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Power System

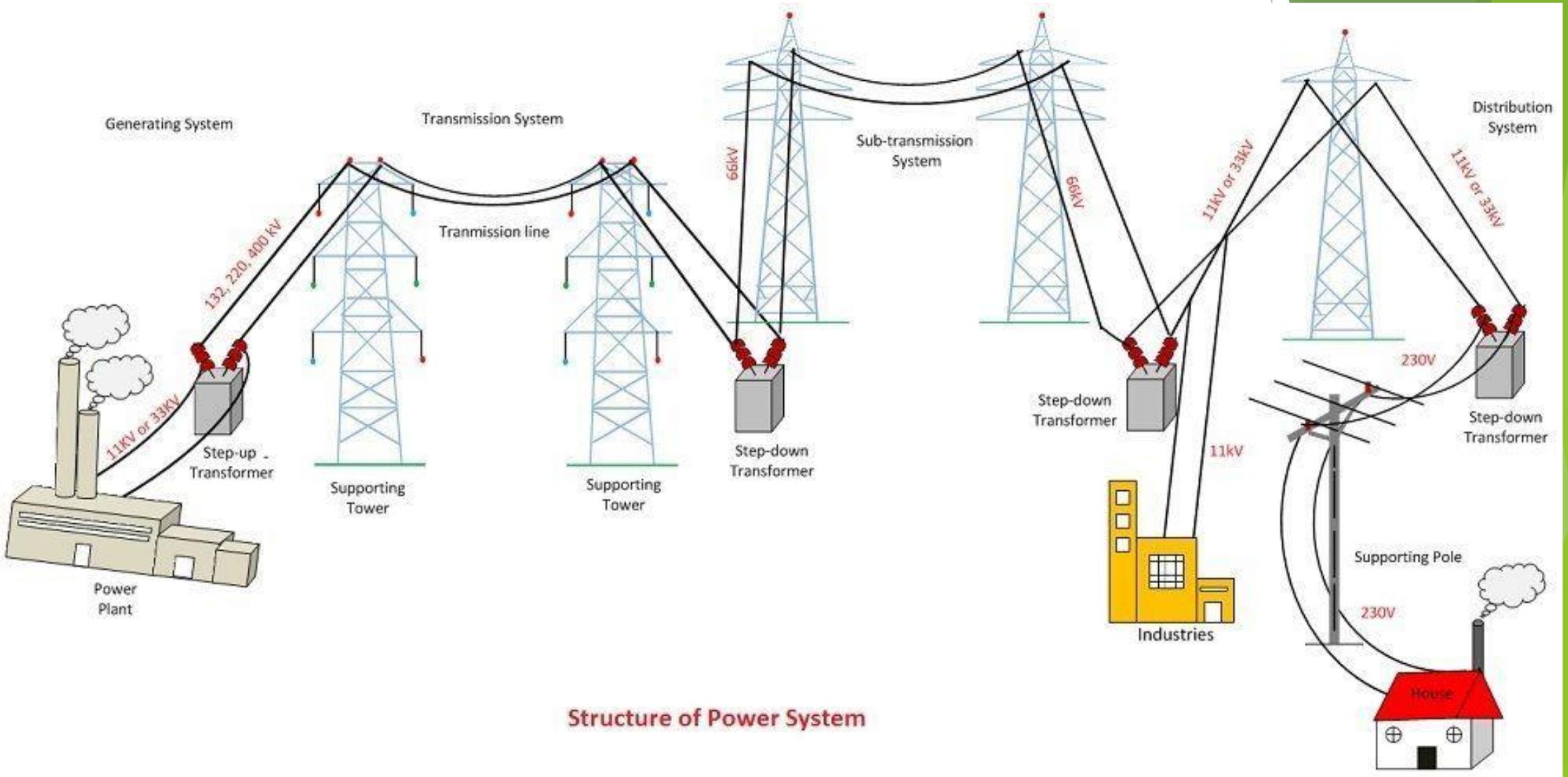
The **power system** is a network which consists generation, distribution and transmission system.

What is a Power System?

An electric power system is defined as a network of electrical components used to supply, transfer, and consume electric power. The supply is done through some form of generation (e.g. a power plant), the transfer is done through a transmission (via a transmission line) and distribution system, and the consumption can be through residential applications such as powering the lights or air conditioning in your home, or via industrial applications such as the operation of large motors.

An example of a power system is the electrical grid that provides power to homes and industry within an extended area. The electrical grid can be broadly divided into the generators that supply the power, the transmission system that carries the power from the generating centers to the load centers, and the distribution system that feeds the power to nearby homes and industries.

Power System



Structure of Power System

Generating Substation

In generating station the fuel (coal, water, nuclear energy, etc.) is converted into electrical energy. The electrical power is generated in the range of 11kV to 25kV, which is step-up for long distance transmission. The power plant of the generating substation is mainly classified into three types, i.e., thermal power plant, hydropower plant and nuclear power plant.

The generator and the transformer are the main components of the generating station. The generator converts the mechanical energy into electrical energy. The mechanical energy comes from the burning of coal, gas and nuclear fuel, gas turbines, or occasionally the internal combustion engine.

The transformer transfers the power with very high efficiency from one level to another. The power transfer from the secondary is approximately equal to the primary except for losses in the transformer. The step-up transformer will reduce losses in the line which makes the transmission of power over long distances.

Transmission Substation

The transmission substation carries the overhead lines which transfer the generated electrical energy from generation to the distribution substations. It only supplies the large bulk of power to bulk power substations or very big consumers.

The transmission lines mainly perform the two functions

1.It transports the energy from generating stations to bulk receiving stations.
2.It interconnects the two or more generating stations. The neighboring substations are also interconnected through the transmission lines.

The transmission voltage is operating at more than 66kv and is standardized at 69kv, 115KV, 138KV, 161KV, 230KV, 345KV, 500KV, and 765KV, line-to-line. The transmission line above 230KV is usually referred to as extra high voltage (EHV).

The high voltage line is terminated in substations which are called high voltage substations, receiving substations or primary substations. In high voltage substation, the voltage is step-down to a suitable value for the next part of flow toward the load. The very large industrial consumers may be served directly to the transmission system.

Sub-Transmission Substation

The portion of the transmission system that connects the high voltage substations through the step-down transformer to the distribution substations is called the sub-transmission system.

The sub-transmission voltage level ranges from 90 to 138KV. The sub-transmission system directly serves some large industries. The capacitor and reactor are located in the substations for maintaining the transmission line voltage.

The operation of the sub-transmission system is similar to that of a distribution system. Its differ from a distribution system in the following manner.

1.A sub-transmission system has a higher voltage level than a distribution system.
2.It supplies only bigger loads.
3.It supplies only a few substations as compared to a distribution system which supplies some loads.

Distribution Substation

The component of an electrical power system connecting all the consumers in an area to the bulk power sources is called a distribution system. The bulk power stations are connected to the generating substations by transmission lines. They feed some substations which are usually situated at convenient points near the load centers.

The substations distribute the power to the domestic, commercial and relatively small consumers. The consumers require large blocks of power which are usually supplied at sub-transmission or even transmission system.

IOT Usage in the Electrical Power Industry

The evaluation of the IOT in the electrical power industry transformed the way things performed in usual manner.

IOT increased the use of wireless technology to connect power industry assets and infrastructure in order to lower the power consumption and cost.

Some of the examples of IOT usage include SCADA, smart metering, building automation, smart grid, and connected public lighting.

SCADA

SCADA(Supervisory Control And Data Acquisition) is one of the major application areas of IOT. SCADA allows the centralized monitoring and control of remote located generation and transmission systems. It consists of sensors, actuators, controllers and communication devices at the remote field place, and central master unit with communication systems at the controlling side. It collects the data from sensors in the field and provides a user interface in HMI at central station. Also, it stores the time-stamped data for later analysis.

IOT SCADA is a step beyond SCADA that has been in use from earlier days. It provides real-time signal acquisition and data logging through IOT servers and internet technologies. It integrates the individual devices, machines, sensors and other electrical equipment with internet by realizing the functionality of supervision and control.

Smart Metering

Smart metering is an essential element in smart grid implementations as they are using Internet of Things technologies to transform traditional energy infrastructure. Smart metering through IOT helps to reduce operating costs by managing metering operations remotely. It also improves the forecasting and reduces energy theft and loss. These meters simply capture the data and send it back to the utility companies over highly reliable communication infrastructure.

Building Automation

IOT based solutions enable the efficient way of monitor and control of buildings to property owners as they connect lighting systems, elevators, environmental systems and other electrical appliances with internet and communication technologies. It saves the power consumption by automatically turning off the lights when rooms are not occupied and also by making sure of not drawing too much power by appliances. IOT based appliances provide remote monitoring and control through mobile and web applications to the end users or owners.

Connected Public Lighting

This is the part of a project under smart cities where wireless IOT solutions are deployed to connect IP based lights. This smart public lighting uses intelligent-connected outdoor LED luminaries which are centrally controlled from the control station. This type of infrastructure also facilitates dynamical adjustment of illumination based on environmental changing conditions. This would dramatically result lower operating costs and power consumption.

Smart Grid

As discussed above that smart meter is a key part of the smart grid and there are millions of smart meters already connected to the grid. Smart grid makes better use of available energy supply by optimizing electricity generation and distribution depending upon the load demand.

This includes Ethernet based communication connected substations with intelligent equipment devices at each substation. This enables the automation of substations which can be coordinated effectively for a better power distribution especially during peak hours.

Thank You