Three phase electricity diagram

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In a star (wye) connected topology, with rotation sequence L1 - L2 - L3, the time-varying instantaneous voltages can be calculated for each phase A,C,B respectively by:

The below images demonstrate how a system of six wires delivering three phases from an alternator may be replaced by just three. A three-phase transformer is also shown.

Generally, in electric power systems, the loads are distributed as evenly as is practical among the phases. It is usual practice to discuss a balanced system first and then describe the effects of unbalanced systems as deviations from the elementary case.

Hence (substituting back):

The load need not be resistive for achieving a constant instantaneous power since, as long as it is balanced or the same for all phases, it may be written as

for all phases and the instantaneous currents are

Now the instantaneous powers in the phases are

Using angle subtraction formulae:

which add up for a total instantaneous power

Since the three terms enclosed in square brackets are a three-phase system, they add up to zero and the total power becomes

showing the above contention.