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Analysis of Magnetizing Inrush Current on Power Transformer Using MATLAB

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Abstract: ***This paper provides information about the effect of magnetising inrush current on power transformer. Transformer is vital and major component in electrical power system .It has uses in various sectors. To reduce weight of core and cost, modern transformers are used at high saturation level and leads to harmonics. . With the help of TRIAC, as a high switching device magnitude of inrush current at various switching angle is studied. Inrush current normally appears due to saturation of magnetization of iron core, when power transformer is switched on no load. In the proposed method TRIAC is used for the short period of time for energization of transformer. By controlling the phase angle of TRIAC magnetic inrush current is reduced. To study the performance of proposed method simulation of power system model is carried out in MATLAB and inrush current at various switching angle is studied.***

Keywords: Power transformer, Inrush current, Transients, TRIAC, Switching angle, MATLAB

I. INTRODUCTION

The most essential component in power system is the power transformer and its reliability is very important as well as it is necessary to maintain its power quality. When transformer is energized, the transient current is drawn at the initial period. This current rises up to the 10 cycles, and this current is 5-6 times more than the rated current.

The high magnitude of inrush current of power transformer decreases the magnetising resistance of the transformer and impedance connected to system until it reaches to normal current value. The effect of inrush current on power transformer such that fast aging as it heats up winding, insulation failure and gives rise to harmonics. Transients occurs due to opening or closing of circuit breaker or due to switching surges which creates large amplitude current and peak voltages and hence degrades the insulation of power transformer.

Inrush current of power transformer is categorised as energization inrush, recovery inrush and sympathetic inrush. Reapplication of system voltage to transformer which is earlier de-energized results in energization inrush. Recovery inrush is due to reduction of transformer voltage by nearby short circuit on system. When an unloaded transformer is switched on results into sympathetic inrush.

II. METHODOLOGY

Inrush phenomenon occurs when a power transformer draws a non symmetrical magnetizing current at the time of energization. Inrush current normally appears due to saturation of magnetization of iron core, when power transformer is switched on no load. In the proposed algorithm triac is used for the short period of time for energization of transformer. By controlling the phase angle of triac magnetic inrush current is reduced and normal rated current in transformer. When firing angle is increases magnetic inrush current is reduce

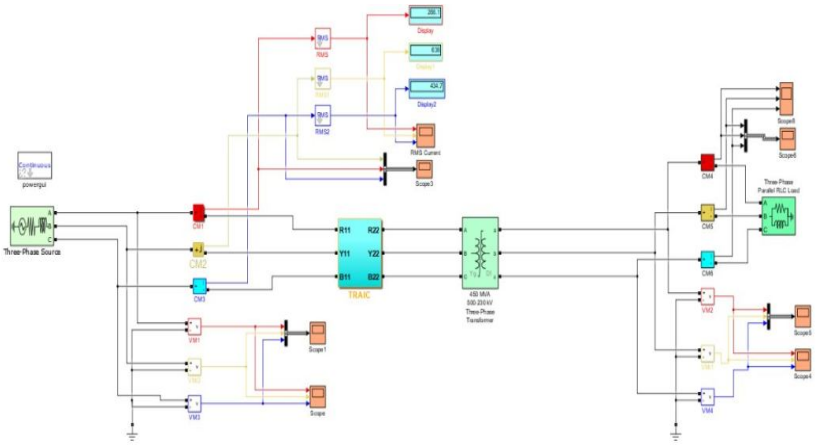

Fig. 1 simulink model

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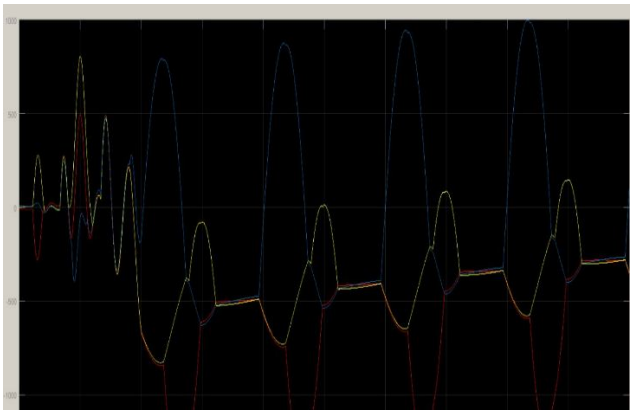
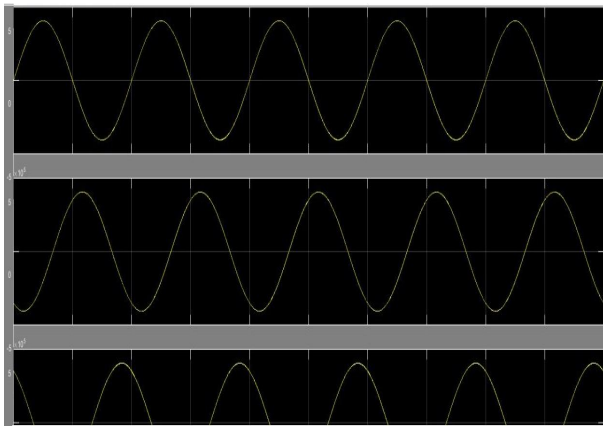
III. SIMULATION AND RESULT

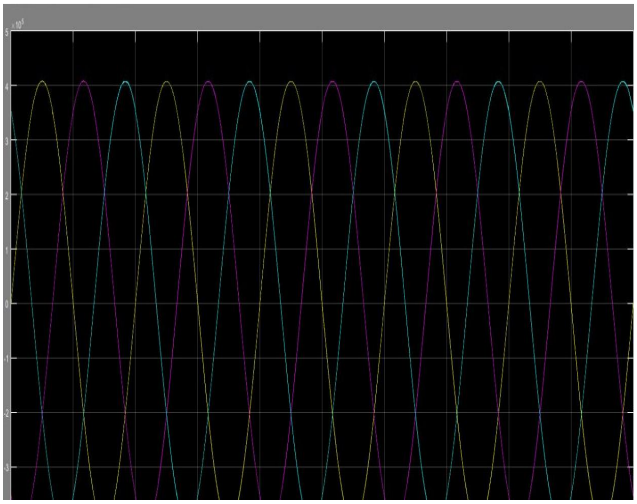
The inrush current phenomenon is studied on a three phase 600-230kv, 450MVA transformer by using MATLAB Simulink model. At the time of switching on the transformer inrush current is very high as compared to normal magnetizing current as shown in fig. For R phase , for supply frequency of 50 Hz, for 50 cycle time duration is 1000msec and for one cycle time duration is 20msec. so for 0 to 90 degree time duration is 5 msec. For Y-phase, phase shift is 120 degree apart, therefore 90+120=210degree. So for 0 to 210 degree time duration is 11.66 msec. Next for B phase, phase shift is 240+90= 330 degree. So for 0 to 330 degree time duration is 18.33 msec. Magnetic inrush current is reduced when the firing angle is increases.



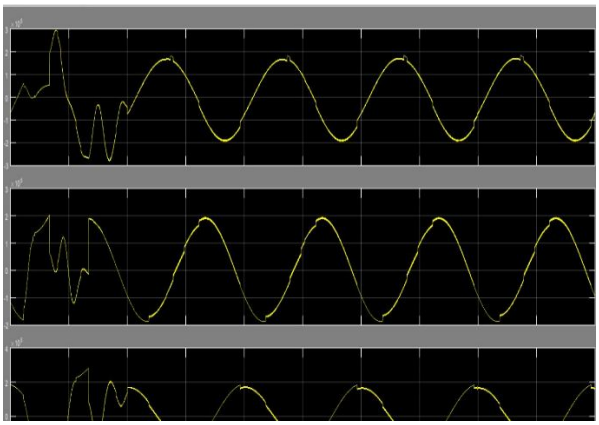
Scope 3 RMS Current



Scope _Voltage



Scope 1 Voltage



Scope 4 Voltage

Sr.No.	Angle(degree) α	I(R) Amp	I(Y) Amp	I(B) Amp
1	0	1922	988.3	338.6
2	15	2256	158.3	152.3
3	30	2548	1173	700.8
4	45	2496	517	74.01
5	60	2122	289.8	71.31
6	75	219.3	1359	405.5
7	90	226.1	461.2	234.9
8	105	446	517	340.5
9	120	546.7	60.55	711.7

Table No.1

IV. CONCLUSION

In this paper, a methodology has been proposed for the study of magnetizing inrush current of power transformer. In the three phase transformer magnitude of inrush current produced can be controlled by the high switching device. TRIAC is a high switching device which is used to control the phase angle of transformer. When the firing angle is increases, the magnitude of magnetic inrush current is reduced. By using MATLAB Simulink model magnetising inrush current is analysed and simulation results are presented. The peak value of magnetizing inrush current is found at 0 degree and goes on decreasing as phase angle increases. Low value of magnetizing inrush current found at 90 degree.

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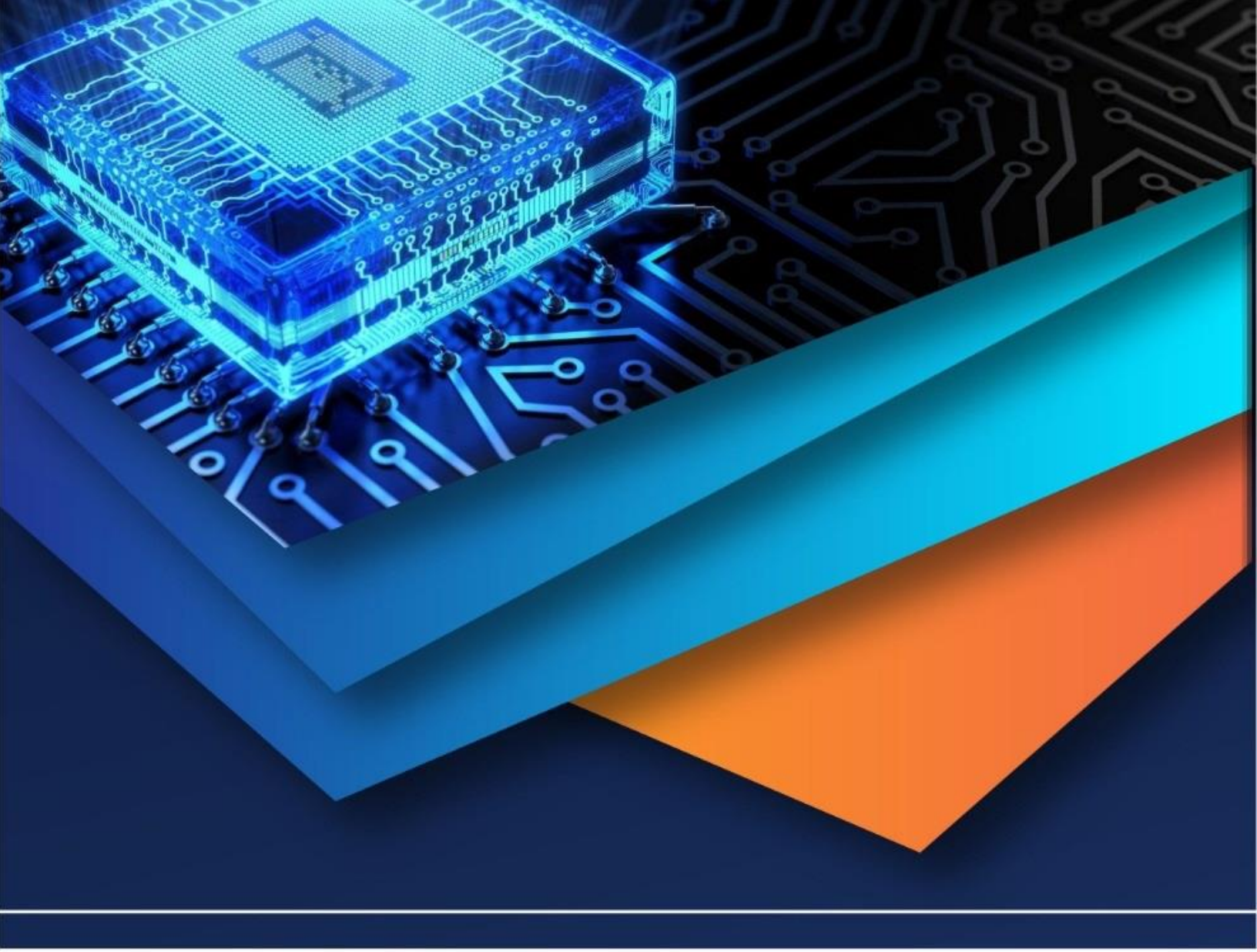

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