Centre Universitaire Mila

Département des Sciences et Techniques

Spécialités: Génie Mécanique / Electromécanique

Module : Anglais technique et terminologie

Lecture 04

The electric power system, in very general terms, is made up of generators, transformers, transmission and distribution lines, and loads. Each of these components is itself a complex system on its own and has many components. Electric power system is three-phase, 50 or 60 Hz for the smallest loads, such as residences, where the three phases are split into single-phase, low-voltage supply.

Generators and Transformers

Almost all generators turn mechanical power into electrical power through a 50 Hz synchronously rotating machine. The only exceptions are the new generators that convert solar, wind, or chemical power into electrical energy, but the amount of generation available in these modes is yet a small fraction. A nonsynchronous generator, when connected to the grid, an interfacing equipment that converts to 50 Hz is necessary. Turbines drive synchronous generators in power plants. A governor is used to maintain 50 Hz at any time controls the rotating speed of the turbines. The electrical generator has a voltage regulator and exciter that control its output voltage. The main purpose of a transformer is to transform one AC voltage level to another by a fixed ratio. A transformer has no moving parts except that some have the capability of changing the transformation ratio by small percentages through moving taps; This enables better control of the output voltage. Transformers can be single-phase or three-phase, and three single-phase transformers can sometimes be used instead of one three-phase transformer. Although one three-phase transformer is cheaper than three one-phase transformers for the same purpose, if a spare is needed for reliability purposes, two three-phase transformers are more expensive than four one-phase transformers! A special type of transformer is the phase-shifting transformer. This type of transformer may or may not transform the voltage magnitude, but it does change the phase relationship between the output and input voltages. The power transfer through the transformer can be controlled by changing this phase angle.

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Transmission and Distribution

The main difference between transmission and distribution lines is the voltage level. They always have three wires for the three phases insulated for the voltage level and can be with or without a fourth grounded (uninsulated) wire. They can be strung overhead on wooden or steel towers, or they can be laid underground. Overhead lines are bare and suspended from a string of insulators that can insulate the high voltage from the tower. Underground cables have to be covered in insulation throughout. The design and installation of overhead lines and underground cables require very specialized engineering that gets quite complex for higher and higher voltages. For high-voltage overhead lines, the design of the wires, towers, and insulators and their installation over hundreds of miles of different terrain require the resolution of electrical, mechanical, material, and civil engineering issues. Similarly, for high-voltage cables, a different set of equally complex issues arise in design, especially in the insulation that may even require pressurized oil; installation underground in crowded downtown areas or under water has its own challenges. The main use of DC transmission is to interconnect two separate areas where some power transfer is desirable but a synchronous (AC) connection is not. The main features of such an interconnection are the AC–DC conversion and the DC–AC inversion that allows the connection of two AC systems with a DC line. The design of the line itself—two wires with or without a ground wire—is not particularly different from AC transmission. In some cases, where the geographic distance between the two separate AC areas is small, the interconnection may not even require a DC transmission line but only back-to-back AC–DC and DC–AC converters.

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