DESIGN AND IMPLEMENTATION OF AUTOMATIC TRANSFORMER OVERLOAD PROTECTION SYSTEM

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Abstract- Load sharing provides sufficient protection to distribution transformer under overloaded conditions. Due to overload on transformer, the efficiency drops and windings get overheated and may burn. By sharing a load current on transformer for each phase the transformer was protected. Therefore, the objective of this study was to protect transformers from overloaded conditions by sharing the load.

Because of the differences in our college level studies and industry level requirements, we are allotted a project to get knowledge about the on goings at industries. I did the mini project that covered up a practical knowledge of what I have studied so far in books. I did experience an exposure to various electronics devices and equipment's which I would not have able to get easily anywhere else.

In electric power distribution, an automatic overload protection System Is a circuit breaker equipped with a mechanism that can automatically close the breaker after it has been opened due to a fault. Automatic overload protection systems are used in coordinated protection schemes for overhead line power distribution circuits.

Keywords: Transformer overloads, Fuzzy logic controller, Government, management, Challenges, Suggestions.

1. INTRODUCTION

Overloading protection means detecting problems with distribution transformer and isolating from the load. Fuzzy logic controller is an intelligent tool that serves as an overloading protection for distribution transformers. It has logical rules which protect distribution transformers against overloading conditions.

Overloading protection for the distribution transformer can reduce around 20% of electric power interruption. Protection and overloading protection in a particular, is one of the measurement strategies to improve power system's reliability status.

In this project we (including four members of class) work together and complete this project and make a small prototype of over idea and we use a step-down transformer (12volt \ 500mA) because we work on a small size project. In this project me make a rectifier circuit to convert 12volt AC into 12volt DC. In this project we use a DC load circuit for step down transformer, so that's why we use a rectifier circuit to manage load circuit according to our real load of transformer.

Two type of load for the transformer and distribute it into a primary load and a secondary load circuit. For primary load we use a small size 12volt DC fan of and for secondary load we use a LED Load circuit. In secondary load we use an arrangement of four LED's in such a manner so that it works as Overload Circuit with main load on a transformer. And this circuit is connected to the sensing circuit which sense the overload condition and which give command to the circuit and operate the load and avoid the overload condition on transformer. Due to which we can avoid the Condition of failure or break down of transformer.

For sensing circuit a 12volt relay module circuit. For operation of relay we use a 9volt battery to supply the relay module and the battery is connected to the voltage terminal of the relay module. Then we connect the output of load circuit into the input terminals of the sensing circuit and output of the sensing circuit is connected to the input of the load circuit. From this type of arrangement of the circuits we can easily manage and control the over load of a transformer and provide automatic switching to the load of a transformer.

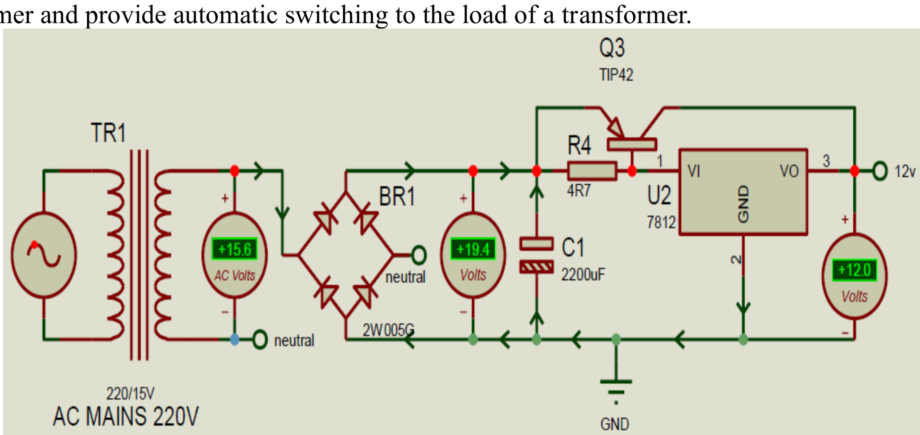

Fig. 1.1 Schematic circuit Diagram

When supply is given to the transformer it convert the 240volt AC into 12volt AC and then the rectifier circuit is convert 12volt AC into 12 volt DC supply for the DC load. Then the primary load is start working after that if we increase load by operating the secondary load one by one then the relay circuit start sensing the current and voltage on load. After that when we switch ON the all secondary load and create a condition of the overload then the relay circuit is operate and close some of the secondary load so that our main load or primary load doesn't affected by the over load and the transformer is also protected from the overload

2. REVIEW ON TRANSFORMER OVERLOAD CONDITION OND PROTECTION

2.1 Transformer Background

A power transformer is one of the most important and expensive components in a power network. They allow efficient transmission and distribution of electricity through different voltage levels. If a power transformer suffers an outage, it may affect the reliability of the entire network and have considerable economic impact on the system. Using power transformers efficiently requires planning and control. Normally, transformers are designed to operate within its nameplate ratings.

Since an overloaded power transformer will have an operating temperature increase which harms its lifespan, it is essential to model the heat transfer characteristics between windings and oil in order to predict the hot-spot temperature in the transformer as a function of the load, while considering the cooling characteristics.

The overloading may also occur because of economic considerations. If the transformer is maintained properly so that it is always within specifications, it will last longer before needing to be replaced. Accelerated aging is one of the main consequences of overloading power transformers.

2.2 Normal Life Expectancy Loading

Normal life expectancy occurs when the power transformer has a continuous hot-spot temperature of 98°C for non-thermally upgraded paper, and 110 °C for the thermally upgraded paper. However, it is permissible to operate the transformer over this temperature for a short time during a period, providing that the transformer has operated for a long time under this temperature. The exact end of life of transformers are unknown, however, according to International Electro technical Commission (IEC), there are different predictions for insulation life depending on mechanical properties such as, retained tensile strength and/or retained degree of polymerization.

2.3 Planned Overloading

This type of loading occurs when the utility operator plans to overload the transformer during a specific time that is more typical in utility operation. The hot-spot temperature may rise to 120130°C during this type of loading. No-system outage, planned repetitive loads and shorter life expectancy are the characteristics of this type of loading. For this loading type, calculations can be made to define the time period in which the acceptable loss of life can be achieved.

2.4 Long-term Overloading

In this type of overloading, the transformer is operated beyond its nameplate rating for a long time, from several hours to several months, carrying emergency loads. It might occur one or two times during the normal life of the transformer. Long-term overloading occurs because of an outage in a power system or contingencies on the transmission system. However, the risk of failure is greater than the planned overloading and the hot spot temperature can rise to 120°C -140°C under operation. For this loading type, calculations can be made in order to evaluate the acceptable loss of insulation life during a specific load cycle

2.5 Short-term Overloading

Short term overloading is the heavy loading of a transformer during a short time that causes the temperature to increase rapidly and exceed the limits defined by the name plate ratings. In this type of loading, the hot-spot temperature may rise to 180°C for a short time period with the severe loss of insulation life. The main characteristics of this type of loading are:

- Highly unlikely operation conditions on the transmission system.
- It is expected to occur one or two times over the normal life of a transformer and it usually lasts for a short time (less than half an hour).
- The risk of failure even is greater than long term overloading, due to the bubble and gas formation in the oil.

2.6 Risks of Overloading

There are certain risks of overloading of transformers. They are mentioned below.

- Gas bubbling from the insulated conductors and insulation adjacent to the metallic structural parts may reduce and jeopardize the dielectric strength.
- Temporary deterioration of the mechanical properties at higher temperatures could reduce the short-circuit strength.
- Mechanical or dielectric failures due to thermal expansion of conductors, insulation materials, and

structural parts.
- Increasing pressure in the bushings could result in leaking gaskets, loss of oil and extreme dielectric failure.
- Increased resistance in the contacts of the tap-changer that may result from an increase of oil decomposition products.
- Breaking of very high current in the tap-changer could be risky.
- Oil expansion in the tank may occur when the top-oil temperature rises above the standard limitation.
- The voltage regulation through the transformer may increase due to the increased apparent power loading and possibly dropping power factor.

3. RESULTS AND DISCUSSION

3.1 Test and Simulation Results

The designed system is tested by loading it. When the quantity of current flowing in the transformer exceeds the rated value, the relay is excited in order to disengage the transformer until the over current fault is cleared. The relay maintains checking routinely on condition the fault is subsisting and keeps disengaging the transformer until over current fault is cleared. The succeeding results have been acquired from simulating the design system. When no load is placed on the system, then the no load current measured as shown in is 0.00A. When the first load is connected, it gives a corresponding amount of current that been consumed by the Bulb. The load current been revealed on the LCD as depicted is 0.5A indicating that the first Bulb consumes a current of 0.2A.
When the second load is added, it gives a corresponding higher amount of current that been drawn following the addition of the Bulb. The load current been revealed on the LCD as shown in Fig. 12 is 0.96A indicating that the second Bulb increases load current to 0.96A. When the third load is connected, it gives a corresponding higher amount of current that been consumed as a result of inclusion of the Bulb. The load current been revealed on the LCD as shown in Fig. 13 is 1.48A indicating that the third Bulb raises the current to 1.48A. Finally, it was observed that when the forth Bulb was connected; the current rose up to level of 2.22A and then the relay as well as the buzzer set off. The buzzer blow an alarm notifying the operators of the Over current fault and concurrently, relay isolates the system from transformer.

3.2 Experimental Results

The practical experimentations of the circuit to validate the results obtained during simulations. The current reading on the LCD increases with the increasing load addition up to the preset value point. The experimental performance as depicted closely relates with the simulation. Shows the situation of the system on no load while that of overload. The system shown in the Fig. 16 indicates the LCD display of OVER CURRENT, meaning that the current circulating in the transformer exceeds the rated value. At this time, the buzzer is activated to notify the system operator of the fault occurrence in the particular transformer. A signal is also directed to the relay to isolate the load from the transformer. A comparison of the results obtained from simulations and those of the experiment is shown in Table 3.1.

Table 3.1: Comparison of the Simulation and Experimental Results

No. of Connected Loads	Simulated Load Current (Amp)	Experimental Load Current (Amp)	State of Relay	State of Buzzer
None	0.00	0.08	OFF	OFF
1	0.52	0.62	OFF	OFF
2	0.96	0.99	OFF	OFF
3	1.48	1.43	OFF	OFF
4	2.22 (OC)	2.28 (OC)	ON	ON

It was noted that as the load increases, the current flowing in the transformer also rises. This is portrayed in the Table 3.1 and an increment in the sensor output voltage prompted a comparable rise in the current value presented on the LCD. The plot shows the trend of current on loading the system.

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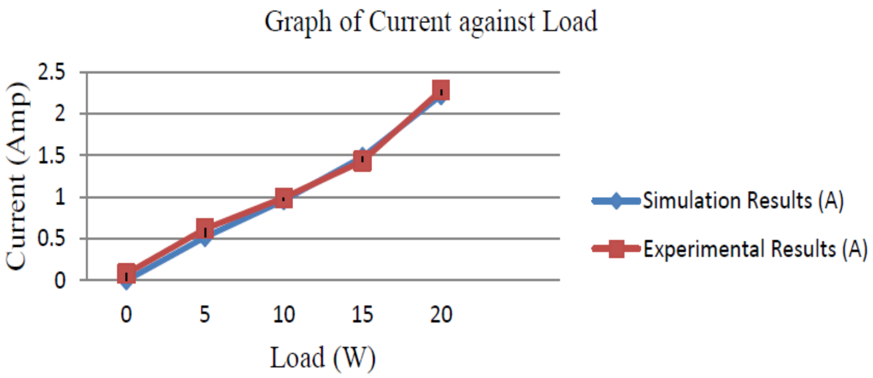

Fig. 3.1 The Trend of Current on Loading the System

CONCLUSIONS

In this paper, a new designed topology of sustainable overload protection of distribution transformer has been implemented and presented. The relay is the main switching component in the system. When electrified, it opens its contacts and deactivates the contactor thus cut off the system from overloading the transformer to safety. The other marginal accessories make up media of delivering cautioning notes should an over current fault crops up. The cost of executing the system is somewhat economical as the elements utilized are handful and sourced in local market. This makes the overall project cost effective. Generally, findings reveal a means for modesty and veracity of the fad design topology to use handy and soon accessible constituents and substances to build the invention. In comparison to variant arrangements in literature, this topology here was able to incorporate an alarm complement together with display element to immediately create awareness. This makes it better than the existing analogue design.

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