

TAP CHANGING USING SOLID STATE DEVICES FOR SINGLE PHASE TRANSFORMER

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Abstract:- Transformers which are currently employed in power system have tap changers installed in them. The tap changer mechanism helps to regulate the voltage and balance out the voltage changes and irregularities on load side by switching the ta. The tap changers used in system so far are mechanical tap changers which have arcing and various losses while operating. Aim of this paper is to look at various problems associated with current tap changers in system and how the alternative solution of using a solid state tap changer is beneficial for system.

Key Words: solid state, tap changer, single phase, power electronics, microprocessor

1. INTRODUCTION

Transformers have been an important and most crucial part of the entire high voltage transmission and distribution system. The transformer does job of stepping up and stepping down voltage depending on the load demand and its ratings.

Transformer windings have tapings drawn out of it which are used to change the voltage rating of transformer by certain value. This is done when there are sudden load changes. The taps can be drawn out from both input and load side but they are usually placed on high voltage side as the current on low voltage windings is quite high.

The unusual voltage fluctuations that occur at load side are balanced with help of tap changers present inside transformers.

1.1 Types of Tap Changers

Briefly there are two types of tap changers:

1. No Load Tap Changers
2. On Load Tap Changers

No load tap changer is used in system where the changing of loads is infrequent and de-energization of transformer is permissible. So its generally employed to low voltage systems or to places where load variation is infrequent.

On load tap changer is used where supply interruption during tap changing is not possible. This tap changer comes with a

complex tap changing mechanisms which are mechanical, electronic and hybrid (both electronic and mechanical).

Mechanical tap changer is the most widely used mechanism since the invention of on load tap changer in 1973. This tap changer establishes new connection with tap before releasing old tap and avoids high circulating current with help of high impedance diverter switch. It has a complex construction and is placed in oil filled compartment besides transformer.

1.2 Problem Statement

The mechanical tap changer causes various problems. It creates arcing between taps as switching action takes place this leads to carbonization and degradation of oil in transformer. This leads to losses and less life of transformer as well as wear and tear of parts in tap changer which in turn increases maintenance cost and since the tap changer is required to be fitted in separate tank the size of transformer increases making it bulky in nature.[1][2]

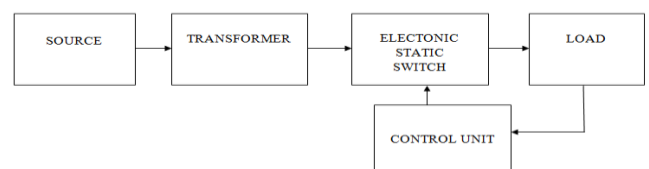
To tackle these problems Solid state tap changer is introduced.

2. Solid State Tap Changer

Solid State Tap changer is device which is completely operated by using power electronics devices belonging to thyristor family as well as other transistors which can basically act as switches.

The power electronic devices are generally arranged in anti parallel fashion and are switched on by triggering at various firing angles and using various control techniques to maintain a steady output. Since we are using solid state devices as tap changers the switching speed of the tap changer is increased significantly so the problem of arcing is eliminated. As these devices are small in size, the overall size of the transformer gets reduced.

2.1 Block Diagram



The source is generally single phase or three phase AC source providing supply to transformer. But since the power electronics devices in present time does not possess high power handling capability ,the supply provided is single phase low voltage.[5]

Here the electronic static switch is the actual configuration of solid state devices used in tap changer. These devices are switching devices like IGBT TRIAC, GTO, SCR which are connected to each other in anti parallel fashion.[4]

Firing angle control can be used in applications like controlling the speed of fan motors, controlling the intensity of a bulb, by controlling the application of power to the SCR. The firing angle control is achieved by varying the time of application of Gate pulses to the SCR. The voltage to the Gate terminal of the SCR can be applied at a given time decided by the remote input.

Basically by controlling the firing angle means to manage the point on the AC signal waveform when the SCR is going to be triggered or in other words, the time corresponding to the AC signal waveform when the SCR gate is going to be given DC supply voltage. Normally to trigger a SCR we use optoisolator.

The feedback from load is taken by using voltage and current sensors which is then sent to control unit. The control unit usually comprises of microprocessors[3] or micro controllers or arduino board [6]which take the feedback and compare it with reference signal to trigger the electronic devices via optoisolator so that we get regulated output despite change in supply or load.

3. CONCLUSIONS

As the solid state on loading tap changer of transformers removes sparking problem, reduces switching loss and size, fast reaction time and more reliability.

Hence, we conclude that the solid state on loading tap changer of transformers are convenient than mechanical tap changer

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