Transformer Protection

Introduction

Many kinds of transformers can be found in the market which includes two winding power transformers, three windings power transformers, auto transformers, regulating transformers, earthing transformers.

Depending on the use of **the transformer**, winding connections, earthing methods, mode of operation and other various factors, decision on the kind of protection that should be used for **the transformer** is made.

Normal service condition, kind of transformer fault, amount of sustained over load, tap changing method also influence the kind of protection to be used for a specific transformer.

To transformers of 1.5 MVA and above value, generally the Buchholz relay protection is provided. For protection of small size distribution transformers, however, High Voltage fuses are used. Over current protection and earth fault protection are two main protection strategies utilized for larger rated and important distribution transformers. For transformers which are rated above 5 MVA, it is suggested that differential protection should be utilized.

Stress Factors and Protection Methods

Supply network

Increased voltage is likely to cause stress on the transformer. Two kinds of voltage flows which most commonly occur are atmospheric and operating voltage surges. The falling of a lightning stroke near an overhead line or on it causes the atmospheric voltage surge. When deviation is experienced in the set operating conditions of an electrical network an operating voltage surge occurs. The voltage surge of this kind is mostly a high frequency surge wave.
Both these kinds of over voltages can be controlled by the use of a varistor made of zinc oxide. The varistor has no deleterious effects on switchgear in any way.

Load

Increase in the number of small loads or when the apparent power demand of a specific installed device increases, overloading is experienced. These may be encountered when there is a need to expand by increasing the building area, along with other factors. The temperature of the wiring and the insulation material rises with the increase in load, which decreases the life of the equipment by decreasing its efficiency. Both the primary and secondary sides of the transformers can be used to install the overload protection equipment.

The overload protection equipment commonly used nowadays is a digital **relay device**. This **relay device** helps to turn off the **circuit breaker** which is present on the secondary side of the transformer. This digital relay device, known as thermal overload relay, by considering the time constant of the transformer, mimics the temperature artificially. Using this relay device, prediction can be made of the time when the overload tripping would occur and the waiting duration after the **circuit breaker** has tripped. Load shedding operation is easily controlled with this information.

Oil-immersed transformers have two different thermostats as the protection. One thermostat rings the alarm while the other trips the circuit breaker. The alarm and tripping is both controlled by heat sensors in case of dry-type transformers. These heat sensors are located in the hottest part of the insulation of windings.

Internal faults

Buchholz mechanical relay, a kind of transformer-mounted device, is used to provide protection to transformers experiencing internal faults.

These transformers are those which are fitted with air-breathing conservator tanks. Arcing of initial faults in the insulation of the winding may result in the accumulation of gases, as can the entrance of air because of an oil leak. The accumulation of gases in both these cases is a very slow process but can still be detected by the relay. If the situation is minor then the alarm goes off. But if the situation aggravates further, which happens when the oil enters the connecting pipe between the main and the conservator tank, the upstream circuit breaker trips.

Transformers have been modernized and equipped with cooling oil radiator elements. The function of cooling oil radiators is a concerting action and helps prevent the pressure from rising.

Internal faults are of two types:

- Internal phase-to-phase short-circuit

  This kind of error in the transformer can be corrected by either using three fuses located on the primary side of the transformer or an over-current relay. The over-current relay will trip the circuit breaker present upstream of the transformer.

- Internal phase-to-earth short-circuit

  Most commonly encountered internal fault is the phase-to-earth short-circuit. Earth fault relays have been found useful in detecting this internal fault. Specific core current transformer is the first option if sensitive detection is required to be made. A two current transformer set can serve the purpose well.

RET650- A recent innovation

RET650 is a modern invention which can be used for ready-made, optimal “off-the-shell” protection solutions. Protection of two winding transformers and three winding transformers can be achieved by RET650. It also helps to control the voltage for a single transformer.

A separate voltage control unit is also available for use and can handle two parallel operating transformers. It is also useful for the integration of back-up protection functionality.

Intelligent electronic devices (IEDs) are the type tested variants of RET650. These IEDs when delivered are also configured to ensure complete and proper functionality. They are set on default settings to facilitate handling of products.

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