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STUDY on POWER TRANSFORMER

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***Abstract*- This paper will address you about the working of power transformer, uses of power transformer. Key equipment for the electric power transmission is the transformer. Because of the high failure Frequency and the resultant reliability and safety implications in particular of main transformers, an In-depth assessment is necessary. Main transformers are considered as critical equipment because of the large quantity of oil in contact with high voltage elements. Experience has shown an Increasing number of transformer explosions and fires in all types of power plants worldwide. Therefore, these phenomena have been investigated in more detail and are discussed with regard topotential root causes for these events such as potential influence of the age of the transformers. Moreover, possible diagnostic measures to avoid such events and enhance the reliability are shortly described. For investigating the current status of the reliability of transformers different types of databases have been evaluated**

I. INTRODUCTION

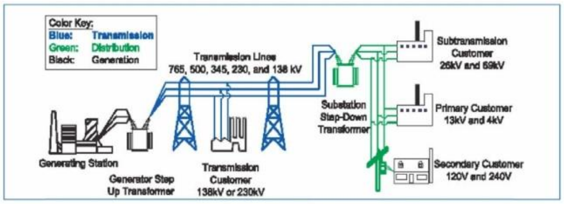
A broad spectrum of events such as design defects, voltage surges, lightning strikes, structural damage, rapid unexpected deterioration of insulation, sabotage, and even maintenance errors can lead to transformer fires and explosions. Experience has shown that the consequences of such events can be severe.

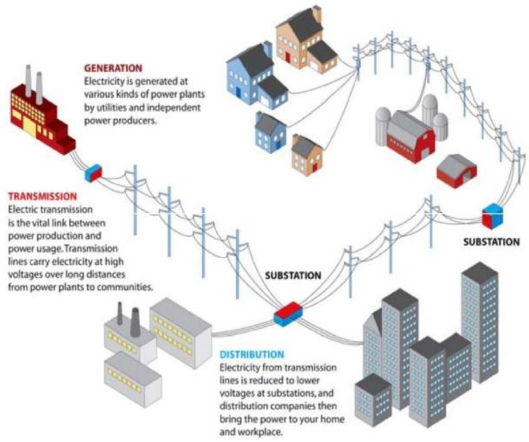
In particular, a fire of an oil-cooled transformer that contains several thousand liters of combustible insulating oil can result in severe damage to nearby power plant structural components such as concrete walls and damage or destroy electrical components such as nearby transformers, bus work, and circuit breakers (US Department of the Interior 2005). A one-year research project led to the discovery of 730 transformer explosions in the USA only. Many experts anticipate that the number of failures per year will increase significantly in the near future to 2%. In addition, the shorter lifetime of new transformers will sharply increase above this rate after 2010. Because about 115 000 large transformers are in operation in the US and about 400 000 worldwide, the number of impacted transformers is high, even when only in some cases fire and explosion lead to a total damage (Berg & Fritze 2010).

Power transformers with an upper voltage of more than 100 kV are necessary for the undisturbed operations of a developed society. In electricity generation plants, power transformers transform the voltage of the generator to a higher level for the transmission of electricity in the main grid. The voltage of the main grid must again be transformed to a lower voltage, so that the electrical energy can be utilized in numerous purposes (Valta 2007).

Electric power is normally generated in a power station at 11 to 25kV. In order to enable the transmission lines to carry the electricity efficiently over long distances, the low generator voltage has to be increased to a higher transmission voltage by a step-up transformer, i.e. 750 kV, 400kV, 220kV or 110kV as necessary. Supported by tall metal towers, the lines transporting these voltages can run into hundreds of kilometers. The grid voltage has then to be reduced to a sub-transmission voltage, typically 26kV, 33kV or 69kV, in terminal stations (also known as power substations).

Sub-transmission lines supply power from terminal stations to large industrial customers and other lower voltage terminal stations, where the voltage is stepped down to 11kV for load points through a distribution network lines. Finally, the transmission voltage is reduced to the level adapted f r household use, i.e 415V (3- phase) or 240V (1-phase) at distribution substations adjacent to the residential, commercial and small to medium industrial customers. Figure 1 shows a typical electrical network system, in which power is transformed to the voltages most suitable for the different parts of the system.





At every point where the e is a change in voltage, a transformer is needed that steps the voltage either up or d own. There are essentially five levels of voltages (Unite d States Department of Energy 20 06) used or transmitting and distributing AC power (Table 1): Ultra-High Voltage.
UHV, 1100 kV), Extra-High Voltage (EHV, 345 to 765 kV), High Voltage (HV, 115 to 230 kV), medium (or sub-transmission) voltage (MV, 34.5 to 115 kV), and distribution voltage (2.5 to 35 kV). The UHV, EHV, HV, and MV equipment is mainly located at power plants or at electric power substations in the electric grid, while distribution-level transformers are located in the distribution network on poles, in buildings, in service vaults, or on outdoor pads.

Table1. AC voltage classes

Transmission Voltages		Distribution Voltages	
Class	**kV**	**Class**	**kV**
Medium voltage (MV)	34,5	2.5	2.4
	46	5	4.16
	69	8.66	7.2
	115	15	12.47
High voltage (HV)	115	25	22.9
	138	35	32.5
	161		
	230		
Extra-High voltage (EHV)	345		
	500		
	765		
Ultra-High voltage (UHV)	1100		

For the different activities of changing voltage, the following two types of transformers are commonly used:

- Dry type transformers and
- Liquid insulated transformers.

II. MAIN COMPONENTS O F A TRANSFORMER

The major components of a transformer are the c oils (windings), the c ore, the tan k or casing, the radiator, and the bushings as shown in Figure 2. Generally, transformer coils are mad e of copper because it has a lower resistance and is mo re efficient compared to other metals. Each winding is wrapped with an insulating material such as paper. The primary winding is usually wound around the transformer core and the secondary winding is t hen wound on top of the primary winding. Between each layer of the windings, another layer of insulating material is wrapped to provide extra insulation between the windings. There are ten major transformer components (Ng 2007).

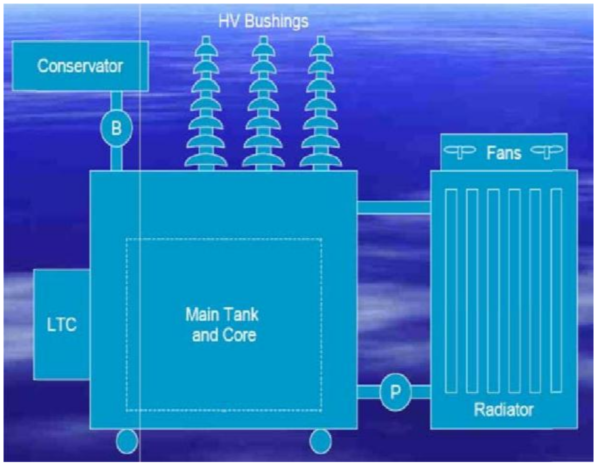


Figure 2. Main transformer components

These components can briefly be described as follows:

1) Core is a ferromagnetic material (commonly soft iron or laminated steel) that provides a path of high magnetic permeability from the primary circuit to the secondary circuit.
2) Windings allow a secondary voltage to b e induced in the secondary circuit from the
alternating current (A C) voltage in the pri
the transformer core caused b y applying
Magnetic field and, hence, voltage on the secondary winding.
3) Tank or casing, which is usually a reinforce d rectangular structure in these transformers,
Contains the dielectric material, t he core and the windings.

4) Dielectric material is a substance that is a poor conductor of electricity but an efficient supporter of electrostatic fields. It can be fluid oils, dry solids or gases.
5) The expansion tank or conservator containing dry a r or
Above the fluid level.
6) Bushing is an insulating structure that pro ides a con ducting pat h though its centre, its primary function is t insulate the entrance for an energized conductor into the tank.
7) Pressboard barriers, between the coils and between t e coils and core, are installed to increase the dielectric integrity o f the transformer.

8) The tap c hanger is a connection point along a transformer winding that allows the number o turns to be selected, o r so-called voltage regulating dev ice.
9) The radiator provides s a heat transfer path to dissipate the internal heat generated in the transformer.

10) The pressure relief device is us d to protect the tank against excessive pressure release inside a transformer tank.

III. CONCLSION

Further investigation

It has been found that main transformer failures require an in-depth assessment because of the high failure frequency and the resultant reliability and safety implications (USNRC 2010).
ary circuit. The change in magnetic field in
primary AC voltage causes an induced
A lot of events in all types of power plants and substations has shown that ageing transformers are a matter of concern. Thus, transformer age might be an important factor to consider when identifying candidates for replacement or rehabilitation. Age is one important indicator of remaining life and upgrade potential to current state-of-the art materials. During transformer life, structural strength and insulating properties of materials used for support and

electrical insulation (especially paper) deteriorate (US Department of the Interior 2003). Ageing reduces both mechanical and dielectric strength. All transformers are subject to faults with high radial and compressive forces. Clamping and isolation can then not longer withstand short circuit forces which can result in explosions and fires.

Although actual service life varies widely depending on the manufacturer, design, quality of assembly, materials used, maintenance, and operating conditions, the designed life of a transformer is about 40 years, but in practice industry has noted that they last 20 to 30 years.

However, in some cases the transformer are younger as in the case of the transformer fire at the Diablo Canyon plant in 2008 where the transformer was only nine years old.

The most mostly applied method for obtaining this information is to take oil samples from the transformer oil and carry out a so called Dissolved Gas Analysis. Certain gases are formed in transformer oil as a result of the transformer’s age but they are also formed as a result of different over-loading situations, partial discharges and electric arc phenomena, etc. This method will now implemented in several nuclear power plants to avoid recurrence of a fire event.

However, the effectiveness of the current practice of oil sampling to predict the failure of power transformers has been checked within a research project. It was found that the current method of oil sampling using dissolved gas analysis alone is not as effective as usually perceived. An average of only 1,7% of transformer failures were actually predicted by this method. Thus, alternative mitigating strategies have to be developed to manage the risk of transformer failures (Visser & Brihmohan 2008).

One approach might be a combined use of gas and optical sensing technologies for the testing of transformer oil. The performance of such a method was evaluated to-date only on a small database of transformer oil samples and has to be further validated (Amrulloh, Abeyratne & Ekanayake 2010).

A further aspect which needs to be taken into account is the fact that the detection method Dissolved Gas Analysis is not able to measure the amount of the gases that are inside the solid insulation.

However, temperature variations can cause the generated gases to migrate into the solid insulation or more gases come out from the solid insulation into the liquid. This could generate error in Dissolved Gas Analysis measurements or trigger a false alarm. A mathematical model can be used to convert the Dissolved Gas Analysis results to the real amount of gas present in the system based on the current gas concentration in the oil and the system temperature.

REFERENCE:

Sites:

- **www.wiki.in**
- **www.google.com**

Books:

- Electrical Machines