Inrush Current Control In Transformer By Threshold Frequency Cutting Method

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Abstract- *When transformer is energized its current reaches very high value generally approximately 10 to 20 times greater than its rated current. This paper deals with study of control of inrush current in transformer by threshold frequency cutting method. Different methods are available to control inrush current in transformer. This paper deals with study of inrush current control by threshold frequency cutting method.*

Keywords- Inrush current, Threshold frequency.

I. INTRODUCTION

Transformer is a static device which transforms electrical energy from one circuit to another without any direct electrical connection and with the help of mutual induction between two windings and without changing its frequency but may be indifferent voltage level. Transformer plays vital role in the reliable operation of power system. Reliability means continuity of supply. The demand for a reliable supply of energy has increased considerably requiring nearly a no-fault operation of power systems. A transformer is a rather large and expensive unit therefore, in a competitive and low margin market, utilities tend to postpone as much as possible the replacement of aged units. This inconveniently reduces the network reliability. A transformer breakdown could have consequences on the rest of the power system and in addition the repair time of transformers is long. The costs associated with repairing a damaged transformer is very high.

The understanding and prediction of these situations can result in better protection schemes and integration of power transformers in the network. Hazardous operations like inrush currents, overvoltage, internal resonances, and lightning impulse stresses manifest as electromagnetic transients and are usually difficult to accurately predict.

Inrush currents are instantaneous currents flowing in the transformer primary circuit when it is energized. They are normally of short duration, usually of the order of several seconds. Even though they cannot be eliminated, it can be possible to limit and reduce them to a harmless state. High inrush currents can result in voltage dips and tripping of differential current relays both leading to a power quality reduction. Some providers have installed synchronized breakers to migrate high inrush currents, but this practice generally results in higher overvoltage and increases the risk of resonances. The trend of increased short circuit capacity and reduced losses in power systems intensifies the inrush current problem and makes the proper setting of relays more difficult.

Hence, with the help of this project, we can reduce inrush current for transformer; it can provide voltage angle controlled switching to connect the desired voltage to transformer primary circuit at the initial starting very effectively.

II. 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 up to 680 volts.
- PTC thermister for inrush current protection .Rated for up to 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-Thistechniques 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.
- Using Threshold frequency cutting method.

III. THRESHOLD FREQUENCY CUTTING METHOD TO CONTROL INRUSH CURRENT

Block Diagram-

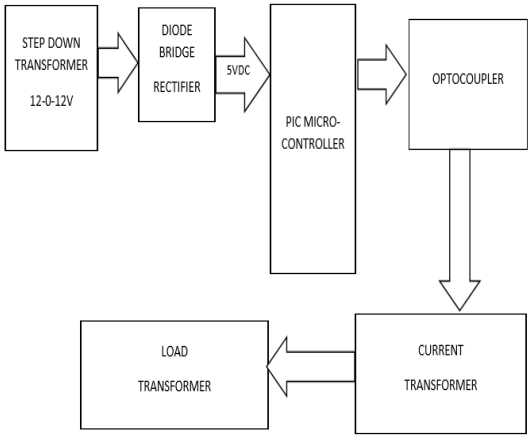

Figure 1. Block diagram of Threshold frequency cutting method to control inrush current

Working- The step-down transformer of 230/12 volt (main transformer) is used for power supply to overall circuitry. Primary of the transformer is connected to the 230 v supply and secondary is given to Bridge rectifier which converts AC 12V into DC 7V and it is given to the IC 7805 and two electrolytic capacitors which reduces the value of voltage to 5V and removes AC ripple factors. This 5V Pure DC output voltage is given to PIC controller, where we have programmed to produce delay in the peak value of 5msec using thyristors and its capacitors circuit. After this process the current transformer of 1000:1 ratio is connected at end of PCB. Across the terminals of current transformer, a resistor of 10Kilo-ohm is connected and that terminals are connected to CRO through CRO probe. Where we can see the actual waveforms of the inrush current at the condition of reducing of its value results.

APPLICATIONS

- Most suitable in Industrial sector.
- For applying variable load at secondary.
- In secondary power distribution.

IV. CONCLUSION

As reduction in inrush current in transformer is important aspect in power system. Many of the methods are used for reducing inrush current in transformer one of them is point on wave switching method or by current compensator etc.

Reduction in transformer inrush current on primary side of load transformer is results with the time delay on 5msec when Triac is OFF for 5msec and less current passes to the load transformer results in reduction in transformer inrush current.

This paper discusses on the reduce the magnetic inrush current by threshold cutting method. The magnetic inrush current is reducing using bridge rectifier, filtering capacity and PIC controller. The system performance is improving; saturation on the system is also reduce. Hence by using this project circuitry we can minimise the inrush current in transformer.

REFERENCES

[1] "Reduction of three-phase transformer magnetizing inrush current by use of point on wave switching" F. Fard Ali Asghar, and K. P. Basu. 978-1-4244-5187-6/09/ ©2009 IEEE pp 368 -369

[2] Improved Modelling and Calculation on Electromagnetic Transient of Power Transformer" Chen Zhe, Wen Yuan fang, Lu Guojun

[3] "Study of the Inrush Current Identification Using the Improved Half-Cycle Fourier Analysis" Duan Jiandong Wu Chang Yu Jianming. 978-1-4244-2487-0/09/©2009 IEEE

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

[5] Ametherm circuit protection thermister and NTC

[6] IEEE guide for protecting power transformer

[7] IEEE power Engineering Society May 2008

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

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

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