS and Iabc_13RMS with fault. Here maximum values of graph are Vabc_13RMS= -287.71392 to 2589042532 and Iabc_13RMS= -0.2408 to 2.16724

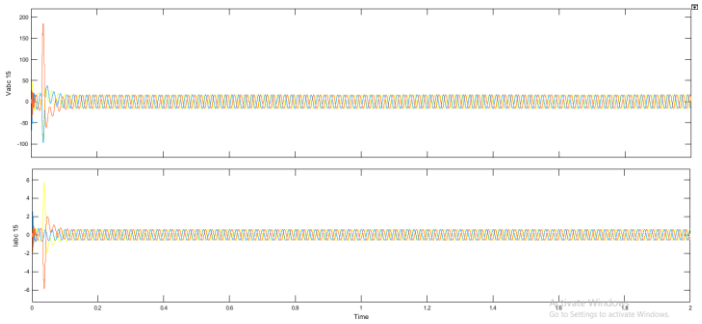

Fig-11: Waveform of Vabc_15 and Iabc_15 with fault

Above waveforms are Vabc_15 and Iabc_15 with fault. Here maximum values of graph are Vabc_15= -132.21138 to 220.08674 and Iabc_15= -7.2865 to 7.14334

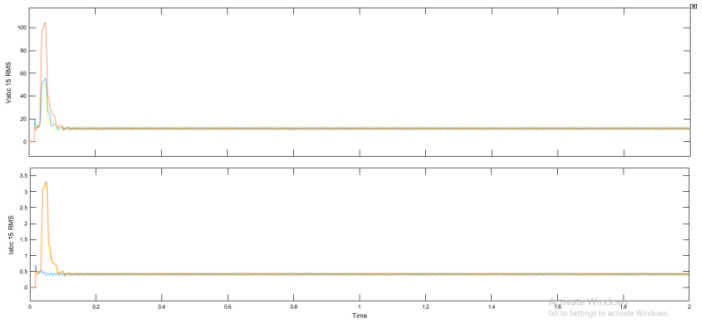

Fig-12: Waveform of Vabc_15RMS and Iabc_15RMS with fault

Above waveforms are Vabc_15RMS and Iabc_15RMS with fault. Here maximum values of graph are Vabc_15RMS= -13.07263 to 117.6537 and Iabc_15RMS= -0.41469 to 3.7322

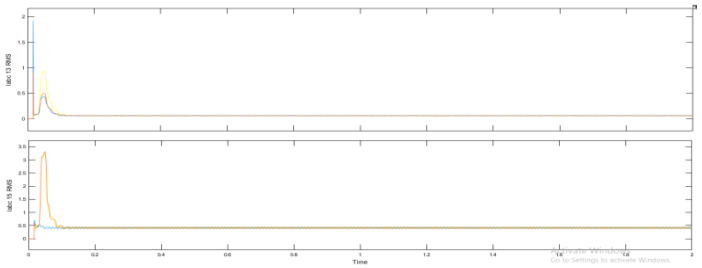

Fig-13: Comparison waveform of Iabc_13RMS and Iabc_15RMS with fault

Above comparison waveforms are Iabc_13RMS and Iabc_15RMS with fault. Here maximum values of graph are Iabc_13RMS= -0.2408 to 2.16724 and Iabc_15RMS= -0.41469 to 3.7322

Table-1: Over-Current Relay Data

Parameters	Without Fault	With Fault
Vrms ph-ph	38e3	38e3
Vabc_13	-30391.10401 to 30363.36244	4955.53756 to 5056.08687
Iabc_13	-6.80431 to 6.79544	-9.40925 to 6.64794
Vabc_13RMS	-1307.11289 to 11764.01604	-287.71392 to 2589.42532
Iabc_13RMS	-0.2495 to 2.24553	-0.2408 to 2.16724
Vabc_15	-1269.1857 to 1276.27994	-132.21138 to 220.08674
Iabc_15	-41.85733 to 41.5259	-7.2865 to 7.14334
Vabc_15RMS	-38.53172 to 346.78545	-13.07263 to 117.6537
Iabc_15RMS	-1.39165 to 12.52485	-0.41469 to 3.7322

4. CONCLUSION

In this paper, after modeling of digital over-current relay compare its data with fault and without fault conditions, and it's show the sensitivity of relay. Digital over-current protection has vast future. Presently digital relays are commonly used in industries, transmission and discom. As I present the modeling of numerical differential over-current relay so further work, apply by this modeling, these data can be used in neural network for training and testing.

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