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Real Time Monitoring & Protection of Transformer Using PLC

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Abstract – *Transformer is very important device in the power system. In this paper, we have presented a system to provide. We have used Programmable Logic Controller (PLC) and various sensors to protect the transformer against overvoltage, overcurrent, phase to phase fault and phase to neutral fault. Real time monitoring of the transformer is also a very important part so as, we can sense the upcoming fault or abnormal condition. The monitoring and protection can avoid various faults like short circuit fault, thermal overload and transformer can give better performance.*

***Key Words*: Arduino Uno, Control, Monitoring, Protection, Sensor, etc.**

1. INTRODUCTION

From many decades transformer are playing vital role in industries, substations, generation, distribution etc Main aim of studying this paper is to design and implementation of PLC (programmable logic controllers) automation to monitor as well as to diagnose condition such as load, currents, transformer temperatures and voltages of the Distribution transformers of substation which is one of the most important equipment in the power system network.[1] The Data acquisition, condition monitoring, automatic controlling are important issues as there are large no of transformers and various components over a wide area in power system.

In proposed system with PLC, relays and sensors are used to detect the faults of transformer such as overloading, overvoltage, under-voltage, phase to phase fault and over temperature faults.[2] Probability of faults on distribution transformers is undoubtedly more and hence protection of transformer is highly essential.

Automation control is used for various systems for operation of equipment's. Some processes are completely automated. Benefit of automation is it saves labor and saves energy and material; improve quality, accuracy and precision.[3] Reduces dependency on human presence and decision making for any process A distribution transformer is a transformer that provides the final voltage transformation in the electrical power distribution system stepping down the voltage used in the distribution lines to the level used by the customer. Distribution transformers normally have ratings less than 200 KVA although some national standards can allow for unit up to 5000 KVA to be described as distribution transformer. Since these transformers are energized for 24 hours a day, its proper working is very important and so a strong protection is required.[4]

The main concern of this paper is to rescue the distribution transformer in power system network against the internal and external faults. Overloading of transformer beyond the rating can cause a rise in temperature of both transformer oil and winding, overloading is nothing but it is an over current fault occurring on secondary side of distribution transformer or rise in the load. Increase in the winding temperature will increase the stress on the insulation, and then insulation deteriorates and may fail. Power system faults external to transformer can increase or decrease the voltage of the transformer, which leads to overvoltage or under-voltage fault. When fault occurs current increases, and hence a comprehensive transformer protection scheme needs to include protection against overvoltage, under-voltage, overload, phase to phase fault and over temperature. Following system is a proposed system which consist all this protections.

2. METHODOLOGY

In this paper, we will use PLC for protection and control of a Transformer. The methodology is very simple, we want to create a protection circuit which will protect transformer from over current and overheating. For that purpose we use temperature sensor LM35 which is placed on the Winding of a transformer, which continuously measures the temperature inside the winding and sends to PLC. Then if temperature is greater than limit then the PLC will operate the relay and Control circuit then supply will stop. This type of protection is also given for the over current, and CT is used for measurement of current. Similarly, if voltage changes or occurrence of fault then control circuit will operate and protect transformer from damage.

2.1 Block Diagram

Block diagram of the proposed system is shown in the Fig -1. The system will work properly if all the subsystems work without any error.

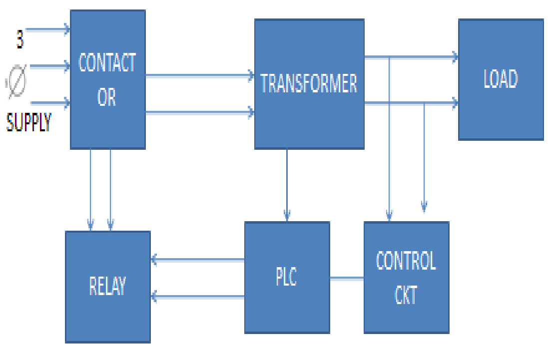

Fig -1: Block Diagram

When a relay is used to switch a large amount of electrical power through its contacts, it is designated by a special name: contactor. Contactors typically have multiple contacts, and those contacts are usually (but not always) normally-open, so that power to the load is shut off when the coil is de-energized. Perhaps the most common industrial use for contactors is the control of electric motors.

The top three contacts switch the respective phases of the incoming 3-phase AC power, typically at least 480 Volts for motors 1 horsepower or greater. The lowest contact is an “auxiliary” contact which has a current rating much lower than that of the large motor power contacts, but is actuated by the same armature as the power contacts. The auxiliary contact is often used in a relay logic circuit, or for some other part of the motor control scheme, typically switching 120 Volt AC power instead of the motor voltage. One contactor may have several auxiliary contacts, either normally-open or normally-closed if required.

The three “opposed-question-mark” shaped devices in series with each phase going to the motor are called overload heaters. Each “heater” element is a low-resistance strip of metal intended to heat up as the motor draws current. If the temperature of any of these heater elements reaches a critical point (equivalent to a moderate overloading of the motor), a normally-closed switch contact (not shown in the diagram) will spring open. This normally-closed contact is usually connected in series with the relay coil, so that when it opens the relay will automatically de-energize, thereby shutting off power to the motor. We will see more of this overload protection wiring in the next chapter. Overload heaters are intended to provide over current protection for large electric motors, unlike circuit breakers and fuses which serve the primary purpose of providing over current protection for power conductors.

2.2 Hardware Design

Transformer is major part of this project. Transformer designing is important aspect for this system. We have used 1kVA, 3 phase, 50 Hz, 415/230V transformer.

Specification	Ratings
Rating	1 kVA
Voltage Ratio	415/230 V
No. of phase/ Frequency	3ph/50Hz
Connection	Delta-Star
Winding Material	Aluminium
Tapping on HV	At +2.5%, +5% for HV variations
Impedance	4.5%
Maximum flux density	1.6 Tesla
Maximum Current density	1.5 A/ sq-mm
Temperature	40/50°C

Table -1: Transformer Parameters

The protective scheme depends on the size of the transformer. The rating of transformers used in transmission and distribution system range from a few kava to several hundred MVA. For small transformers of medium size over current relays are used. For large transformers differential protection is recommended.

2.3 Results

Results for the load current read is shown in Fig -2.

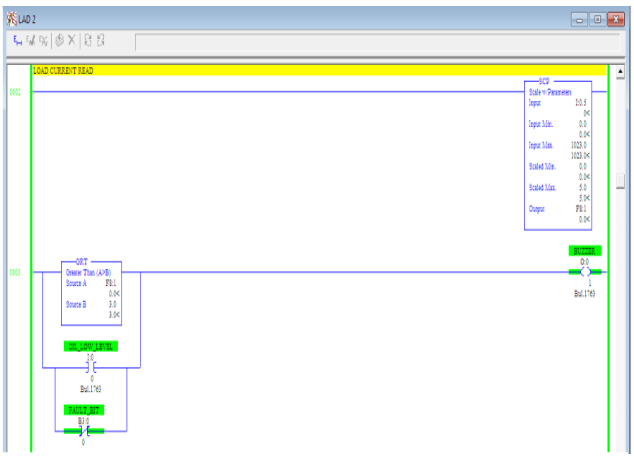

Fig -2: Real time value of load current.

Result for the phase to phase fault is shown in the Fig -3.

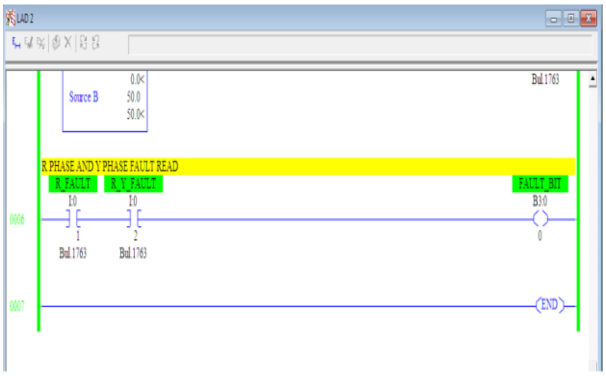

Fig -3: Protection against phase to phase fault.

Result for the primary voltage read is shown in the Fig -4.

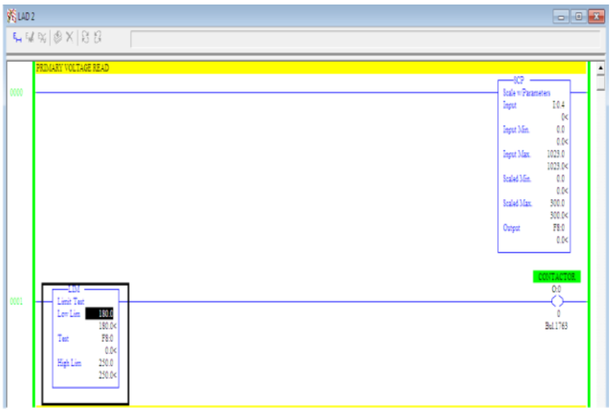

Fig -4: Real time value of primary voltage.

Results for the temperature read is shown in Fig -5.

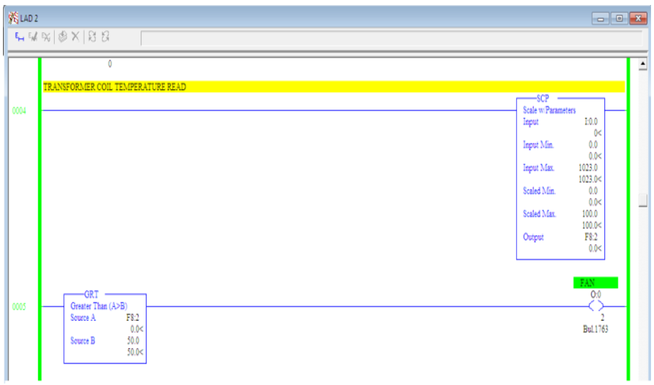

Fig -5: Real time value of temperature.

3. CONCLUSIONS

In this paper, we have introduced a system than can protect and monitor a transformer by using the Programmable Logic Controller (PLC). Various parameters like current, voltage and temperature and their real-time values can observed on the screen. Protection against the overcurrent, overvoltage, phase to phase fault, phase to neutral fault is done by PLC programming and sensors. Also control of transformer is achieved. All the desired objectives are completed and new protection, control and monitoring system is developed which is discussed in this paper.

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[2] In 2003 Ali reza proposed a design which was based on differential relay for transformer protection.

[3] In 2007 S.M. Bashi designed and build a microcontroller based system for transformer protection.

[4] In 2010 V. Thiyagarajan & T. G. Palanivel proposed an innovative design that was used for monitoring the current of distribution transformer & protect overload current.

BIOGRAPHIES

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