

## ***Evaluation of factors that need to be considered for construction of an Electric Power Generation Station***

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### ***Abstract***

*In this paper, all the factors that affect the economy and smooth flow of power generation and transmission are outlined. It is hoped that power administrators would be able to manage power generation and transmission smoothly and economically, and sustain it for several years. The power generation plant as well as the structure of transmission needs to be analyzed and continuously evaluated for the system to work efficiently. This paper deals with all these considerations and we hope that it aids in effective implementation of a foolproof power management policy. Spacecraft need to be guided accurately on missions that may last many years whilst also maintaining the desired attitude throughout.*

***Keywords: Power Generation, Power Management Policy, Transmission.***

### **INTRODUCTION**

For economical generation of power large generating stations are used. Capacities of individual generating sets have gone up recently. Generating sets in the range of 10 MW, 210 MW and 500 MW are being manufactured in many countries. Generating stations are now not necessarily located at load centers. In fact other factors like availability of fuel and water play more

dominating role in the selection of sites for thermal stations. Hydro stations are obviously located only at the sites where water is available at sufficient head. A vast network of transmission system has been created so that power generated at one station may be fed to grid system and may be distributed over large areas and number of states. The transmission and distribution system comprises a network of three-phase

circuits with transforming and or switching substations at the various junctions. The parts of a transmission and distribution network maybe grouped as given below.

Electrical power is generated at different generating stations. These generating stations are not necessarily situated at the load center. During construction of generating station, a number of factors are to be considered from economical point of view. These all factors may not be easily available at load center; hence generating stations are not normally situated very nearer to load center. Load center is the place where maximum power is consumed. Hence there must be some means by which the generated power must be transmitted to the load center. Electrical transmission system is the means of transmitting power from generating station to different load centers.

### **FACTORS TO BE CONSIDERED FOR CONSTRUCTING A GENERATING STATION**

During planning of construction of generating station the following factors to be considered for economical generation of electrical power.

1. Easy availability of water for thermal power generating station.

2. Easy availability of land for construction of power station including its staff township.
3. For hydro power station there must be a dam on river. So proper place on the river must be chosen in such a way that the construction of the dam can be done in most optimum way.
4. For thermal power station easy availability of fuel is one of the most important factors to be considered.
5. Better communication for goods as well as employees of the power station also to be kept into consideration.
6. For transporting very big spare parts of turbines, alternators etc, there must be wide roadways, train communication, and deep and Wide River must pass away near by the power station.
7. For nuclear power plant, it must be situated in such a distance from common location so that there may be any effect from nuclear reaction the health of common people.

Many other factors are also to be considered, but there are beyond the scope of our discussion. All the factors listed above are very difficult to be available at load center. The power station or generating station must be situated where all the facilities are easily

available. This place may not be necessarily at the load center. The power generated at generating station then transmitted to the load center by means of electrical power transmission system as we said earlier.

The power generated at generating station is in low voltage level as low voltage power generation has some economical values. Low voltage power generation is more economical than high voltage power generation. At low voltage level, both weight and insulation is less in the alternator.

This directly reduces the cost and size of alternator. But this low voltage level power cannot be transmitted directly to the consumer end as because this low voltage power transmission is not at all economical. Hence although low voltage power generation is economical but low voltage electrical power transmission is not economical. Electrical power is directly proportional to the product of electrical current and voltage of system. So for transmitting certain electrical power from one place to another, if the voltage of the power is increased then associated current of this power is reduced. Reduced current means less  $I^2R$  loss in the system, less cross

sectional area of the conductor means less capital involvement and decreased current causes improvement in voltage regulation of power transmission system and improved voltage regulation indicates quality power. Because of these three reasons electrical power mainly transmitted at high voltage level.

Again at distribution end for efficient distribution of the transmitted power, it is stepped down to its desired low voltage level. So it can be concluded that first the electrical power is generated at low voltage level then it stepped up to high voltage for efficient transmission of electrical energy. Lastly for distribution of electrical energy or power to different consumers it is stepped down to desired low voltage level. This brief discussion of electrical transmission system and network, but now we will discussed little bit more details about transmission of electrical energy.

## **TRANSMISSION OF ELECTRICAL ENERGY**

Fundamentally there are two systems by which electrical energy can be transmitted.

1. High voltage DC electrical transmission system.
2. High AC electrical transmission system.

***There are some advantages in using DC transmission system –***

- Only two conductors are required for DC transmission system. It is further possible to use only one conductor of DC transmission system if earth is utilized as return path of the system.
- The potential stress on the insulator of DC transmission system is about 70 % of same voltage AC transmission system. Hence, less insulation cost is involved in DC transmission system.
- Inductance, capacitance, phase displacement and surge problems can be eliminated in DC system.
- Even having these advantages in DC system, generally electrical energy is transmitted by three (3) phase AC transmission system.
- The alternating voltages can easily be stepped up and down, which is not possible in DC transmission system.
- Maintenance of AC substation is quite easy and economical compared to DC.
- The transforming of power in AC electrical substation is much easier than motor-generator sets in DC system.

***But AC transmission system also has some disadvantages like:***

- The volume of conductor used in AC system is much higher than that of DC.
- The reactance of the line, affects the voltage regulation of electrical power transmission system.
- Problems of skin effects and proximity effects only found in AC system.
- AC transmission system is more likely to be affected by corona effect than DC system.
- Construction of AC electrical power transmission network is more completed than DC system.
- Proper synchronizing is required before inter connecting two or more transmission lines together; synchronizing can totally be omitted in DC transmission system.

**METHOD OF TRANSMISSION**

Transmission lines are sets of wires, called conductors that carry electric power from generating plants to the substations that deliver power to customers. At a generating plant, electric power is “stepped up” to several thousand volts by a transformer and delivered to the transmission line. At numerous substations on the transmission system, transformers step down the power to a lower voltage and deliver it to distribution

lines. Distribution lines carry power to farms, homes and businesses. The type of transmission structures used for any project is determined by the characteristics of the transmission line's route, including terrain and existing infrastructure.

Typical transmission lines structures—

- High-voltage (230-kV, 345-kV, 400-kV (DC), 500-kV (DC): Currently in Minnesota, the high-voltage system is generally comprised of 230-kiloVolt and 345-kV systems. There are also two direct current (DC) lines, one of 400-kV and one at 500-kV. Structures are generally steel lattice towers, wooden H-Frames or single-pole steel. (photos below of each).
- Lower voltage transmission systems

161-kV and 115-kV systems are responsible for transmitting power from the larger transmission system and generation facility throughout the entire state. Some large industrial customers may be served directly from 161-kV and 115-kV systems. 161-kV

and 115-kV structures are generally single pole structures between 70 and 95 feet tall.

69-kV through 23-kV systems transmit power to distribution substations. These also provide connection to some of the more remote and sparsely populated areas in greater Minnesota. Many smaller and rural industrial customers receive power directly from these systems. Structures are generally single pole towers, constructed of both wood or steel and range from 50-70 feet tall.

## **HOW DEPENDABLE ELECTRICITY REACHES US**

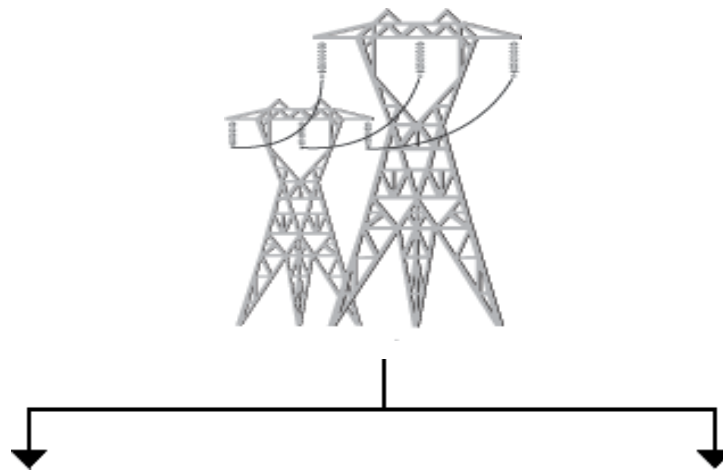
Generation and transmission cooperatives (G&Ts), like Great River Energy, operate power generating facilities. At a steam generating plant, the fuel (coal, nuclear or biomass) heats water to make steam and drive a turbine. In a combustion turbine, the fuel (gas or oil) is burned and the hot gas drives a turbine. Wind hydro and solar are other forms of energy producers.



**Figure1: -High-voltage transmission lines**

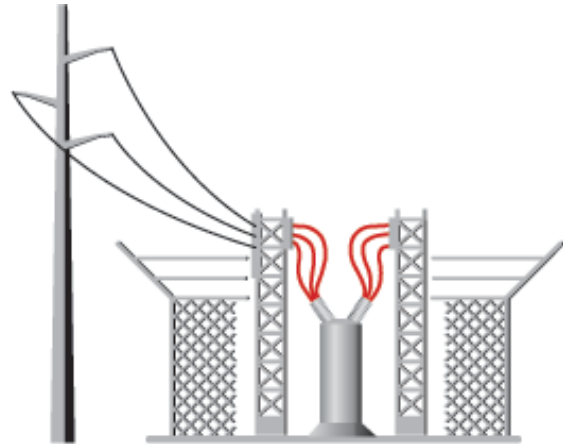
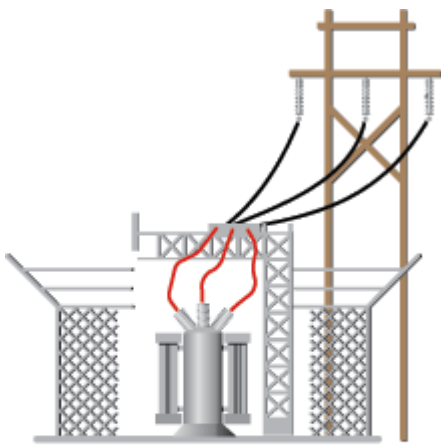
Transformers at the generating plant increase the voltage up to a transmission voltage (69 kV, 115 kV, 230 kV, 500 kV, 765kV), so it can travel long distances over

high-voltage transmission lines. G&Ts operate these lines, which carry the electric energy from the generating stations to the places where electricity is used



<b>TRANSMISSION</b>	<b>SUBSTATION</b>
Transformers reduce the electric energy down total over voltage(69kV,34kV) making it suitable For high-volume delivery over short distances.	

<b>LOCAL DISTRIBUTION SUBSTATION</b>
Transformers reduce the electric energy down to a lower voltage (69kV,34kV) making it suitable for high-volume delivery over short distances.



**Large industrial user**

Most industries need 2,400 to 4,160 volts to run heavy machinery. They usually have their own substation at the facility.

**Distribution lines**

Lines belonging to local electric co-ops carry electricity to transformers that reduce power levels to 120/240 or 120/208 volts for use in schools, farms, small businesses and homes

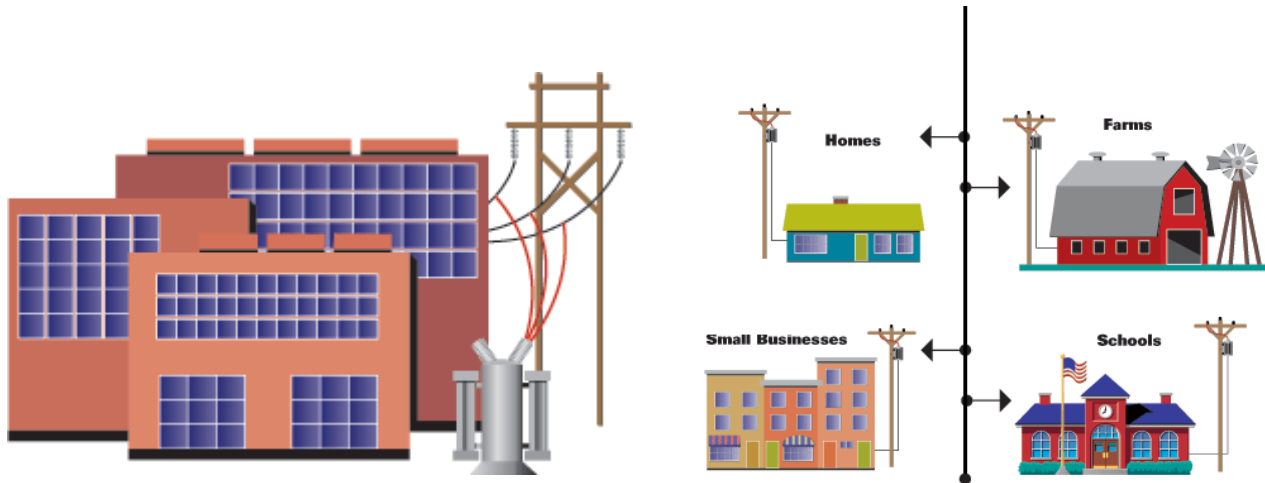


Figure 2

## CONCLUSION

It is important to consider all the important factors for transmission of electric power generation station. In this paper, all these factors are discussed to enable electric power transmission in a smooth and orderly manner. Economical generation of power is as important as enabling its smooth transmission as otherwise, it would be hard to sustain such a power generation and transmission set up. By understanding the basics as outlined in this paper, the power administrators can function better.

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