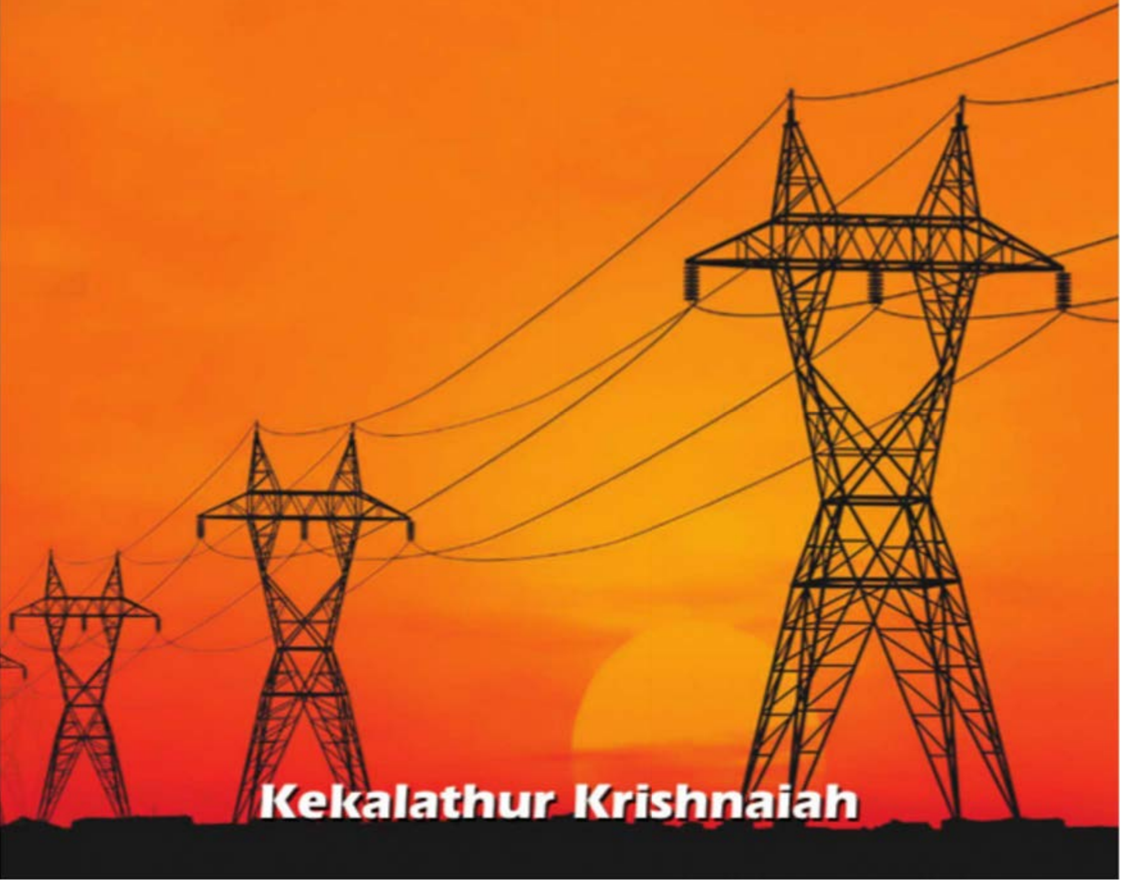
'How I did'

A Guide to

Survey & UHT Transmission Line Construction



Kekalathur Krishnaiah

Dedicated to my
Colleagues & Field work Supporters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“How I Did It”
A GUIDE TO SURVEY & UHT TRANSMISSION LINE CONSTRUCTION

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CHAPTER - 1

DEVELOPMENT OF ELECTRICITY

Of all the sources of energy, electricity takes the pride of place. It is convenient, inexpensive, produced easily and transmitted over long distances quickly and efficiently and above all, is available for instant use. No wonder, it is indispensable in most production processes of modern times.

The largest chunk (over 70 per cent) of electricity in the world is produced by the thermal stations, but their share may decline as they gradually give way to nuclear plants.

Modern electric power plants have capacity to generate hundreds of millions of kilowatts, while their annual output may equal millions and millions of kilowatt hours. The phenomenal magnitude of electric power production has indisputable economical advantages. As a result, the specific cost per 1 kw of installed power and service costs become cheaper, equipment efficiency improves, and the power plant construction time is shortened. The power production engineering across the developed world treads this path..

To increase the transmission voltage, "step-up substations" are built at the generating station. The power is then transmitted over high- voltage transmission lines to step-down substations built at considerable distances in the territory served.

This form scan electric grid made up of a series of networks operating at different voltages, which are interconnected through transformers. A transmission network essentially comprises overhead (aerial) high – voltage transmission lines which deliver bulk power from the generating stations to the sub-stations and on to the switchgear devices of the customers. Low voltage underground cable lines are used to deliver the electric power directly to the receiving devices of the users. Sometimes, when transmission lines traverse densely populated areas or locations (in cities, industrial enterprises) where space is of premium, high-voltage cable systems are in use.

Usually electric power systems are formed in separate territories and integrated by transmission feeders into the common '**power systems grid**'. Power stations combined into such systems had accounted for 97 per cent of all the power produced in the country in 1989.

Integration of power stations and users into power systems help smoothen the total load curves of the power stations (since the peak loads of the different customers do not coincide in time, as a rule), allow the joint operation of diverse types of electric stations (thermal, hydro and nuclear), raise the equipment utilisation factor, decrease the number of standby power units, facilitate more economically efficient and repeated operation of generator-turbine sets of the order of 500-1200 mw, besides providing for higher reliability and trouble-free operation of the power supply facilities.

Integration of electric power stations and users into power systems smoothens the curves of the total load of the power stations, allows the joint operation of electric stations of diverse types (thermal, hydraulic, nuclear) raises the equipment utilisation factor, decreases the number of stand-by power units, allows more economically efficient generator-turbine sets of high unit power (500-1200M.W.) to be put into operation more often, and also improve the reliability and trouble-free operation of the power supply facilities.

c) Basic requirements :

The electric power stations, transformer sub-stations, transmission lines and electric motors, i.e., electrical installations for production, conversion, distribution and consumption of electrical energy shall meet the specifications for the electrical installations. The construction and assembly of electrical installations shall be in accordance with the technical operation instructions, and industrial safety rules.

As to at the degree of electrical power supply reliability, electrical loads fall into three categories.

Category I covers the loads where energy supply interruptions involve danger to human life, serious damage to the economy, and considerable damage to the equipment, entail mass rejects, disturbances in a complex production process, serious disturbances in the municipal public services. Besides, we distinguish here a special group of electrical loads the uninterrupted operation of which is necessary for failure -proof disconnections of production process with a view to p reventing a threat to human lives, explosions, fires and damage to expensive equipment.

Interruptions in the supply of loads under Category II are associated with mass under-production, idle time, production delays, transportation halts and disturbances in the normal activity of town dwellers.

Category III covers all the other loads that are not listed under categories one and two.

The electrical loads on Category I shall be supplied from two independent sources of power.. An interruption in the service is allowed

To secure normal operation of loads, the rated (operating) voltage specified by the state standards must be applied to their terminals. For instance, the following rated voltages are specified by the state standards. 11,33,66,110,132,220,400 and 765KV.

However, because of power losses taking place during the transmission from the power generation plant and electrical sub-stations to customers, the voltage drops. Therefore, the output voltages of the power supply facilities (generators, power transformers) should be above the ratings (0.23, 0.4, 6.3 KV, 13.8KV etc). The specifications for electrical installations permit voltages somewhat different from the rated values to be supplied to the intake terminals of electrical loads. Thus terminal voltage of electric motors may vary with in $\pm$5%.

Usually electric power systaems are formed in separate territories and combined by transmission feeders in to the integrated **"Power Super Grid"**. Power stations combined into power systems produced 97 per cent of all the electric power in the country in 1989.

EFFICIENCY OF TRANSMISSION LINE & LOSSES

Transmission efficiency is significantly improved by devices that increase the voltage, and proportionately reduce the current in the conductors, thus keeping the power transmitted nearly equal to the power input. The reduced current flowing through the line reduces the losses in the conductors. According to Joule's law, energy losses are directly proportional to the square of the current. Thus, reducing the current by a factor of 2 will lower the energy lost to conductor resistance by a factor of 4.

Transmitting electricity at high voltage reduces the fraction of energy lost to resistance, which averages around 7%. For a given amount of power, a higher voltage reduces the current and thus the resistive losses in the conductor. For example, raising the voltage by a factor of 10 reduces the current by a corresponding factor of 10 and therefore the L^2R losses by a factor of 100, provided the same sized conductors are used in both cases. Even if the conductor size (cross- sectional area) is reduced 10 fold to match the lower current , the L^2R losses are still reduced 10 fold . Long distance transmission is typically done with over head lines at voltages of 110 to 1200 K.V. At extremely high voltages, more than 2000 K.V. between conductor and ground, corona discharge losses are so large that they can offset the lower resistance loss in the line conductors. Measures to reduce corona losses include conductors having large diameter, often hollow to save weight, or bundles of two or more conductors.

LINE TRANSMISSION LOSSES

To calculate the power carrying capacity of the transmission line, the positive sequence line inductance and its reactance at power frequency are necessary. After the detailed calculation the line parameters for the system transmission voltage is arrived. The line losses are calculated taking these reactance and resistance of the line other losses like corona loss etc., are neglected I^2R losses is major part.

The standard values of line parameters are

System	K.V.	400 K.V.	750 K.V
Resistance	r ohm/km	0.031	0.0136

End of Preview.

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