Unit - II

Introduction to Ac distribution System :-

-> Now-a days electrical energy is generated, transmitted and distributed in the form of alternating current

-> One important reason for widespread use of alternating current in preference to direct current is the fact that alternating voltage can be conveniently changed in magnitude by means of transformer.

-> Transformer has made it possible to transmit Ac power at high voltage and utilize it at a safe potential

-> ~~High~~ ~~Ex~~

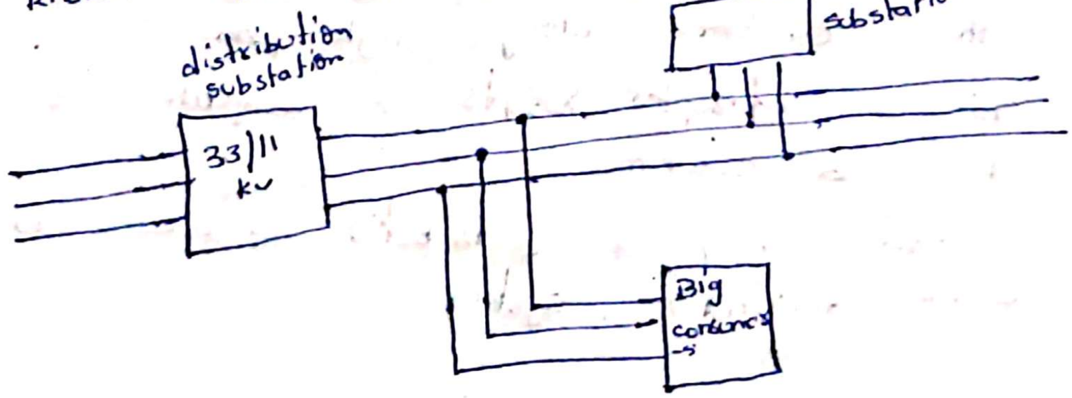
The Ac Distribution system is classified into

a) primary distribution system

b) secondary distribution system.

primary distribution systems :-

The part of the electric utility system which is in between, the distribution substation and distribution transformer is called primary distribution system and is made up of circuits known as Feeder (or) primary feeders



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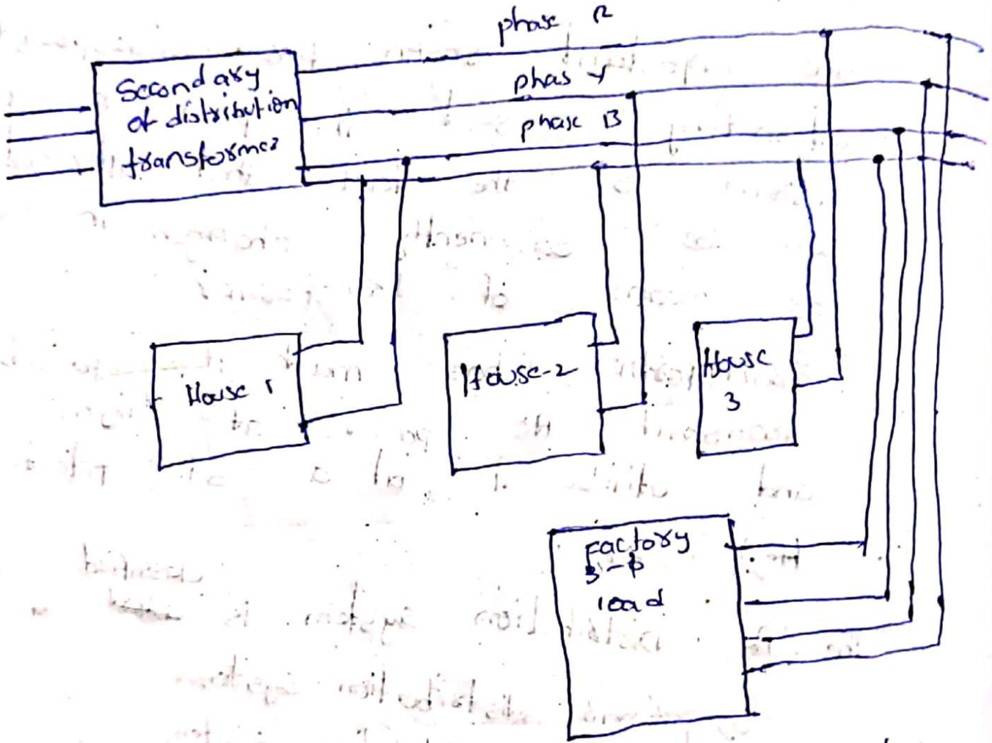
Secondary distribution system:-

The part of electric utility system which is in between distribution transformer to electric energy delivered to consumer is known as secondary distribution system

voltage levels is 400/230V 3-φ 4 wire system



Design consideration of Radial Type primary feeder

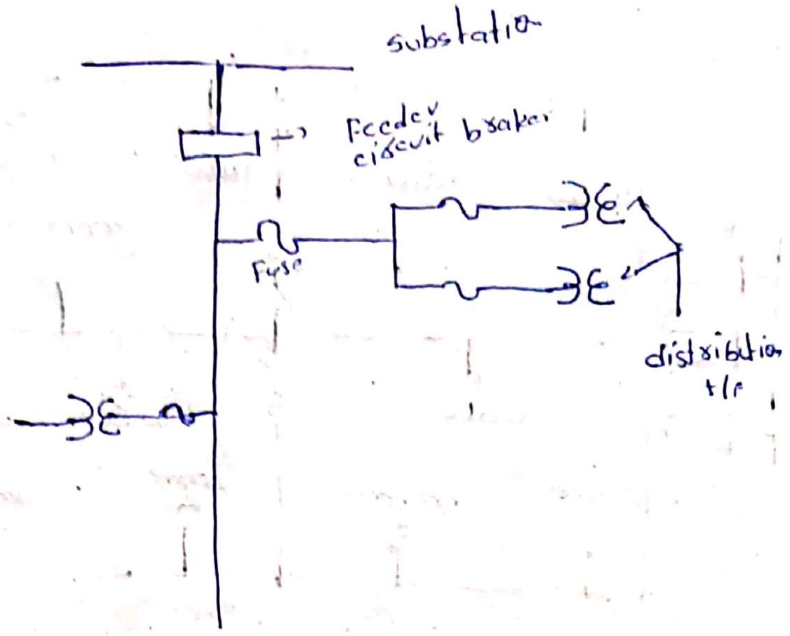
-> most of distribution system are designed to be radial distribution system.

-> In radial distribution system, only one path is connected between each customer and substation

-> The electric power flows from the substation to the consumer along single path.

-> This, if interrupted, results in complete loss of power to customer.

-> In india 99% of distribution of power is by radial distribution system



Advantages

-> ~~Consumer~~ Simple in construction, design and operation

-> cheaper in cost

Disadvantages

-> Consumer at far end of feeder is subjected to voltage fluctuations with respect to variation in load

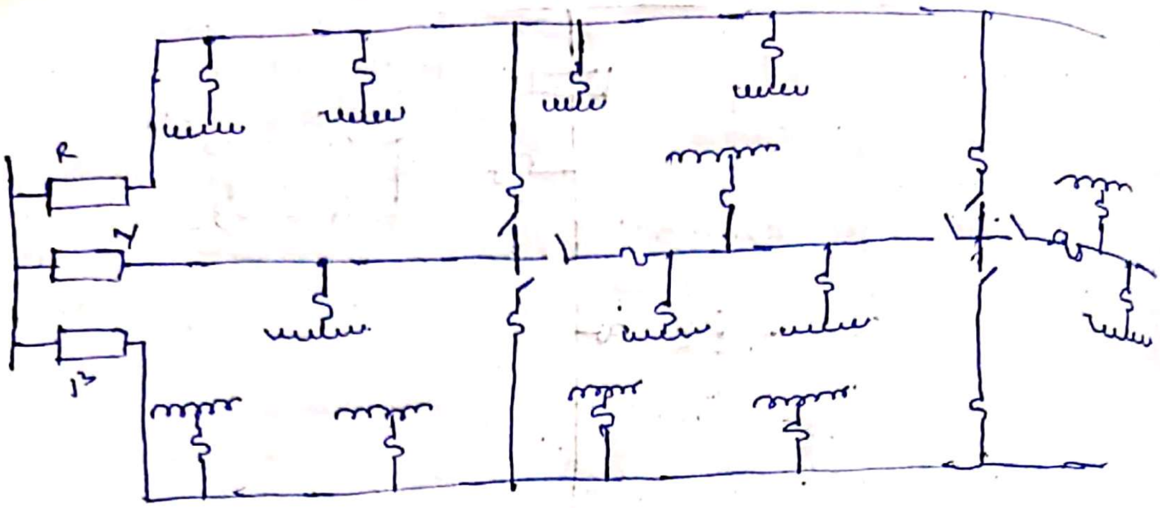
-> Reliability of service is low.

-> If fault occurs at any location on the radial primary feeder causes power outage to every consumer of feeder.

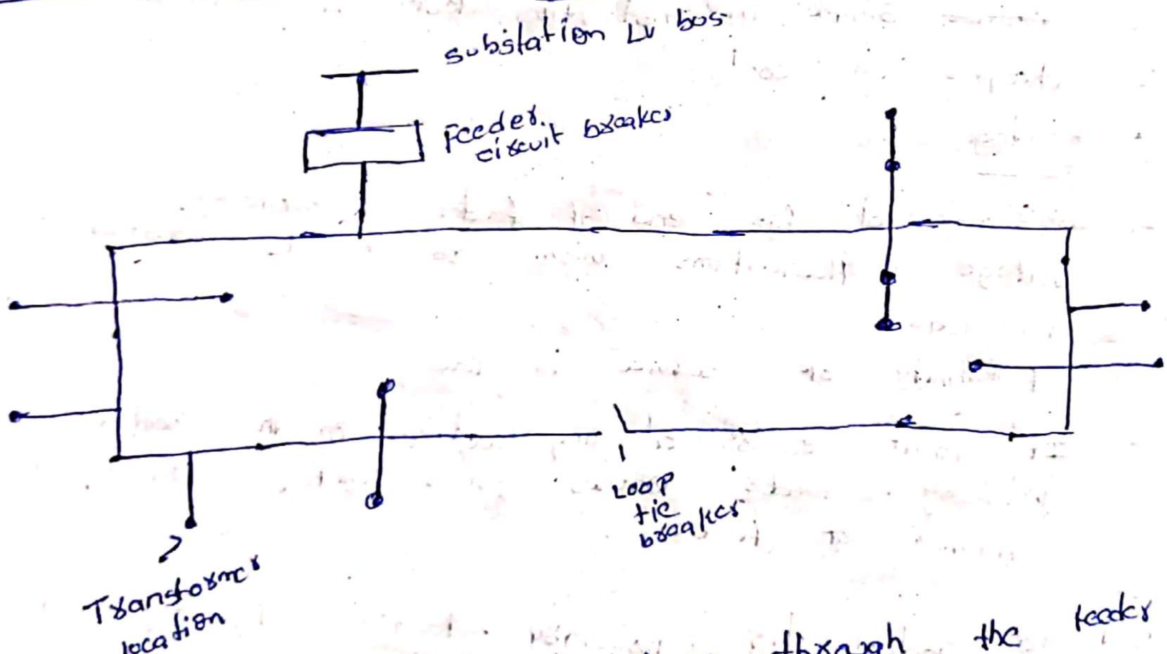
Modified Radial type primary feeder with Tie and ~~Secon~~ Sectionalizing switches.

-> In order to get rid from the power outage problem for a given radial type primary feeder, it is modified by employing tie switches and sectionalizing switches.

-> Hence modified radial type primary feeder with tie switches and sectionalizing switches provides fast restoration of service to consumers by switching unfaulted section of feeders to an adjacent feeders.



Design consideration of Loop Type primary Feeder



-> Loop type primary feeder loops through the feeder load area and returns to bus bar

-> Loop type primary feeder arrangement is beneficial to provide service for the loads where high service reliability is import i.e., in areas of hospitals (or) any emergency service centres.

-> Less conductor material is required as part of the ring carries less current than in radial distribution system.

Advantags

-> more reliable.
-> less voltage fluctuation.
-> Less conductor material is required as the past of ring carries less current than in radial distribution system.

Disadvantags

-> difficult to design when compared to radial type primary feeder

Factors affecting primary feeder voltage levels:

The primary ~~voltag~~ feeder voltage level is most important factor affecting the system design, cost and operation.

Some of the design and operation aspects affected by primary feeder voltage level are:

1) primary feeder length
2) primary feeder loading.
3) no. of distribution substations
4) Rating of distribution substations
5) number of sub transmission lines
6) System maintainance practise
7) The extent of tree trimming
8) joint use of utility poles.
9) Type of pole - line design and ~~cost~~ construction
10) Appearance of pole line.

Introduction to Ac distribution systems voltage drop calculations

All the methods used for solution of Dc distributors will apply equally well for solution of Ac distributors.

-> The resistance have to be replaced by impedance, the currents in various sections of distributor and voltages at load points are vector sum and not simply arithmetic sums.

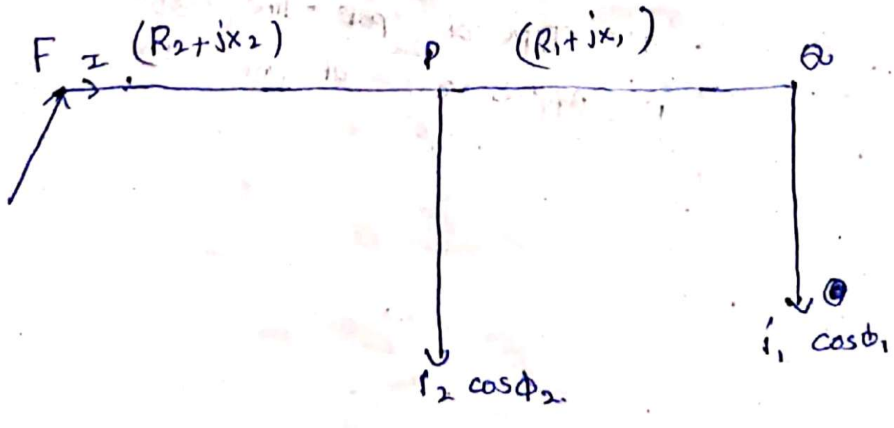
-> Further the loads tapped off from a given distribution will be at different factors.

-> To illustrate it, Ac distribution system can be explained in two different cases:

1) power factor referred to receiving end voltage
2) power factor referred to respective load voltage

1) power factor referred to receiving end voltage

consider the distributor FQ with concentrate loads of I_1 and I_2 tapped off with power factor of $\cos\phi_1$ and $\cos\phi_2$ at points Q and P, respectively as shown in below fig.



(R_2+jx_2) and (R_1+jx_1) be the impedances of section FP and PQ.

current in section PQ is = $I_1(\cos\phi_1 - j\sin\phi_1)$

voltage drop in section PQ is given by.

$$V_{PQ} = V_1 = I_1 (\cos\phi_1 - j\sin\phi_1)(R_1 + jX_1)$$

current in section FP is

$$I = I_1 + I_2$$

$$I = I_1(\cos\phi_1 - j\sin\phi_1) + I_2(\cos\phi_2 - j\sin\phi_2)$$

$$I = I(\cos\phi - j\sin\phi)$$

voltage drop in section FP

$$V_{FP} = V_2 = I(\cos\phi - j\sin\phi)(R_2 + jX_2)$$

$\therefore$ voltage at point F

$$V_F = V_R + V_1 + V_2$$

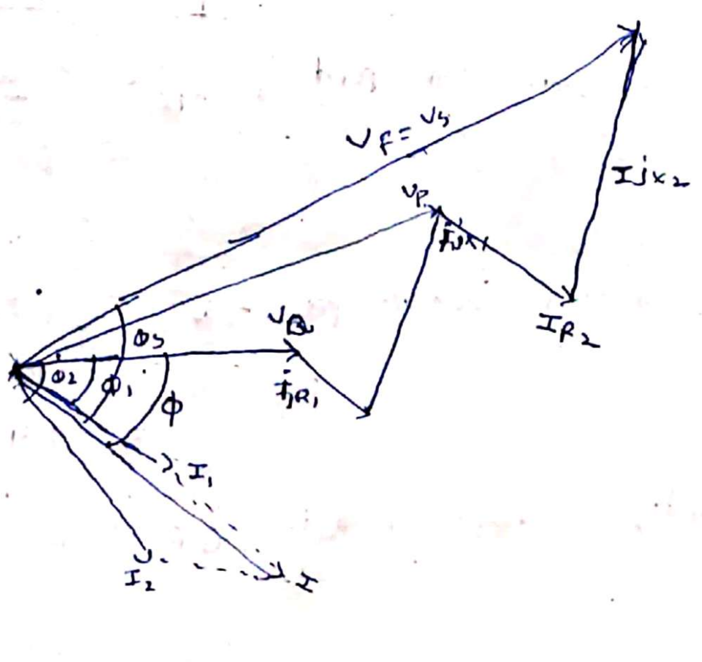
voltage at sending end $= V_F \angle \phi_s$

ϕ_s = sending end phase angle.

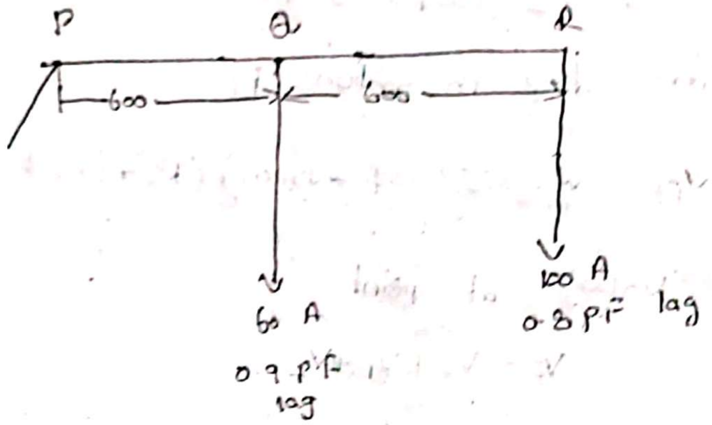
The phasor diagram is shown in below fig.

-> In phasor diagram receiving end voltage V_Q is taken as refference voltage.

-> In this case power factor of loads are reffered to V_Q, hence currents I_1 and I_2 lags ~~both~~ behind V_Q by an angle ϕ_1 and ϕ_2.



A two wire distributor 1200 m long is loaded as shown in fig. The power factors at the two load points refer to the voltage at R. The impedance of each line is $(0.15 + j0.2)\,\Omega$. calculate the sending end voltage, current, and power factor. The voltage at point R is 230 V



Sol:-

$i_1 = 100\,A$

$\cos\phi_1 = 0.8$

$i_2 = 60\,A$

$\cos\phi_2 = 0.9$

$V_R = 230 \angle 0$

$V_R = 230 + j0$

$Z_{PQ} = Z_{QR} = (0.5 + j0.2)\,\Omega$.

Load current at point R: $I_R = 100 \angle \cos^{-1} 0.8$

$= 100 \angle -36.86\,A$

$\boxed{I_R = 80 - j60\,A = I_{QR}}$

Load current at point Q $I_Q = 60 \angle \cos^{-1}(0.9)$

$= 60 \angle -25.84$

$= (54 - j26.16)\,A$

current in section PQ $I_{PQ} = I_Q + I_R$

$= 80 - j60 + 54 - j26.16$

$= 134 - j86.16 = 159.3 \angle -32.7\,A$

voltage drop in section QR, $V_{QR} = I_{QR} Z_{QR}$

$= 100 \angle -36.86 \times (0.15 + j0.2)$

$= 25 \angle 16.26$

voltage drop in section PQ $V_{PQ} = I_{PQ} \times Z_{PQ}$

$= 159.3 \angle -32.7 \times (0.15 + j0.2)$

$V_{PQ} = 39.82 \angle 20.39$

$\boxed{V_{PQ} = 37.329 + j13.87}$ v

$V_P = V_R + V_{PQ} + V_{QR}$

$V_P = 230 + 39.82 \angle 20.39 + 25 \angle 16.26$

$\boxed{V_P = 292.1 \angle 4.24^\circ}$ v

$\boxed{V_P = 292.1 \text{ v}}$

sending end current $I_{PQ} = 159.3 \angle -32.74^\circ$ A

power factor at sending end is $\cos(\phi)$

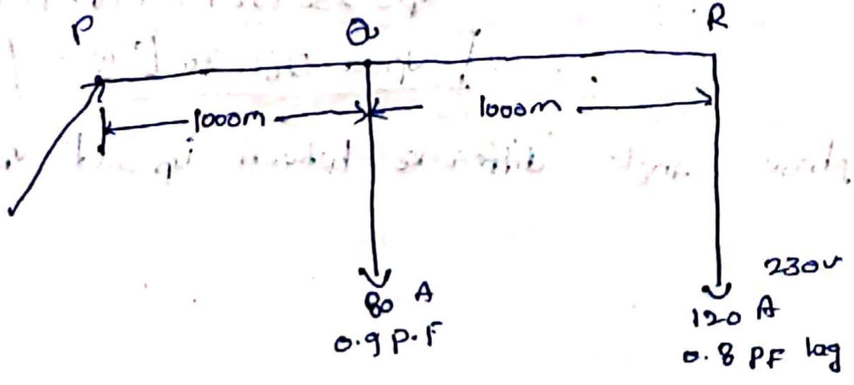
$\cos(4.24 - (-32.74))$

$\cos(36.84) = 0.8$ lag

A single phase distributor 2 km long supplies a load of 120 A at 0.8 p.f lagging at its far end and a load of 80 A at 0.9 p.f lagging at its mid point. Both power factors are reffered to voltage at far end. The impedance per kilo meter is $(0.05 + j0.1)\,\Omega$. If the voltage at far end is maintained at 230 v determine the following

1) voltage at sending end
2) phase ~~and~~ angle between the voltage at both ends.

sol:



$Z_{PQ} = (0.05 + j0.1)$

$Z_{QR} = (0.05 + j0.1)$

$V_R = 230 + j0$ V

$V_R = 230 \angle 0°$

~~I_R~~ =

current at point R $I_R = 120(\cos\phi - j\sin\phi)$

$I_R = 120(0.8 - j0.6)$

$I_R = (96 - j72)$ A

current at point $I_Q = 80(0.9 - j0.436)$

$= (72 - j34.8)$ A

current in section QR $I_{QR} = I_R = (96 - j72)$ A

current in section PQ $I_{PQ} = I_Q + I_R$

$= 72 - j34.8 + 96 - j72$

$\boxed{I_{PQ} = 168 - j106.88 A}$

voltage drop in section QR $V_{QR} = I_{QR} Z_{QR}$

$= (92 - j72)(0.05 + j0.1)$

$= (12 + j6)$ V

voltage drop in section PQ $V_{PQ} = I_{PQ} Z_{PQ}$

$= (168 - j106.88)(0.05 + j0.1)$

$= (19.12 + j11.48)$ V

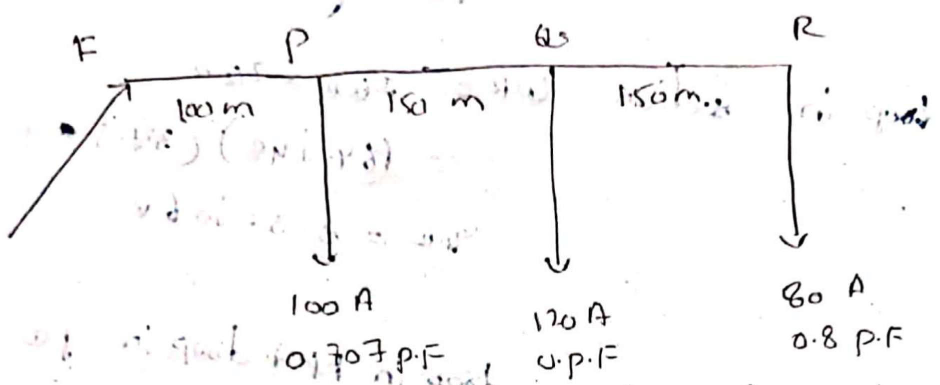
sending end voltage $V_P = V_R + V_{QR} + V_{PQ}$

$V_P = 230 + j0 + 12 + j6 + 19.12 + j11.48$

$\boxed{V_P = 261.70 \angle 3.83 \text{ V}}$

2) phase angle difference between V_P and $V_R = 3.83°$

3) Determine the total voltage drop of a single phase distributor as shown in below fig. The impedance is $(0.25 + j0.125)\ \Omega$ per kilometer



Sol:-

Impedance of section FP $Z_{FP} = (0.25+j0.125) \times \frac{100}{1000}$

$= (25 + j12.5) \times 10^{-3}\ \Omega$

Impedance of section PQ $Z_{PQ} = (0.25 + j0.25) \times \frac{150}{1000}$

$= (37.5 + j18.75)\ 10^{-3}\ \Omega$

Impedance of section QR $Z_{QR} = (0.25 + j0.25) \times \frac{150}{1000}$

$= (37.5 + j18.75) \times 10^{-3}\ \Omega$

current in section QR $I_{QR} = I_R = 80\ (0.8 - j0.6)$

$I_{QR} = I_R = (64 - j48)\ A$

current in section PQ $I_{PQ} = I_R + I_Q$

$= 80(0.8 - j0.6) + 120(1 + j0)$

$I_{PQ} = 184 - j48\ A$

current in section FP $I_{FP} = I_P + I_Q + I_R$

$= 100(0.707 - j0.707) + 120(1 + j0)$

$+ 80(0.8 - j0.6)$

$I_{FP} = (254.7 - j118.7)\ A$

drop in section FP $V_{FP} = I_{FP} \times Z_{FP}$

$= (254.7 - j118.7) \times (25 + j12.5) \times 10^{-3}$

$= (7.85 + j0.126)\ V$

drop in section PQ = V_{PQ} corr. = $I_{PQ} \times Z_{PQ}$

$= (184 - j48)(37.5 + j18.75) \times 10^{-3}$

$V_{PQ} = (7.8 + j1.65)V$

drop in section QR = $I_{QR} \times Z_{QR}$

$= (64 - j48)(37.5 + j18.75) \times 10^{-3}$

$V_{QR} = 3.3 - j0.6\ V$

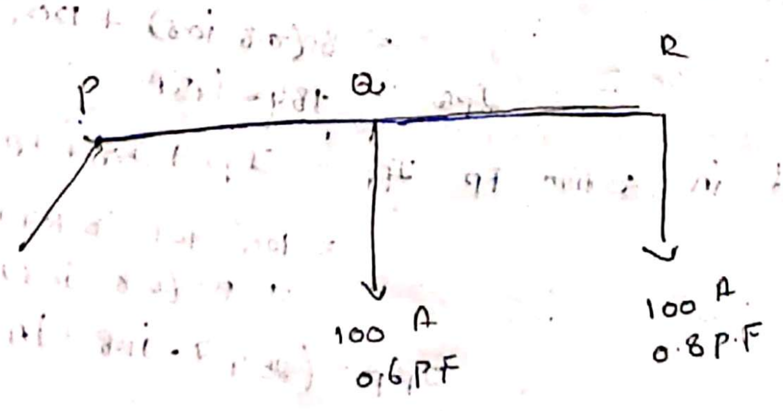
Total voltage drop = drop in FP + drop in PQ + drop in QR

$= (7.85 + j0.126) + (7.8 + j1.65) + (3.3 - j0.6)$

$= 18.99 \angle 3.82° V$

$\boxed{\text{Total drop} = 18.99V}$

A single phase distributor PQR fed at P is shown in Fig. The power factors are lagging with respect to the voltage at far end. The impedance b/w the section PQ and QR is $(0.1 + j0.15)\Omega$. If the voltage at far end is 230V, calculate the voltage at supply end and also its phase angle with respect to far end.



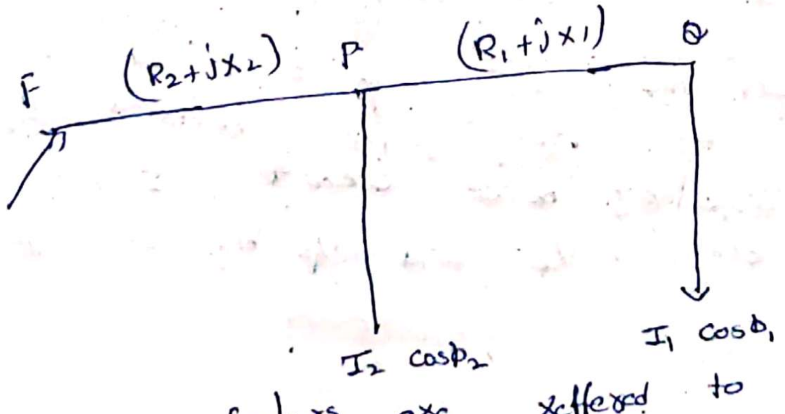
$Z_{PQ} = 0.1 + j0.15$

$Z_{QR} = 0.1 + j0.15$

current in section QP is $I_{QP} = I_P = 100(0.8 - j0.6)$

power factor referred to respective load voltage

Consider a distributor FQ with concentrated loads of I_1 and I_2 tapped off with power factors of $\cos\phi_1$ and $\cos\phi_2$ at points Q and P respectively as shown in below fig.



→ If the power factors are reffered to respective load point voltage, the current I_2 lags behind voltage V_P by an angle ϕ_2, whereas current I_1 lags behind voltage V_Q by an angle ϕ_1

V_1 and V_2 are the voltage drops in section PQ and FP respectively.

let $(R_2 + jX_2)$ and $(R_1 + jX_1)$ be impedance of FP and PQ.

→ current in section PQ is $= I_1 (\cos\phi_1 - j\sin\phi_1)$

voltage drop is section PQ is given by

$$V_1 = I_1 (\cos\phi_1 - j\sin\phi_1)(R_1 + jX_1)$$

voltage at point P is

V_P = voltage at point Q + voltage drop is section PQ

$V_P = V_Q + V_1$

$V_P = V_P \angle\alpha$

$I_2 = I_2 \angle -\phi_2$

$I_2 = I_2 \angle -(\phi_2 - \alpha)$

$I_{FP} = I_2 + I_1 = I_2 (\cos(\phi_2 - \alpha) - j\sin(\phi_2 - \alpha)) + I_1 (\cos\phi_1 - j\sin\phi_1)$

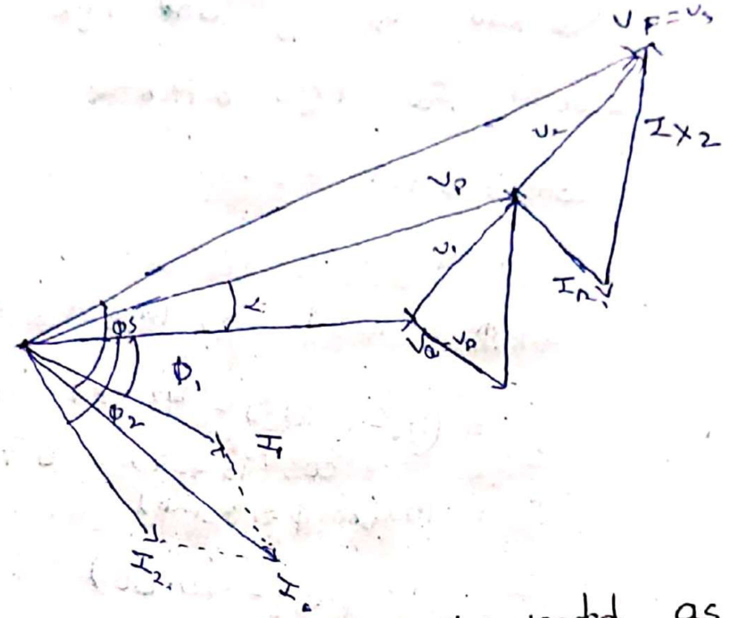
voltage drop in section FP, $V_2 = I_{FP} (R_2 + jX_2)$

voltage at point F, $V_F = V_P + V_2$

→ The phasor diagram of Ac distributor is shown in fig.

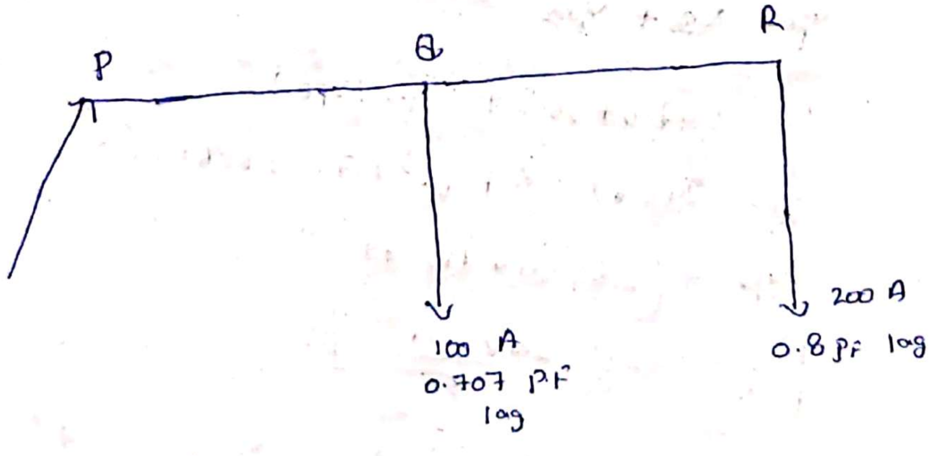
→ In phasor diagram, respective load voltage V_P and V_Q are taken as refference vectors.

→ In this case power factors $\cos\phi_1$ and $\cos\phi_2$ of the loads are reffered to V_P and V_Q respectively, hence currents I_1 and I_2 lags behind V_Q and V_P by an angle ϕ_1 and ϕ_2.



A single phase two wire AC feeder is loaded as shown in fig. The power factors are lagging and are reffered to voltage at the respective load points. The impedance of section PQ and QR are $(0.03 + j0.05)$ and $(0.05 + j0.08)\ \Omega$, respectively. Determine voltage magnitude and phase angle at the supply end, if voltage at the far end is 230 V

Sol:-



$Z_{PQ} = 0.03 + j0.05$

$Z_{QR} = 0.05 + j0.08$

Voltage at Q $\quad V_Q = V_R +$ drop in section QR

$V_Q = 230 + I_R \times Z_{QR}$

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$V_Q = 230 + I_R(\cos\phi_R - j\sin\phi_R)$ ~~Z_{RQ}~~

$V_Q = 230 + 200(0.8 - j0.6)\ (0.05 + j0.08)$

$V_Q = 247.6 + j6.8$

$V_Q = 247.69\ \angle 1.573^\circ$ V

V_Q leads V_R by and angle 1.573°

current I_Q lags reference vector by $(\phi_1 - \alpha)$

$\cos\phi_1 = 0.707$

$\phi_1 = 45^\circ$

$\therefore$ The current I_Q lags reference vector by $(\phi_1 - \alpha)$

$= (45 - 1.573) = 43.427$

$\therefore \cos(43.427) = 0.72 \quad \sin(43.427) = 0.68$

$I_Q = 100(\cos\phi - j\sin\phi)$

$I_Q = 100(0.72 - j0.68)$

$I_R = 200(0.8 - j0.6)$

$I_{PQ} = I_Q + I_R$

$I_{PQ} = 100(0.72 - j0.68) + 200(0.8 - j0.6)$

$I_{PQ} = (232.7 - j188.67)$

$V_P = V_Q + V_{PQ}$

$V_P = 247.6 + j6.8 + I_{PQ}(Z_{PQ})$

$V_P = 247.6 + j6.8 + (232.7 - j188.67)(0.03 + j0.05)$

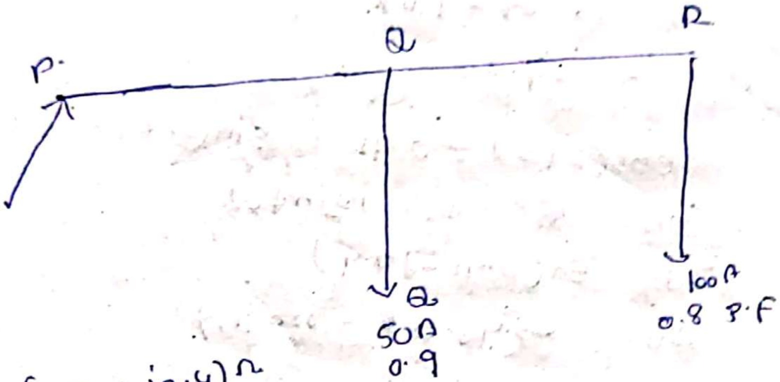
$V_P = (264.01 + j12.77)$ V.

$\boxed{V_P = 264.32\ \angle 2.77^\circ \text{ V}}$

phase angle b/w V_R and $V_P = 2.77^\circ$

A 1-φ distributor has loop resistance of 0.3Ω and reactance of 0.4Ω. The far end of the distributor has a load current of 100A and a power factor 0.8 lag at 220V. The midpoint Q of distributor has load current of 50A at power factor 0.9 lag with reference voltage at Q. Determine the sending end voltage and power factor.

Sol:-



$Z_{PR} = (0.3 + j0.4)\Omega$

$Z_{PQ} = Z_{PR}/2 = \frac{0.3 + j0.4}{2} = (0.15 + j0.2)\Omega$

$Z_{QR} = Z_{PR}/2 = \frac{0.3 + j0.4}{2} = (0.15 + j0.2)\Omega$

voltage at far end R is $V_R = 220\angle 0°$

Load current at point R $I_R = 100(0.8 - j0.6)$

$I_R = 80 - j60$

current in section QR $I_{QR} = I_R = 80 - j60$

voltage drop in section QR is given by.

$V_{QR} = I_{QR} * Z_{QR}$

$V_{QR} = (80 - j60) * (0.15 + j0.2)$

$V_{QR} = 24 + j7\ V$

voltage ~~drop~~ at point Q $V_Q = V_R + V_{QR}$

$V_Q = (220) + (24 + j7)$

$\boxed{V_Q = 244 + j7 = 244\angle 1.64\ V}$

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$\alpha = 1.64^\circ$

current I_Q lags reference vector by $(\phi_1 - \alpha)$

$\cos\phi_1 = 0.9$

$\phi_1 = 25.84$

current I_Q lags refference vector by $(\phi_1 - \alpha)$

$= (25.84 - 1.64)$

$= 24.2$

$\cos(24.2) = 0.91 \quad \sin(24.2) = 0.4$

$I_Q = 100(\cos\phi_2 - j\sin\phi_2)$

$I_Q = 50(0.91 - j0.4)$

$I_Q = (45.5 - j20.49)$

$I_{PQ} = I_Q + I_R$

$I_{PQ} = (45 - j20.49) + (80 - j60)$

$I_{PQ} = (125.6 - j80.49)$ A

voltage drop in sect PQ

$V_{PQ} = I_{PQ} \times Z_{PQ}$

$V_{PQ} = (125.6 - j80.49) \times (0.15 + j0.2)$

$V_{PQ} = (34.93 + j13.30)$ V

$V_P = V_Q + V_{PQ}$

$V_P = (244 + j7) + (34.93 + j13.30)$

$\boxed{V_P = 279.66 \angle 4.1}$

phase angle b/w V_P and $V_R = 4.11^\circ$

sending end current $= I_{PQ} = 125.6 - j80.49$

$= I_{PQ} = 149.18 \angle -32.65$ A

sending end power factor = Power factor of current + power factor of voltage

sending end power factor = 4.11 + 32.65
= 36.86

cos (36.86) = 0.801 lag

Design consideration of secondary distribution system:-

-> secondary distribution system receives power from secondary side of distribution transformed at low voltage a supplies power to various loads through service lines.

-> secondary distribution system are generally radial type except for some specific areas such as hospitals, business centres and military installations.

-> secondary side of distribution transformer supplies power through secondary mains through service conductor to service meter and also includes:-

A separate service system for each customer with separate distribution transformer and secondary connection.

The radial system with a common secondary main which is supplied by one distribution transformer and feeding a group of customers.

objectives of distribution system protection

primary objectives of distribution system protection:

1) minimize fault duration
2) minimize the number of customers affected by fault

secondary objectives:-

-> Eliminate safety hazards as early as possible

-> minimize service failure to the smallest possible branch of distribution system.

-> protect the consumer's apparatus

-> protect the distribution system from unnecessary service interruption and disturbances.

-> Disconnect the faulted branches, transformers (or) other components.

Types of common faults in distribution system

-> over head distribution system are subjected to two types of faults and they are are temporary (or) Transient and permanent fault.

-> Depending on the nature of system involved, most of faults are Temporary in nature.

-> Temporary faults occur when phase conductor of the system gets in contact electrically with other phase conductor (or) to the ground memontarily due to trees, birds (or) other animals, high winds, lightening flashovers etc..

-> The duration of this fault is to be minimized by using

-> The duration of this fault is to be minimized by using high speed (or) instantenous tripping

-> Automatic reclosing of a relay prevents unnecessary fuse braking.

-> permanent faults are those that require repair by a repair crew in term of following.

-> Replacing the burden down conductors, blown fuses (or) any other damaged apparatus.

-> Removing tree limbs from ling

-> manually reclosing a circuit breaker to restore the service.

Generally the types of faults in distribution system are:

1) Single line to ground fault (SLG)
2) Line to ~~ground~~ line fault (LL)
3) Double line to ground fault (LLG)
4) Three phase fault (LLL)

Procedure for fault calcution:

~~The~~ ~~sol~~

The possible fault types that might occur in a distribution system are:

1) single line to ground fault (SLG)
2) Line to Line fault (LL)
3) Double line to ground fault (LLG)
4) Three phase fault (LLL)

The first, second and third type of faults can take place on two phase (or) three phase feeders and fourth type of fault can take place only one three phase feeder.

-> However even on these feeders usally only LG fault takes place due to multigrounded construction.

-> The relative number of occurrance of different types of faults depend up on the various factors like feeder configuration, height of ground wires, voltage levels, grounding methods, relative insulation, level of between phases, speed of fault clearing, atmospheric conditions etc..

-> The relative number of occurance of different types of fauts in a distribution system are mentioned as follows

-> single line to ground fault (SLG) = 70%
-> line to line Fault (LL) = 15%
-> Double line to ground fault (LLG) = 10%
-> Three phase fault = 5%

-> The actual fault current is usally less than the bolted three phase value.

-> However, LG fault often produces a greater fault current than that of three phase fault especially when generators are neutral grounded.

-> In general the maximum and minimum values of fault currents are both calculated for a given distribution system.
The maximum fault current is determined based on following assumption:
-> All generators are connected.
-> Fault is a dead short circuit
-> Load is maximum.

-> The minimum fault current is determined based on following assumptions:
-> minimum number of generators are connected
-> Fault is not a dead short circuit
-> Load is minimum.

-> The calculated maximum fault current values are used to determine the rating capacity of protected devices.
-> The calculated minimum fault current values are used in co-ordinating the operations of protective devices.

-> To determine fault currents, one has to determine the positive, negative and zero sequence impedance of system at the side of distribution substation transformer.

-> These impedances are usally readily available from transmission fault studies

-> ∴ for any given fault on radial feeder, one can simplify add Thevenin's impedance to the appropriate impedance as the fault is moved away from substation along the feeder.

principle of operation of Fuse:

-> It is an over current protective device with circuit opening ability when directly heated and gets destroyed due to flow of over current through it in the event of an overloaded (or) short circuit condition

-> Hence the purpose of the fuse is to isolate the failure line from system.

-> Fuse is made up of material having low melting point, high conductivity and least deterioration due to oxidation.

Eu: silver, copper etc.

-> It is kept in series with the circuit to be protected.

operation

-> under normal operating conditions i.e; without short circuit condition (or) over load condition, the fuse is at a temparature below its melting point since it carries the normal current without over heating.

-> under abnormal operating conditions i.e: short circuit condition (or) over load condition, the current flow through the fuse increases beyond its rated value such that the temparature rises and fuse gets melted resulting in the disconnecting of circuit to be protected by it.

-> Time required to blow out the fuse depends upon the magnitude of excessive current i.e, greater the current then the smaller is the time taken to blow out the fuse.

Advantages

-> cheapest form of protection
-> Require no maintainance.
-> Breaks heavy short circuit current without noise (or) smoke.
-> minimum time of operation can be made much shorter than that of circuit breaker

Disadvantages

considerable time is required in removing (or) replacing the fuse after operation.

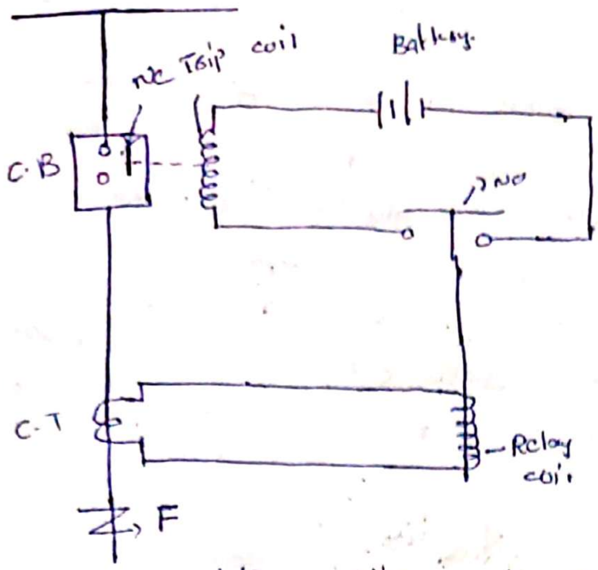
principle of operation of circuit breaker;

circuit breaker is an automatic interrupting device which is capable of breaking and making of a circuit under all conditions i.e; faulter (or) normal operating conditions.

-> circuit breaker isolate the circuit under fault condition with the help of relay.

-> A relay has two basic contacts named as NO (normally opened) and NC (normally closed) contact.

-> with the help of these contacts we can operate the relay.



under normal condition the NC coil is closed and NO coil is opened and current through current Transformer is constant. So the relay coil doesn't magnetize.

when fault occur on distribution line the current through the current transformer increases and relay coil gets magnetize and attracts the no contact downward. So due to closed circuit Trip coil gets energize and attracts the NC contact. So the circuit breaker operate and isolate the faulty section.

→ A circuit breaker essinlially consist of fixed contact and moving contact called as electrodes.

→ under normal operating condition, the contacts remains closed; under fault condition these two contacts get open and breaks the circuit.

→ whenever fault occurs on any part of distribution system, the trip coil of circuit breaker gets energized and moving coil is pulled away from fixed contact by some mechanism resulting in opening of circuit

→ when contact of circuit breaker are separated under fault conditions, an arc is struck between contacts.

→ The production of arc not only delays

the current interruption process but if ... enormous amount of heat which may cause damage to system (or) circuit breaker itself.

-> Hence primary task of a circuit breaker is to extinguish the arc that is developed due to separation of its contacts in an arc extinguishing medium such as air in case of air blast circuit breaker, vaccum in case of vaccum circuit breaker, and oil in case of oil circuit breaker, SF_6 gas in case of SF_6 circuit breaker.

Objectives of co-ordination

- minimize the extent of faults in order to reduce the number of costumers affected.
- minimize the service interruptions due to temporary faults.
- minimize the duration of service outages to identify the location of fault.

General co-ordination procedure:

- Gather the required and aforementioned data.
- select the intial ~~on~~ location for protective device on the given distribution circuit
- Determine the maximum and minimum fault current values at each of selected locations and at the end of feeder mains, branches and laterals.
- pickout the necessary protective device located at the distribution substation in order to protect the substation transformer properly from any fault that might occur in distribution circuit
- co-ordinate the protective devices from the substation outward (or) from the end of the distribution circuit back to substation.

-> Re consider and change if necessary the intial locations of protective devices

-> Re- examine the choosen protective device for current carrying capacity, interrupting capacity and minimum pick up rating.

-> Draw a composite Tcc curve showing the co-ordination of all protective devices employed with the curves drawn from common base voltage.

-> Draw a circuit diagram which shows the circuit configuration, the maximum and minimum values of fault currents and the ratings of protective devices employed and ~~son~~ so on.