EE-401 POWER TRANSMISSION & DISTRIBUTION

Power Transmission and Distribution EE-401

(Electrical power Group)

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Book Recommended: The principles of Electrical Power Transmission, H. Waddicor.
Power Transmission and Distribution by Cotton.

PTD Introduction

- Important of the course PTD
- Electrical Transmission of Power
- History of Electrical Power System
- Types of Electrical Power Transmission
- Influence of Line Voltage on the Cost of Conductors(Transmission lines)

Electrical Transmission of Power

- Electrical power posses a unique advantages for transmission purpose,
- It may be carried at very high efficiency
- In far greater quantities and for greater distances
- Method of control are extremely flexible
- Transformation to other form of energy i.e heat, light, and motion can be effected with unparalleled direction and simplicity

History of Electrical Power System

→ The Electricity was invented in very early age but its commercial useage began in the late 1870s when arc lamps were used for lighthouse illumination and street lighting.

→ The credit for inventing electric Power system goes to thomas Edison. Edison had established the Electricity at the historic Pearl Station, New York in 1881. which began operation in Sep 1882. This Station had Capacity of 4, 25 hp boilers supplying steam to Six engine-dynamo Sets (dc generator) and Supply Power to 59 Consumers with in area of roughly 1.5 km in radius at 110V through underground cable System.

→ The invention of T/F and a.c system by L. Gaulard and J.D Gibbs of Paris, France and a.c electric Power system possible.

→ The first Practical a.c fy distribution system was installed for 150 - lamps loved in USA by William Stanley at Great Barrington, Massachusetts, in 1886 for Westinghouse.

→ The development of Poly-phase (3ϕ) by N. Tesla increased the attraction of a.c System.

→ In 1889 the first a.c transmission line at 4kV, Single-phase 21 km was put into operation in Oregon, North America.

→ 1893, first 3-phase line in Southern California, North America came into operation at 2.3kV which was 12-km long.

→ A.C transmission system was again challenged by high-voltage d.c (H.V.D.C) Tx system in 1954 when Swedish Power Board energized 60 mile, 100 kV d.c submarine cable between Baltic Island of Gotland and Swedish mainland.

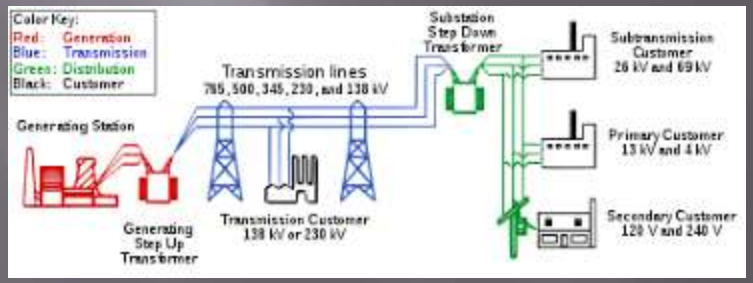
→ With the advent of mercury valves in early 1950s, H.V.D.C Tx system became economical for long-distance transmission. The development of solid-state technology, HVDC has becomes even more attractive.

→ The D.C T/L may be advantageous to ac T/L for more than 600 km for overhead line and 50 km for underground cables.

→ 1998, high Voltage Synch m/c, called Power T/F, is launched is suitable for direct connection to high Voltage network with any Step up T/F *

Types of Power Transmission

- Broadly they are of two types
- (a) Associated with Isolated or independent power system



- (b) Associated with Interconnected Power System

System of Transmission AC or DC

- **AC**

- 3 phase AC Tx is the most economical system
- Generation of 3 phase is simple, effective and voltage up to any level is possible
- More flexible
- As frequency is involved so we have Skin effect, farantee effect, power factor, voltage regulation

DC

- DC Tx results in lower losses and cost then equivalent AC but terminal costs are higher
- Converters at both the end are needed
- As most of the applications at the user end are AC
- Utilize AC current and voltage in industries

Overhead and Under-ground Tx

- **Over-head Tx**

- Cheaper economical
- Easy and quick installation
- Fault location is easy
- Connection disconnection is possible and easy
- More expose of external factors, lightning, faults etc
- Hazardous to human and others
- Interference in other amenities, radio TV ,communication devies

- **Under-ground**

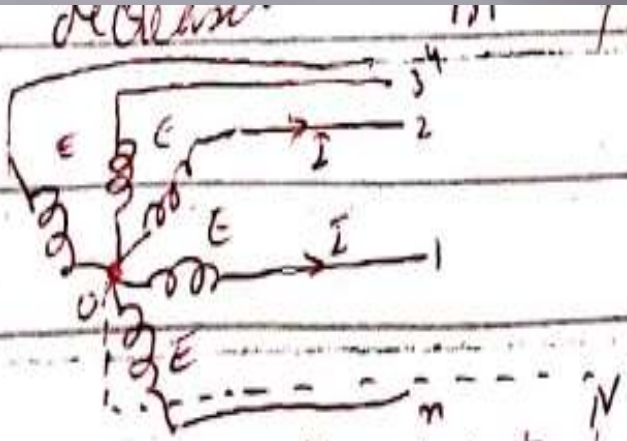
- Proffered in built up areas as safe to..
- Lessor exposer to external factors
- Well adopted inside power house, substation, under ground tunnels or in special areas like air fields, submarine crossing
- Much more expensive relatively

Influence of line voltage on cost of condctor

Cost of Copper or Conductors are Considered to be the large item of expense and has to be Considered when Changing the line Voltage.

When transmitting a given amount of Power at a given loss over a given distance, the amount of Copper required is inversely proportional to the Square of the Voltage.

For if the voltage is raised m times, the current required to transmit the same amount of Power is reduced m times. and the line losses, (i^2R) which is proportional to the product of the Square of the current and line resistance are reduced m^2 times. So to transmit with the same losses before the resistance of the line can be increased m^2 times, i.e the amount of Copper can be



Per transmitted

$P = EI\cos\phi$

$I = P/E\cos\phi$

Line Loss $P_l = I^2 R$

$R_l = \frac{P^2}{E^2\cos^2\phi} R$

$R = \frac{\rho l}{A}$

Volume lA

$= \frac{P^2\rho^2 l^2}{P_l^2}$

$R_l = \frac{P^2 \rho l}{E^2 A \cos^2\phi}$

(or) $A = \frac{P^2 \rho l}{P_l E^2 \cos^2\phi}$

$\frac{1}{E^2\cos^2\phi}$

Let E be the voltage to neutral of an n phase system. I is the current, lagging behind the E by ϕ.