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Q1.

While designing the transmission line we have to consider multiple factors. To transmit the 3478 MW we have to design a transmission line of higher voltage.

⇒ Parameter to consider :-

i- Length :-

There are mainly 3 types of transmission line.

i- Short Transmission line

ii- Medium Transmission line

iii- Long Transmission line.

~~From Tarbela the generation voltage varies from~~

From Tarbela to Peshawer the distance is 127 km. So we can design a medium transmission but the power is very high so we need to design a transision line with 500 KV.

ii- Voltage level :-

At Tarbela the generation voltage varies from 11 KV to 33 KV. To Transmit the power on long lines we step up the power to avoid the current losses in transmission lines. so the voltage level is important thing

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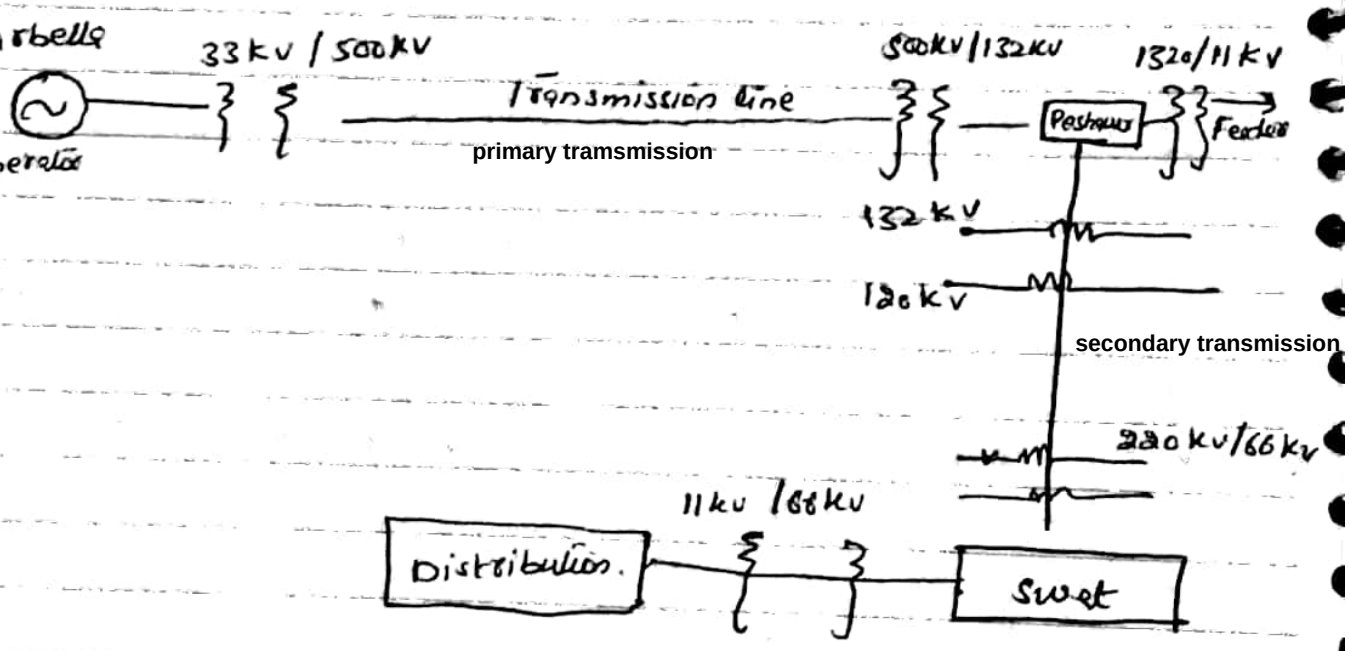
to consider. In this case I will be designing the 500kV voltage transmission line.

ii. Transmission model:-

The performance of transmission line depends on the parameter of line. The transmission line has mainly four parameters. They are also called the distributed parameter of the transmission line.



iv Voltage Regulation :-

It is defined as the change in the magnitude of the voltage b/w the sending and receiving ends.

% voltage regulation = $\frac{\text{sending end - Receiving end voltage}}{\text{sending end voltage}} \times 100$

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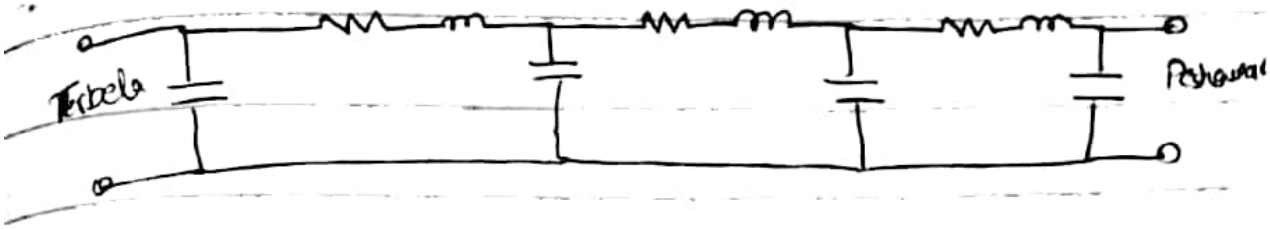
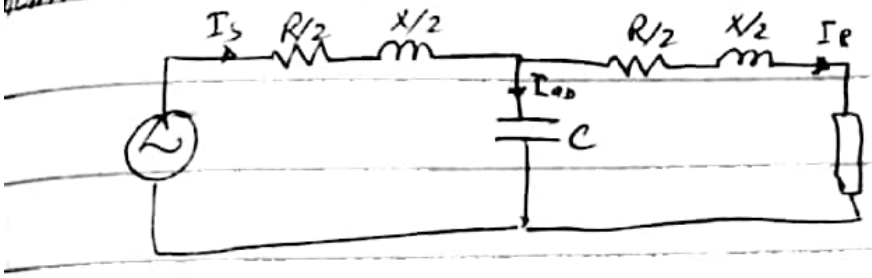
eg schematic for both lines will be



the design I will consider a nominal T model



Here $Z = R + jX$ $\quad Y = j\omega C$

The relation between $\frac{V_R}{I_R}$ and $\frac{V_S}{I_S}$ for such

model will be

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} 1+\frac{ZY}{2} & Z + \frac{Z^2Y}{4} \\ Y & 1+\frac{ZY}{2} \end{bmatrix} \begin{bmatrix} V_1 \\ I_1 \end{bmatrix}$$

For such a system as the TL falls into medium category the effects of capacitance will be taken into account and a lumped load model will be considered as it can give a reasonably accurate result for such system.

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Q2.

If the system primary voltage becomes 700 kV it has some pros and cons. The advantage of high voltage transmission is that large amount of electricity can be transmitted at relatively low current. This is why high voltage transmission is used in the first place.

→ Advantages:-

- Due to low current voltage drop will be less so voltage regulation improves.
- As the reduction in current carring requirment losses reduces result in battery efficiency.
- with increase in the transmission voltage the size of the conductors is reduced.

→ Disadvantages:-

- with increase in the voltage transmission more distance required between the conductors. Therefore cross arm should be long.
- with increase in voltage of transmission, more clearance is required between conductors and ground. Hence high towers are required.

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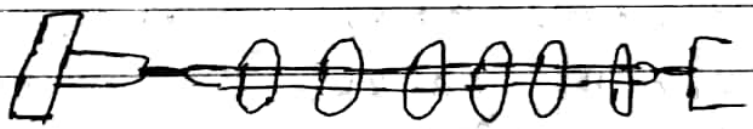
Q3.

When there is a dead end or a line or there is a corner or sharp curve, the line is subjected to greater tension. In order to relieve the line of excessive tension, strain insulator are used. A strain insulator must have considerable mechanical strength as well as the necessary electrical insulating properties.

For low voltage line (< 11 kV), shackle insulators are used as strain insulator. However for high voltage transmission lines strain insulator as shown in figure



The disc of strain insulator is used in the vertical plane. When the tension in lines is exceeding high, as at long river sharp spans. Two are more strings are used in parallel.

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Q4.

First of all it is not true that all the transmissions and distribution voltage are multiple of 11. In most cases, they are multiple of 11 such as 11 kv, 22kv, 33 kv, 44kv & 132 kv. But 400kv, 765 kv and 800 kv etc are not multiple of 11 in case of electrical power system in power line from the generation station to the receiving point.

The commonly used AC waveform we know is sine wave, hps waveform factor 1.11. So the reason given is that the transmitted voltage of 10 kv, 20 kv 60kv etc.

1- 10 kv → 10 x 1.11 = 11.1 kv.
2- 20 kv → 20 x 1.11 = 22.2 kv.
3- 60 kv → 60 x 1.11 = 66.6 kv.
4- 120kv → 120x1.11 = 133.2kv

If we consider the values of first three cases approx correct but there is a big difference in fourth case of about 1.2 kv.

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Qs.

When an alternating P.D is applied across two conductors whose spacing is large as compared to their diameters there is no apparent change in the condition of atmospheric air surrounding wire if the applied voltage is low.

However when the applied voltage exceed a certain value, called critical disruptive voltage the conductors are surrounded by a faint violet glow called corona. The higher the voltage is raised, the larger the lumerous envelop becomes and greater are the sound voltage is increased to break down value, a flash-over will occur between the conductors due to the breakdown of air insulation.

⇒ FACTORS AFFECTING CORONA:-

i- Atmosphere :-

As corona is formed due to ionization of air surrounding the conductors, therefore it is affected by the physical state of atmosphere - In the stormy or wether the no of ions is more than normal and as such corona occurs at much less voltage as compared to fair wether.

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ii- Conductor size :-

The corona effect depends on the shape and condition of the conductors The rough and irregular surface will give rise to more corona -

iii - Spacing between conductors :-

If the spacing b/w the conductors is made very large as compared to their diameter, there may not be any corona effect It is because large distance b/w conductor reduces the electrostatic stress -

iv - Line Voltage :-

The line voltage greatly affects corona - If it is low, there is no change in the condition of air surrounding the conductors and hence no corona is formed -

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Q6 ∴

$m_0 = 0.8$

$\delta_1 = \frac{3.92 \times 73.7}{273+44}$

$= 0.91$

$D = 3.81 m$

Conductor dia $= r = 1.9 cm.$

$V_c = 48.8 m_0 \delta_1 \log_{10} D/r.$

$\log_{10} 381/1.9 = \log_{10} 200.4 = 2.302.$

$V_c = 48.8 \times 0.8 \times 0.91 \times 1.9 \times 2.302$

$V_c = 155.3 \text{ KV/Phase.}$

$V_v = 48.8 m_v \delta_r \left[1 + \frac{0.3}{\sqrt{\delta r}}\right] \log_{10} D/r. \quad —①$

$m_v = 0.66, \ \delta = 0.91, \ \sqrt{\delta r} = \sqrt{0.91 \times 1.9} = 1.314$

use eq ①

$V_v = 48.8 \times 0.66 \times 0.91 \times 1.9 \left(1 + \frac{0.3}{1.314}\right) \times 2.302$

$V_v = 157.5 \text{ KV/Phase.}$

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Q7.

Span $L = \frac{300}{2} = 150$ m.

$A = 0.9\ cm^2 = 0.9 \times 10^{-4}$ m.

$T = 1500$ kg.

$\rho = 8.9\ g/cm^3$.

$W = I A \rho$

$= 2 \times 0.9 \times 10^{-4} \times 8.9 \times 10^3$.

$W = 0.8$ kg.

$Sag = \frac{wL^2}{2T}$.

$= \frac{0.8 \times 150}{2 \times 1500} = 6$m.

Clearance b/w conductor and water at midway b/w towers.

$h = 70 - 6 - 2$.

$\boxed{h = 62\ m}$

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Q8.

i- Disconnect Switch:-

Disconnect switches rapidly disconnect circuit from power supply in the event of an emergency. Disconnect switches can function in conjunction with circuit breakers, devices which interrupt the flow of electricity along a circuit when the current exceeds the circuit capacity. Disconnect switches can work with both AC and DC power.

2. Load Break Switch:-

They are devices used to open an electrical circuit by isolating the source from the customers. A load break switch is a disconnect switch that has been designed to provide making or breaking of specified currents - whether they are ~~manual~~ manual, motorized or with a trip function.

3. Automatic Circuit Reclaser:-

Recloser is a device that is used in overhead distribution system to interrupt the circuit to clear faults. Automatic reclosers have a electric control senses and vacuum interrupter

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that automatically recloses to restore services if a fault is temporary - There are several attempts that may be made to clear and rearrange the circuit, and if the fault still exist the recloser locks out.

4- Automatic Circuit Sectionalizer :-

The sectionalizer is a self-contained circuit-opening device used to conjunction with source-side protective devices, such as reclosers or circuit breakers to automatically isolate faulted section of electrical distribution system.

5- Earthing :-

The process of transferring the immediate discharge of the electrical energy directly to the earth by the help of the low resistance wire is known as the electrical earthing.

6- Lighting Arrestor :-

The device which is used for the protection of the equipment at the sub stations against travelling wave such type of device is called lightning arrestor or surge diverter.

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hmm5

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Q9.

⇒ PRIME RESPONSIBILITIES:-

1- As a sub-divisional engineer I have to make sure the regularity of electricity to the sub-division consumers and attech the faults-

ii- It there is a shutdown on the Line I have to report it to authorities and supervise if every Thing is being done correctly.

iii- It there is any issue on the service line or fault at some distribution transformer - Then to resolve it as soon as possible.

iv- To make sure safety precautions are being followed by everyone.

⇒ Balancing Transformer:-

Balancing of load distribution transformer is done by removing some load (i-e service connection) from heavily loaded phase and placing them on comparatively lightly loaded ones. The target is to get current in each phase near 10% of each other and neutral current to be as low as possible.

To prevent the neutral current from circulating inside the DTRs and heating it. the neutral point is pipe earthed to channel the neutral current into ground.

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1- As a subdivisional enginces I have to balance the active and reactive power.

ii - To make sure the reliability of supply and also to keep demand supply balanced

iii) - To follow every safety precaution himself and insure to the stuff too.

Q10.

i- **Ferranti Effect :-**

The effect in which the voltage and at the receiving end of the transmission line is more than the sending voltage is known as ferranti effect.

Such type of effect mostly occur because of light load or open circuit at the receiving end. Ferranti effect is due to charging current of the line.

ii- **Distribution Transformer :-**

It's function is to step down the voltage and provide isolation between primary and secondary. Electrical energy is passed through distribution transformer to reduce high distribution voltage level down to end-use levels.

→ Generally categorized in several ways

→ type of insulation : liquid-immersed or dry type

→ Number of phases : single phase or Three phase.

→ Voltage level (for dry type) : low or medium

iii- **Differential Relay :-**

The relay whose operation depends on the phase difference of two or more electrical quantities is known as the

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differencial protection relay.

It works on the principle of comparison between the phase angle and the magnitude of the same electrical quantities.

Over Current Relay:-

It is defined as the relay, which operates only when the value of the current is greater than the relay setting time. It protects the equipment of the power system from the fault current. Depending on the time of operation the overcurrent relay is categorized into following types

I. Instantaneous Overcurrent relay.
II. Inverse time overcurrent relay.
III. Define time overcurrent relay.

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