“REMOTE MONITORING OF THREE-PHASE TRANSFORMER”

Synopsis
Bachelor of Engineering
in
Electrical and Electronics Engineering

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INTRODUCTION

The TRANSFORMER is one of the most common device found in electrical system that links the circuits which are operating at different voltages. These are commonly used in applications where there is a need of AC voltage conversion from one voltage level to another. It is possible either to decrease or increase the voltage and currents by the use of transformer in AC circuits based on the requirements of the electrical equipment or device or load. Various applications use wide variety of transformers including power, instrumentation and pulse transformers.

In a broad, transformers are categorized into two types, namely, electronic transformers and power transformers. Electronic transformers operating voltages are very low and are rated at low power levels. The term power transformer is referred to the transformers with high power and voltage ratings. These are extensively used in power generation, transmission, distribution and utility systems to increase or decrease the voltage levels. However, the operation involved in these two types of transformers is same.

The operation of the transformer is based on the principle of mutual induction between two coils or winding which are linked by a common magnetic flux. When the primary winding is energized with AC source supply, a magnetic flux is established in the primary winding. This flux is linked with both primary and secondary windings because the core provides a low reluctance path for the magnetic flux. Hence, most of the flux produced by the primary winding links with the secondary winding. This is called as main flux or useful flux. And also, the flux which does not link with the secondary winding is called as leakage flux. Most of the transformers are designed to have low leakage flux to reduce the losses.

According to the Faraday’s laws of electromagnetic induction, this flux linkage with both primary and secondary windings induces EMFs in them. This EMF induced in each winding is proportional to the number of turns in it. The voltage or EMF induced in the primary winding is called as back EMF which opposes the input supply voltage to the extent that no primary current would flow. But small magnetizing current flows through the primary of the transformer. The EMF induced in the secondary winding is the open circuit voltage. If the secondary circuit is closed or the load is connected, secondary current starts flowing through it which causes to
create demagnetizing magnetic flux. Due to this demagnetizing flux, the unbalance is created between the applied voltage and back EMF. To restore the balance between these two, more current is drawn from the supply source so that equivalent magnetic field is created to balance with secondary field.

A number of transformer fault conditions can arise practically in any time following some special situations. These include the following 5 most common internal faults and few external:

1. Earth faults
2. Core faults
3. Interturn faults
4. Phase-to-phase faults
5. Tank faults
6. External factors

In the case of our project we are using merz-price protection for the protection of transformer. It is for secondary protection.

**The main aim of the project is to detect the fault in the very initial condition by sensors, ARDUINO and RASPBERRY-PI model.**

Merz price circulating current principle is commonly used for the protection of power transformer of 5MVA and above against earth and phase faults. The system as applied to transformers fundamentally the same as that for generators, but with certain complicated features not encountered in the generator protection system.

In a power transformer, currents in the primary and secondary are to be compared. These currents will be different, due to primary and secondary voltages being different. Hence the difference is compensated by different turn’s ratios of CTs.
There is usually a phase difference between the primary and secondary current of a 3-phase power transformer. Even if CTs of proper turns ratio are used, a differential connection for phase difference is effected by appropriate connections for CTs. The CTs on one side of the transformer, are connected in such a way the resultant currents fed into the pilot wires are displaced in phase from the individual phase currents in the same direction as and by an angle equal to the phase shift between the power transformer primary and secondary currents.
LITERATURE SURVEY


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OBJECTIVES

As the proverb says “prevention is better than cure”, in this project we are monitoring all the parameters of transformer which might cause internal faults such as current, voltage, temperature, winding insulation failure and transformer oil permittivity.

These parameters are helpful in preventing any severe damage to the transformer which can cause higher losses to the condition of rest of the system and for economy.

- **Insulation deterioration**: Heat is the prime cause which leads to electrical insulation deterioration. Every 10°C rise in temperature above the limit, reduces the insulation resistance as well as its expected life by around half. At prolonged high temperature, the organic insulating materials start to dry and become brittle, which leads to build up of tracks. Some components are weak in tensile load, some are weak on impact load, and therefore components may fail due to excessive mechanical stresses. Vibration are unavoidable at many places in industries and this is one of the main reason for insulation failure.

- **Transformer overheating**: it is mostly produced in liquid insulation oil. It is a different problem to slightly in transformers. A DGA (Dissolved Gas Analysis) after the test will indicate high thermal gases to generate. Methane, Ethane, and Ethylene these gases to produced by overheating of the liquid oil. These gases are formed from a breakdown voltage of the liquid oil caused by heat.

- **Leakage current**: The leakage current in an equipment flows when an unintentional electrical connection occurs between the ground and an energized part or conductor. ... The leakage in devices is largely due to the imperfections in the insulators or materials that make the component such as the semiconductors and capacitors.

- **Winding failure**: The winding earth fault current depends on the earthing impedance value and is also proportional to the distance of the fault from the neutral point, since
the fault voltage will be directly proportional to this distance. For a fault on a transformer secondary winding, the corresponding primary current will depend on the transformation ratio between the primary winding and the short-circuited secondary turns.
METHODOLOGY

Different faults in transformer

- Overheating
- Contamination of oil
- Voltage drop

Sensors

RASPBERRY-PI MODEL

- Remote monitoring
- Data collection
- Data analysis and forecasting
As the block diagram shows the transformer undergoes various internal faults listed as:

1. Insulation deterioration
2. Winding failure
3. Over heating
4. Contamination of oil
5. Over voltage

➢ So these faults are detected by the various sensors.

➢ The sensed signals are sent to the RASPBERRY-PI MODEL.

➢ Here the data is segregated and evaluated.

➢ Remote monitoring is done.

➢ The collection of data is done.

➢ The collected data is analyzed by the programmed model and different graphs are plotted.

➢ And for parameters such the frequency of occurrence of faults, transformer oil viscosity, humidity are been forecasted to avoid future losses.
CONCLUSION

The work starts with a thorough analysis of a fault condition. From a detailed fault analysis, it has been concluded that performance of the conventional protection scheme is affected to a great extent by the combined effect of load flow in the faulted path. To improve the performance of the conventional protection scheme against such conditions, a new sensor based RASPBERRY-PI model is proposed in this thesis.

The new algorithm uses sensors of voltages and currents to find at what proportion the faulted portion of the transformer get isolated. The result proves that the methodology is precise and robust in these aspects. Also, as the proposed algorithm performs the protection duty with a very less computational bourdon, it is suitable for practical implementation even in fast protection systems designs. As the proposed algorithm follows sensors based fault identification method, it is very simple compared to the other types of fault detection and estimation methods.
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