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DISCRIMINATING INRUSH CURRENT AND FAULT CURRENT BY ANALYZING SECOND HARMONICS

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ABSTRACT

Due to widespread of industrialization there is vast increase in use of power,which insist the security and safety of power transformer.To ensure the safety of power transformer various methods have been extinct. For the credibility of the power transformer from the fault current is in need.To acquire credibility of power transformer , differentiation of inrush current and fault current should be done. The main intention of this paper is to differentiate between inrush current and fault current, avoiding the fib tripping of circuit breaker due to inrush current. Variousmethod used to ascertain inrush and fault current still haven't developed. In order to differentiate inrush and fault current this paper is adduced. As inrush current and fault current can be detected by bdifferentiating theremagnitude with the help of second harmonic.

Keywords: Fault current, Inrush current, second harmonic

I.INTRODUCTION

In electrical technology, power transformer plays vital role and so are having high cost. In order to this, protection and requirement of power has increased multifarious. Stability and credibility of power system are main and initial issues in transformer .Ergo, to maintain credibility of transformer continuity of transformer operation and protection is important in power supply which require no missing operation, no fib tripping and quick fault clearing time. Hence, this requires protective relays.

The relays which can discriminate between input and output currents for power system are called as Differential Relays.

The current may differ in phase angle or in magnitude. To impose operation, magnitude and phase angle should be zero. As Inrush current are of high magnitude differential relay cannot discern between Inrush current and fault current and result in fib tripping of circuit breaker at the time of instantaneous inrush current. Due to fib tripping of circuit breaker because of circuit breaker can create major problem in power system and directly affect reliability on power system. In order to avert this method have been brought into operation, to improve the credibility of power supply.

It is important to understand the second harmonics of inrush current and various fault currents. In this paper , we clarify the magnitude of second harmonics in inrush current and fault current to get the consequences.

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II. INRUSH CURRENT

Generally Inrush current means, the maximum instantaneous input current drawn by an electrical devices when it is first switched on. The transformer inrush current is the maximum instantaneous current drawn by the primary of the transformer when there secondary is open circuit. This happen even if the transformer has no loaded, this inrush current affects the magnetic property of the core. During the inrush current the maximum value attuned by the flux is over twice the normal flux. The inrush current doesn't create any permanent fault,but it causes an unwanted switching in the circuit breaker of the transformer. The magnitude of the inrush current depends on the point on the AC wave, the transformer is switched on when the AC voltage wave is at its Peak value at that time no inrush current drawn by the transformer. The magnitude of the current in this case will be at normal no load value. If at turn on, the AC waveform is going through its zero value, then the current drawn will be the very high and exceed saturation current.

Inrush current is depends on following factors

1. Input voltage waveform
2. Switching instant of input voltage waveform at which transformer energized
3. Rating of the transformer
4. Primary winding resistance and source resistance

a.Voltage input waveform- the starting phase angle of the input voltage waveform depends on the switching of the electrical devices. The equation of the flux expressed as,

$$\Phi = \Phi max \sin(wt + \alpha) + \Phi residual + \Phi max \sin\alpha \quad \ldots..1$$

Where, $\alpha = \theta - \pi/2$

From equation 1 Φ is depends on the residual flux and switching angle.

When the residual flux in the transformer is zero and switching angle of the input voltage waveform 90^0 then flux will be,

$$\Phi = \Phi max\ (sinwt + 0) + 0 + \Phi max \sin 0$$

$$\Phi = \Phi max\ sinwt$$

$$\Phi = 2\Phi max$$

b. The electrical device which on when switching angle of voltage zero.

The flux will be,

$$\Phi = \Phi \max \sin\left(wt + \frac{\pi}{2}\right) + 0 + \Phi \max \sin\frac{\pi}{2}$$

$$\Phi = \Phi \max \cos wt + \Phi max$$

$$\Phi = 2\Phi max \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..2$$

Therefore when switching angle is zero that time magnitude of the flux is equal to 2Φmax. From that it is clear, when voltage switching angle is $90^{0,}$ then flux produced is minimum, and hence current drawn is also be minimum.

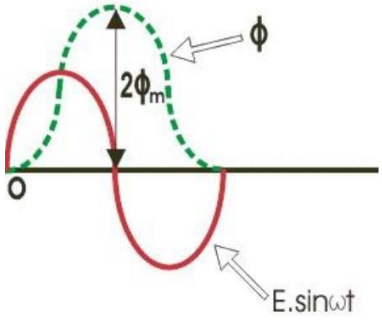


Figure : Voltage-FluxGraph

III. FAULT CURRENT

A fault current is unintended, uncontrolled, high current flow through an electrical system. Short circuit current transpose the most serious general hazard to power system, and they are prime concern in developing and applying protection system. A device that interrupts short circuit current, is advice connected in circuit to provide protection against excessive damage when fault current occurs. It provides protection by automatically interrupting the large value of current flowing in the circuit.

In case of transformer the insulating oil deteriorates gradually with use. The main cause is the absorption of the moisture in the oil, each time the moisture is doubled in transformer, the life of the insulation is cut by one half. Failures due to moisture are the most common cause of transformer. Which may cause reduction in dielectric strength of transformer oil, which develops shortcircuit betweenwinding of transformer oil. This short circuit may cause the hazardous damage to the transformer. Therefore, the most efficient and reliable protection system is used for protection of against any faulty condition. Failure in electrical motors may occurs at start up or during operation most of the electrical motor failure occurs at start up due to factors such as low insulation resistance, over current or machine failure. There are also different factors that can lead to failure in the electrical motors.

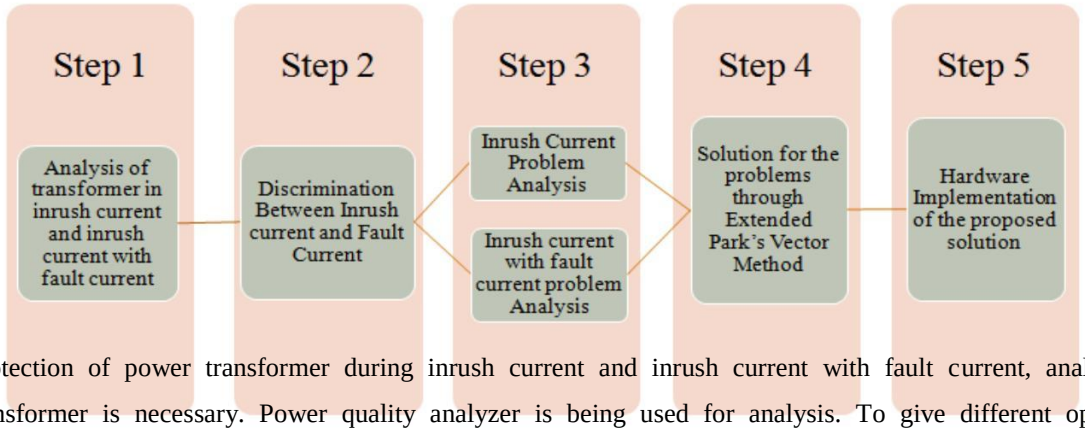
The main causes included- Low insulation resistance, Over current, Overheating vibration, moisture, dirt, lack of maintenance,extreme operating environment and more.

A short circuit is simply a low resistance connection between the two conductors supplying electrical power to any circuit.This result in excessive current flow in a power source through the short and may even causes the power source to be destroyed.

Several types of motor failure cancauses the motor to draw excessive current and trip the overload breaker.The short circuit current contains harmonics.

Harmonics distortion rises the losses in A.C. Induction motor in a similar way as in transformer and causes increased heating, due to additional copper losses and iron losses in the stator winding, a rotor circuit and rotor lamination. These losses are further compounded by skin effect.

IV. METHODOLOGY



Protection of power transformer during inrush current and inrush current with fault current, analysis of transformer is necessary. Power quality analyzer is being used for analysis. To give different operating conditions to transformer, transformer has to be switched at different switching angles. This is achieved by the circuitry using microcontroller during inrush current, unnecessarily transformer trips. So, the problem analysis during inrush current as well as inrush current with fault current is necessary. the solution for these problems can be found using “Structural THD analyzer" technique.To accomplish the aim discrimination between inrush current and fault current isachieved by using “Structural THD analyzer”.In the technique, first step is to find the transformer differential current waveform .

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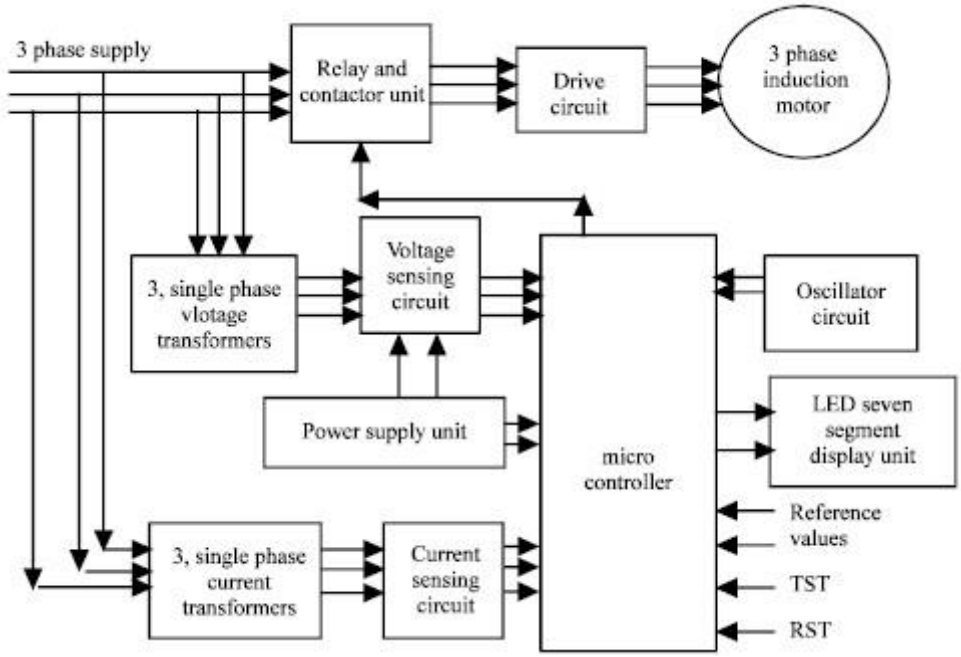

Fig. Block diagram

V. OPERATION

Inrush current is a maximum instantaneous current at which electrical device switched ON. This current is 6 % to 10% higher than the rated current and it should not produce any permanent fault. But our protective relays treat it as a fault current and send tripping signal to the circuit breakers. Due to that our system stability and reliability reduces. In our project, to improve system stability we discriminate Inrush current and fault current on the basis of second harmonics present in currents and waveform spectrum by using microcontroller. Inrush currents have high magnitude of second harmonics and the period of inrush current is in millisecond. But fault current have less magnitude of second harmonics and time period of it is higher than the Inrush current .

CONDITIONS

- Circuit breaker should not trip when only Inrush current flows in system for milliseconds.
- When only fault current flow in system circuit breaker should be trip.
- When Inrush current and fault current at a time flow in system circuit breaker should be trip.

For this, by using THD [Total Harmonic Distortion] we discriminate the Inrush current and fault current in system.

In first condition, controller calculate second harmonics in current, When this harmonics higher than 20% at that time circuit breaker should not trip. Because controller identify it is not fault current .At second condition , this harmonics less than 20% at that time circuit breaker will trip because it is fault current. For third condition, Inrush current and fault current both flows at a time so, normally relay consider the second harmonics greater than the 20% so circuit breaker should not trip. but fault current also present in system. From the waveform

spectrum and time period of current, controller sense it is fault current and send tripping signal to circuit breaker.

It consists of following components:

1.89s52 Microcontroller:-

The 89S52 has four different ports, each one having 8 input output lines providing a total of 32 I/O lines. These ports can be used for output DATA and orders to other devices, or to read the state of a sensor, or a switch. Most of the ports of the 89S52 have 'dual function' meaning that they can be used for two different functions. The first one is to perform input/output operations and the second one is used to implement special features of the microcontroller like counting external pulses, interrupting the execution of the program according to external events, performing serial data transfer or connecting the chip to a computer to update the software. Each port has 8 pins, and will be treated from the software point of view as an 8 bit variable called 'register' each bit being connected to a different input/output pin.

2.ULN2003:

The ULN2003 is known for its high current and high voltage capacity. The drivers can be paralleled for even higher current output. Even further, stacking one chip on top of another, both electrically and physically, has been done. Generally it can also be used for interfacing with a stepper motor, where the motor requires high ratings which cannot be provided by other interfacing devices.

3.Relay:

Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

This block has the potential to drive the various controlled devices. In this block mainly we are using the transistors and the relays. Total 2 relay driver circuits we are using to ON relay.

Output signal from 89C51 are given to base of transistor, which we are further energizing the particular relay. Because of this appropriate device is selected and it do its allotted function. Relay 1 and 2 are used to ON relay.

4.16 * 2 LCD Display

Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

VI. CONCIUSION

This paper introduced a new online approach for the detection of Inrush current and Fault current. Which develops the hazardous condition s. This method is then used to analyze the Inrush current during switching ofelectrical devices on and the fault current produced by internal fault. A simple decision making logic scheme using microcontroller is developed for discriminating between fault current ,Inrush current. This technique can accurately discriminate between fault current and inrush current as well as protect the system.

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