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# Reduction of Magnetic Inrush Current of Power Transformer Using Matlab

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***Abstract*: -- In power transformer, initially current is very high value, which causes to produce the inrush and it affects the transformer core during the period of initial current and this initial current is known as magnetic inrush current. During this period the life of transformer, protective equipment, as well as power quality is of supplying power will be reduced. So, this initial current reduction is very important for the reduction of inrush, controlled transformer switching can be provided to reduce the magnetic inrush current. This paper shows the practical consideration of minimization of magnetic inrush current as well as the experimental result of the simulation. In this paper use a thyristor to control the firing angle of current. This paper shows the theory to explain an experimental result of the reduction of inrush current at different firing angle using MATLAB simulation.**

***Keywords*— Magnetic Inrush Current, and Transformer, Switching Devices, Thyristor.**

## I. INTRODUCTION

In a power system the essential component is the transformer and their reliability. When the transformer is energized, the transient current is drawn at the starting period. This current rise up to the ten cycles, and this current is 5 to 6 times more than the rated current. The inrush current has various effects on the protective devices; the mechanical structure of the transformer may be damage as well as power quality is reducing of the power system. When an unloaded transformer is switched on to normal voltage on its primary side or when a short circuit occurs on its secondary side then inrush occurs. The idea presented in this paper is by observation and research. In view of the fact that the inrush currents are always unbalanced among three phases, a neutral resistor could provide some damping to the currents. Inrush current in transformer is often gets less importance compared to other effects/faults. Though the magnitude of inrush current ma be i some case less than compared to short circuit current, the frequency and duration of inrush current is generally more frequent, hence it will likely have more adverse effect compared to other faults. Inrush current may flow when transformer is energised. The amount of inrush current depends on when in the voltage cycle the transformer is energised and residual flux in the transformer. The other type of inrush current is sympathetic inrush current which flows is already energised transformer when another transformer is energised in parallel connected line. When electrical power transformer runs normally, the flux produced in the core is in quadrature with applied voltage. That means, flux wave will reach its maximum value, ¼ cycle or π/2 angle after, reaching maximum value of voltage wave.

But practically it is not possible to have flux at the instant of switching on the supply of transformer. This is because, there will be no flux linked to the core prior to switch on the supply.

## II. INRUSH CURRENT INFORMATION

When a transformer is energised from a standard power source it draws high starting current which can be as high as 10 – 100 times of transformer's rated current. This current will starts to decay at the rate of effective winding resistance and will settle down to steady state condition. The time to decay can be as long as few seconds. This current is known as magnetising inrush current. Decay of this transient current is proportional to the series resistance of the transformer winding. If resistance of winding is ignored, the flux offset will never fall back to zero and inrush will r. In a real transformer, winding resistance will damp out the inrush. The decay time can range from a few cycles up to a minute depending on the transformer size and relevant design parameters.

## III. EFFECT OF INRUSH CURRENT

**A.** Mechanical and Electrical Stresses in windings: The amplitude of inrush current can be equal to that of the short circuit current and may depends for loner time on system.
This can seriously damage the windings through over mechanical stresses.

**B.** Harmonic Resonant Over Voltages: Transformer inrush currents are excess in harmonics. A sustain harmonic resonant over voltages may occurs and if this over

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voltages found for a longer period of time, they may damage the device.

**C.** Mall Operation Of protective Relays: Due to high magnitude and asymmetrical nature of inrush current a voltage dip is observed by the system. The magnitude, duration and unbalanced of voltages in the respective phases are function of system impedance, source transformer capacities.

## IV. MODEL DESCRIPTION

The simulation models were developed using MATLAB with SimPower Systems. It is then used to simulate at different firing angles using high switching devices and observe the how much quantity of inrush current are reduced.

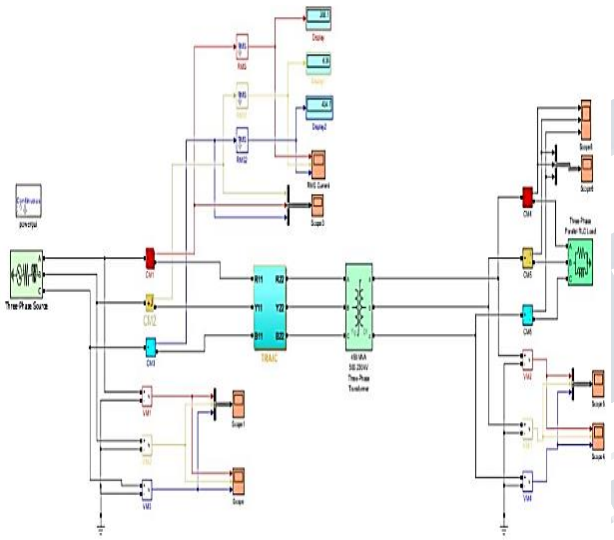

***Fig1. Simulation model***

The model were developed with less numbers of blocks according to the model simplicity and reproducibility for the users. In this stimulation model consist of three separate current measurement connect in series with power transformer in each phase similarly three voltage measurements are connected in parallel with power transformer in each phase for measuring the voltages.

CM 1 Is current measurement for phase R
CM 2 is current measurement for phase Y
CM 3 is current measurement for phase B and similarly
VM 1 voltage measurement for phase R
VM 2 voltage measurement for phase Y
VM 3 voltages measurement for phase B.
RMS block is connected for better visualisation of sine wave.

As shown in model for transformer 450 MVA,500/230 KV is used. Current and voltage measurements are used in secondary side of transformer similar to the primary side and three phase RLC load is connected.

As shown in model TRIAC is used as a high switching device for minimizing the effect of inrush. But the TRIAC high switching device is directly not available in MATLAB library. So we have improve the circuit by making the TRIAC in MATLAB with using different components available in MATLAB library. To make the connection of TRIAC by using the parallel connections of two SCR's and taking the gate terminal common for triggering.

In the simulation result the inrush current of power transformer is decreases at different firing angles as shown in the following table. In this table the inrush current is given at different firing angle for different phases. From the table consider a inrush current for R phases, the inrush current is maximum at firing angle 0 degree and minimum at 60 degree. During the transformer energization the inrush current is flown through the trasformer at some milliseconds this current is represented by transient inrush current is shown in the fig. 3 and fig. 4.

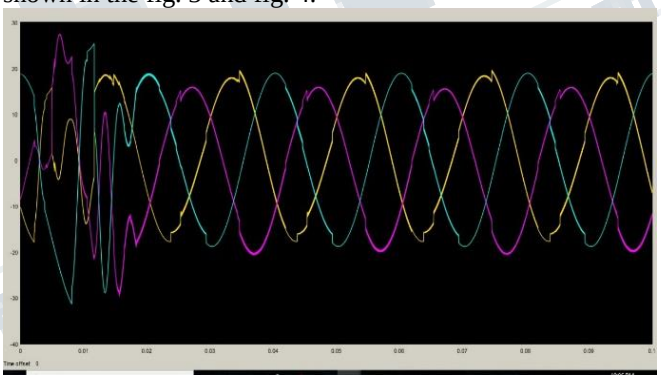

***Fig 2Inrush current at different phases***

The inrush current for different phases is R, Y, B is given by in fig. 5 and the rms value of inrush current is shown in fig. 6.

## V. CONCLUSION

The magnetic inrush current is reducing by power transformer by using switching method. Triac is used to control the firing angle of transformer, when the firing angle is increase then magnetic inrush current is reduced.

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