

The difference between distribution and power transformers

September 27, 2013 by Gregory Hollings



An overview of liquid filled, dry type and GSU transformers

On the distribution level (transmitted power up to 10MVA) there are two main categories of distribution transformers: **liquid filled** (using mineral oil or replacement fluids such as synthetic or natural esters) and **dry type**. The liquid filled transformers are the most compact and cost efficient solution, whereas dry type transformers are preferred in environments where fire safety is of special importance such as, for example, underground substations, mining sites, marine and some industrial applications.

Standard versions of distribution transformers are cooled passively as the heat generated by losses is transported away from the core by natural convection of the insulation medium. In the case of liquid filled products, this heat is then transported through the tank walls by thermal conduction and removed

by the natural or forced convection of air. Dry transformers in closed environments usually have a forced internal convection flow of air to ensure sufficient cooling of the transformer core.

Liquid filled transformer



Dry type transformer



Dubai's 868m high Burj Khalifa building is equipped with 78 ABB dry type transformers



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AMDT (amorphous metal distribution transformers) is an upcoming technology that reduces losses inside the magnetic core. Although the amorphous materials are still more expensive than standard grain oriented steel, their application can be justified depending on how these losses are capitalized over the lifetime of the transformer.

Power transformers

When the transmitted power exceeds around 10 MVA, special designs are required to cope with the mechanical forces of short circuit currents, higher insulation levels and increased cooling requirements. For these ratings, liquid-filled transformers are usually used. The insulation between the windings becomes more and more demanding at higher voltages. Furthermore, resonance effects inside the winding itself have to be considered to avoid insulation failures during highly dynamic impulse stresses such as lightning strikes which may reach amplitudes of one to two thousands kilovolt with a 1 μ s rise time.

Transformers with power ratings above some ten MVA are a key element in the supply of large regions or industrial areas. As a rule of thumb, it can be considered that one person has an average electrical power demand of 1kVA, which means, that a 400 MVA transformer transfers the power needed by 400,000, the equivalent of a medium sized city. Such transformers have to comply with special

requirements on safety and reliability and also have to provide a very high efficiency and low sound level. In recent decades, high voltage DC lines have also become increasingly important, especially in large countries such as China where they connect industrial centers to the remote regions where the electricity is generated. ABB now offers standard solutions for DC converter transformers for up to $\pm 800\text{kV}$ DC.

A transformer located directly next to a power plant is called GSU (**Generator Step-up Unit**). A GSU transforms the electric power from the medium voltage of the generators to the high voltage transmission level. To balance power flow between parallel power lines, phase shifters can be used. These are transformers (usually with a 1:1 translation ratio) that adapt and control the phase angles of voltage and current to optimize the power transmission capacity of the lines. Phase shifters exist up to a power rating of 1,500 MVA.

Phase shifter



Today transformation efficiencies of up to 99.85 percent are achievable by using special magnetic steel qualities and optimized designs. The heat losses, even at these high efficiencies, are still significant: For the 400MVA unit mentioned above, for example, it would be still around 600kW under full load conditions. The cooling system thus remains a challenge. Additionally, the weight and size dimensions of such devices have to be set carefully since there are limitations in the maximum transportation possibilities in the different countries.

Traction and special transformers

Railway vehicles use a special type of transformer that must be highly compact, reliable and robust. Operating frequencies vary (according to countries and systems) from 16.7 Hz to 60 Hz with power classes of up to 10 MVA. To permit trains to cross borders between countries, traction transformers must be compatible with the different frequencies and power systems.

Further reading:

[A brief history of the power transformer](#)

[How transformers work](#)

Editor's note: the article was originally written by Max Claessens and was first published in the [ABB special report on transformers](#)

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Ruby - Solomoncorp.com · a month ago

From what I've learned, the main difference between power transformer and distribution transformer lies in its maximum efficiency. Distribution transformer has maximum efficiency at 50%-70% load whereas Power transformer has 100% maximum efficiency.

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Eric Blaise · 8 months ago

I know that liquid filled transformers are sealed units, and I understand the purpose behind using a liquid as a coolant, but there is a certain uneasiness felt by some people who live around, near, or are dependent on such power sources. To be honest, I was apprehensive myself at first, but it is actually one of the most efficient ways to receive power. The liquid keeps the system cool, boosting efficiency, as well as keeping it quiet. There is greater risk from rainfall than there is from the internal coolant.

Eric | <http://www.epe.com.au/products...>

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Nice blog.does power transformer design varies with the impedance levels transmission voltage and cooling requirements

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Very good explanation on dry type transformers. Language is very lucid.

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Nice post! It really help the Contact Center Brazil !!

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Zohaib Asghar · 2 years ago

more knowledge require for phase shifter

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About the author

I'm a social media editor within the Corporate Communications department at ABB. My interests include renewable energy, clean tech, and urbanisation. I also enjoy working on enterprise collaboration and online community management. Outside of work I'm an enthusiastic, if not talented, supporter of local sports teams in Zurich :-)

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