A Review on Magnetizing inrush current of Transformer

Prof.Sachin S.Dadhe[1], Prof .Dr.N.M. Lokhande[2]
[1, 2] Department of Electrical Engineering
[1] JSPM'S BSP PUNE-412207
[2] TSSM'S BSCOER PUNE-411041

Abstract- *The phenomenon of inrush current is related to transformer. This paper is just review of magnetizing inrush current of transformer and its control schemes. When transformer is switched on at that time the inrush magnetizing currents is several times greater than its rated value. This paper deals with study of magnetizing inrush current and its control methods*

Keywords- Inrush current, causes of inrush current in transformer, methods to control inrush current

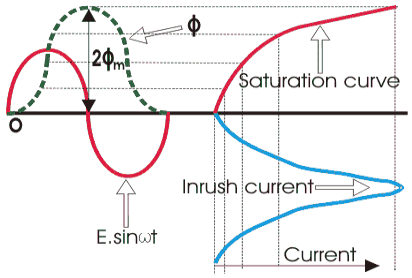
I. INTRODUCTION

At the time of switching transformer the switching current increases several times greater than its rated value generally it is 10 to 15 times greater than its currents. It is called as magnetizing inrush current of transformer. Many times inrush current occurs due to switching operations. Magnitude of inrush current depends upon peak value of transformer. To reduce this inrush current the transformer is to be connected to line when voltage going through its maximum value. Due to inrush current it leads to trip the circuit breaker. This current flows several time through primary of transformer which causes the greater copper loss in transformer. For large transformer with low winding resistance and high inductance these inrush currents can last for several seconds until transients has destroy.

If the transformer is switched on at the instant of voltage zero, the flux wave is initiated from the same origin as voltage waveform, the value of flux at the end of first half cycle of the voltage waveform will be,

$$\varphi_m' = (E/\omega)\int_0^{\pi} \omega.\sin\omega t.dt = \varphi_m \int_0^{\pi} \sin\omega t.d(\omega t) = 2\varphi_m$$

transformer primary will draw a very high peaky current from the source which is called magnetizing inrush current in transformer or simply inrush current in transformer.



In case of transformer primary windings will take large current from sourse which is called magnetizing inrush current in transformer or also called inrush current in transformer.

Inrush current can be classified in three type

a) Energization inrush current- It result in re-energization of transformer, the residual magnetism is zero in this case.
b) Recovery inrush current-This current flows when transformer voltage is restored after reducing the system disturbance.
c) Sympathetic inrush current-This current flows when number of transformer connected in same line and any one of them energized.

Magnetizing inrush current is a current in transformer which is drawn by transformer at the time of energizing the transformer and this is transient in nature ,which exit for few milliseconds.

II. CAUSES OF INRUSH CURRENT

- Now days in advance technology all electrical equipments run efficiently and maintain a low impedance; low impedance transformer draw high current during energizing.
- For high rating transformer the, energizing current is also high due to this transformer takes high transient current,
- Failure of current limiting equipments.

III. CONTROL OF INRUSH CURRE

Different methods are available to control inrush current in transformer which are enlisted below

- By inserting resistor in series with the transformer during energizing the transformer. This resistor can be cut resister after short time.
- Use NTC thermister in series with primary. This provides high switching resistance and control inrush current. This is suitable for small transformer.
- The AS series of inrush current limiter are used in high energy applications for short interval of time.
- Surge guard inrush current limiter formerly of RTI Elin high energy ectronics
- Standard inrush current limiter come in a wide array of sizes,values and ratings.
- The big AMP series of inrush current limiter are used in high current.
- The MS35 IS our most rugged inrush current limiter upto 680 volts.
- PTC thermister for inrush current protection .Rated for upto 680 volts.
- These inrush current limiters are UL and CSA approved.
- The MINI-AMP inrush current limiter is great for compact power applications.
- The mega surge inrush current limiters are best used when you have higher than average voltage and current requirement.
- Harmonic restrain method – Inrush current have high amount of second harmonics .It's magnitude is compared with fundamental frequency.Second harmonic component can be achieved using methods of passive filters,Fourier transform,Haar function,Walsh function.
- Voltage and Flux Restraints-This method based on phase voltage reduced only in case of an internal fault.
- Inductance based Method-The equivalent inductance used to differentiate between internal and magnetizing inrush.
- Pattern Recognition-This techniques used artificial intelligence, wavelet transform and hybrid approach.
- By step voltage method – For this method thyrister is used at energizing stage.Voltage is gradually increased step by step for after 20 cycles or 1000 msec time period counted in 50 HZ supply.
- By series compensator-Inverter based series compensator which is as a single phase inverter and series transformer. Controlled switch on time of the circuit breaker or SCR firing angles have been used to reduced start-up inrush current of transformer.
- By reducing flux with an ultra low frequency power source-Before re-energization, the residual flux is reduced to a minimum and inrush current can be controlled.

IV.CONCLUSION

The inrush current of transformer drawn by transformer is 10 to 15 times greater than its rated full load current causes of tripping of circuit breaker .Different methods are available to suppress inrush current of transformer depending upon rating and system voltage of feeder. Especially inrush current phenomenon is developed for three phase power transformer. The various methods output result can be simulated in MATLAB as per requirement. controlling circuits are required in design of any system. Protection is required for stable, safe, accurate and efficient operation of system. The choice of protection scheme of transformer from inrush current depends upon rating of transformer. The detailed study of each method can be developed to improve the operation of transformer.

REFERENCES

[1] Tony Kuphaldt ,inrush current lesson in electric circuit

[2] Ametherm circuit protection thermister and NTC

[3] IEEE guide for protecting power transformer

[4] IEEE power Engineering Society May 2008

[5] Badri Ram,D.N. Vishwakarma –Power system protection and switchgear 1 OCT 1994

[6] S.P.Paraskar M.A.Beg, G.M.Dhole "Discrimination between Inrush and Fault Transformer : ANN Approach" International Journal of Advancement in Technology Vol 2, No 2 (April 2011) ©IJoAT

[7] E.M. Tag Eldin, "A new algorithm for the classification of different Transient phenomena in power transformers combining Wavelet transforms and fuzzy logic" 0-7803-8294-3/04/ ©2004 IEEE

[8] Omar A.S. Youssef, A Wavelet-Based Technique for Discrimination Between Faults and Magnetizing Inrush Currents in Transformer, IEEE Transactions on Power Delivery, Vol. 18, No. 1, January, 2003.

[9] http://www.electrical4u.com/magnetizing-inrush-current-in-power-transformer

[10] Shantanu Kumar, Member IEEE and Victor Sreeram, Member, IEEE "Elimination of DC Component and Identification of Inrush Current using Harmonic

Analysis for Power Transformer Protection "IEEE 2013 Tenecon – spring

[11] F.C.Trutt,E.A.Erdelyi,andR.E.Hopkins,"Representationo fthemagnetization characteristic of DC machines for computer use," IEEE Transactions on Power Apparatus and Systems, vol. 87,no.3,pp.665–669,1968

[12] A.BenTal,V.Kirk,andG.Wake,"Bandedchaosinpowersyst ems,"IEEETransactionsonPowerDelivery,vol.16,no.1,pp. 105–110,2001.

[13] The Inrush Current Eliminator of Transformer by Electrical Engineering National Taiwan University, Taipei, Taiwan Volume 1

[14] Review on Reduction of Magnetizing Inrush Current in Transformer Haresh S.Nankani1, R. B. Kelkar

[15] The J&P Transformer Book:A Practical Technology of the Power - Martin J. Heathcote - 1998 Technology & Engineering

[16] Transformer inrush current restraining scheme based on closing voltage amplitude controlling methodWeixu Wang; Wei Cong; Yaru Sheng; Jing Xiao; Jianmei Cao; Qingshui Hao 2016 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC)