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A Review on Control System and Electrical Grid Systems

Sujata Parmar
Students
Department of EEE
Geetangali Engineering College
Corresponding Author's Email: - *parmarsujata04@gmail.com*

Abstract

The electrical grid, often known as the power grid, is the network that connects the generating, transmission, and distribution units. It transports electricity from the producing unit to the distribution unit. At 220kV or greater, a huge quantity of electricity is transported from the producing station to the load centre. The super grid is the network formed by these high voltage wires. The super grid provides power to the sub-transmission network, which operates at 140kV or less.

Keywords: - *Electrical Grid Systems, Power Grid, Electrical Substation, Electrical Grid*

INTRODUCTION

An electrical grid is a network that connects producers and consumers to distribute power. Electrical grids come in a variety of sizes and can span entire nations or continents. It is made up of:

- Power plants: frequently positioned near energy and away from densely populated areas
- Step-up or step-down voltage substations
- Transfer of electric electricity over large distances
- Distribution of electric power to individual consumers, where the voltage is stepped down to the needed service voltage (s).

Grids are usually invariably synchronous, which means that all distribution zones use synchronised three phase alternating current (AC) frequencies (so that voltage swings occur at almost the same time).

This enables the transmission of alternating current (AC) power throughout the region, linking a large number of energy providers and consumers and potentially enabling more efficient electricity markets and redundancy generation.

The combined transmission and distribution network is a component of electricity supply, sometimes known as the "power grid" or simply "the grid" in North America. The network is known as the National Grid in the United Kingdom, India, Tanzania, Myanmar, Malaysia, and New Zealand. [2]

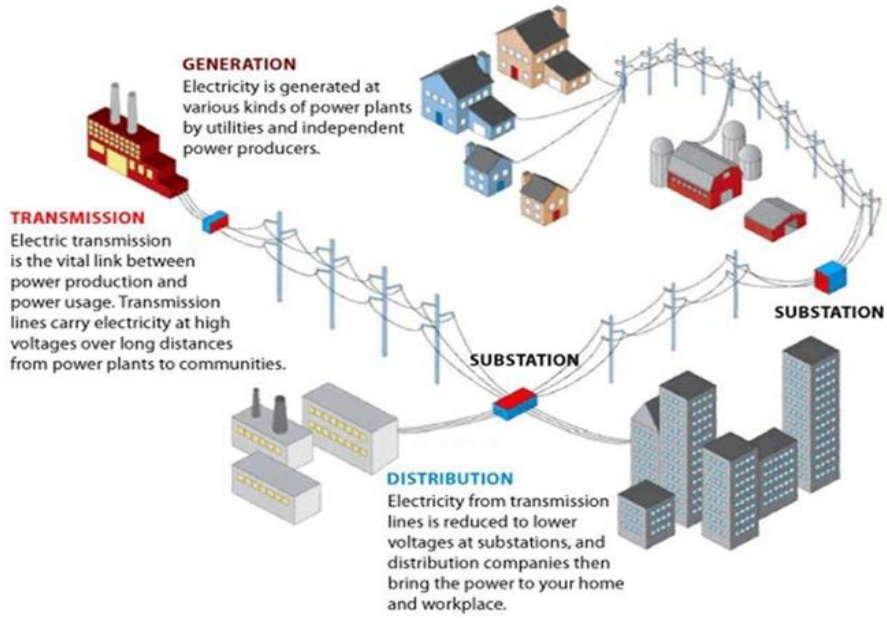

Figure 1: Diagram of an Electric Power System Generation

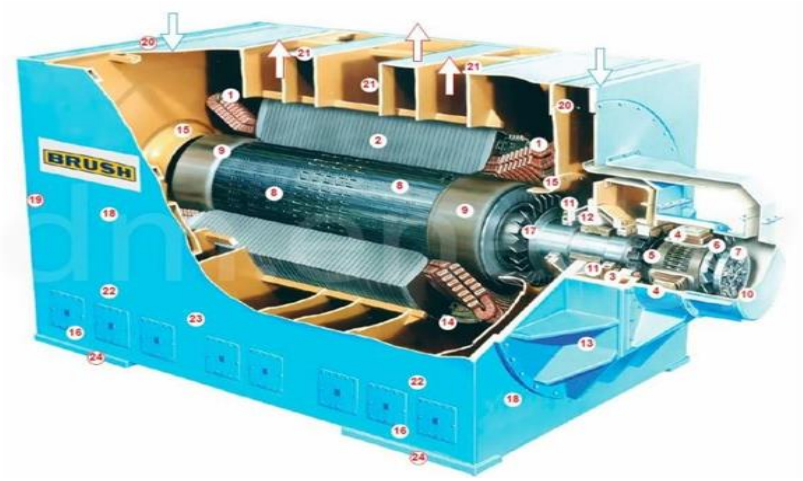

Figure 2: Turbo generator

Electricity production is the process of producing electricity from primary energy sources, often at power plants. Typically, this is accomplished using electromechanical generators powered by heat engines or the kinetic energy of water or wind. Solar photovoltaics and geothermal energy are two alternative energy sources. The total power output of generators on the grid is the grid's production, which is commonly measured in gigatonnes (GW).

Transmission

Electric power transmission is the mass transportation of electrical energy from a producing site to an electrical substation, which is connected to the distribution system, via a web of interconnecting wires. This networked connection technology differs from the local wire that connects high-voltage substations and consumers. Because electricity is frequently generated far from where it is used, the transmission system can travel long distances. Transmission efficiency is greater at higher voltages and lower amperages for a given quantity of power. Voltages are therefore stepped up at the producing station and stepped down at local substations before being distributed to consumers. The majority of transmission is three-phase. Because the neutral and ground wires are shared, three phase may supply substantially more power for a given piece of cable than single phase. Three-phase generators and motors are also more efficient than single-phase rivals.

However, one of the biggest losses in traditional conductors is resistive loss, which has a square law on current and varies with distance. High voltage alternating current transmission lines might lose 1-4% every hundred miles. High-voltage direct current, on the other hand, can have half the losses of alternating current. These efficiencies can offset the additional cost of the required AC/DC converter stations at each end over very long distances. A network diagram of a high voltage transmission system illustrating the connections of the various voltage levels. This graphic displays the network's electrical structure rather than its physical geography.

Transmission networks are intricate, with redundant paths. The physical layout is frequently dictated by the available land and its geology. Most transmission grids give the same level of dependability as more complicated mesh networks. When a line fails due to redundancy, electricity is simply diverted while repairs are made. [5]

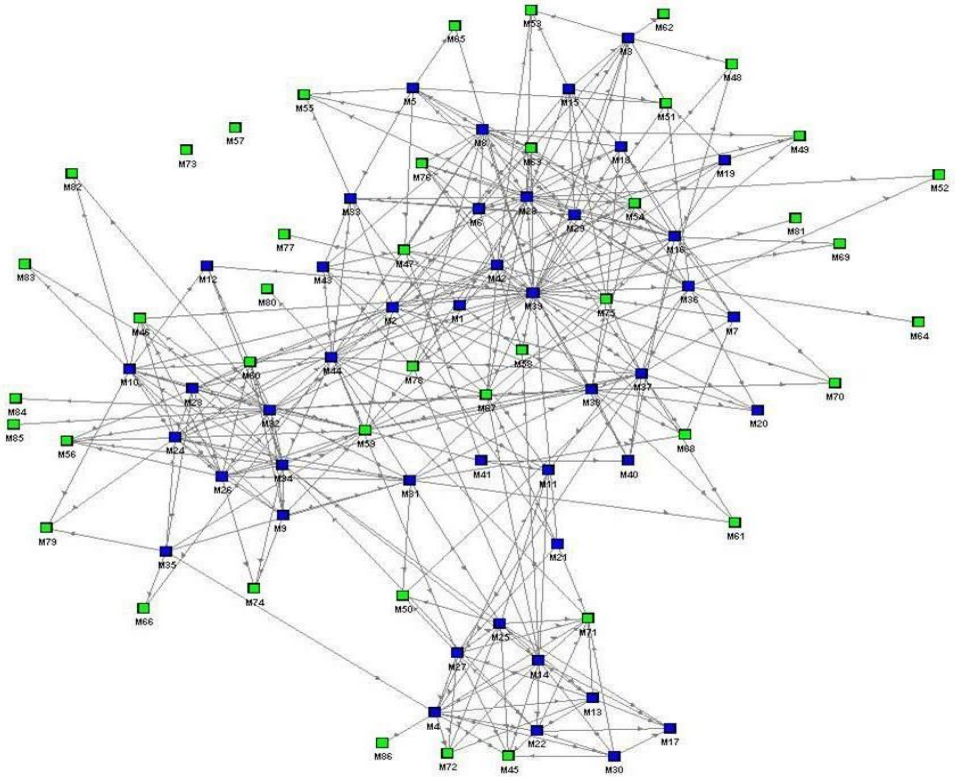

Figure 3: Network Diagram of a High Voltage Transmission System

Electrical substation

Substations can execute a variety of tasks, but the most common are voltage transformations from low to high (step up) and from high to low (step down) (step down). The voltage may be altered multiple times between the generator and the end consumer. [6]

The three main types of substations, by function, are:

Step-up substation: These employ transformers to increase the voltage coming from generators and power plants, allowing power to be transferred over longer distances more effectively and with lower currents.

Step-down substation: These transformers reduce the voltage from transmission lines, allowing it to be utilised in industry or routed to a distribution substation.

Distribution substation: These reduce the voltage again for delivery to end customers.

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6. Closing Sub-Saharan Africa's Electricity Access Gap: Why Cities Must Be Part of the Solution.