1

Pag ① Name Salman Farooq

(Sessional Assignment)

Q.1 A 3 phase 50-Hz over head transmission line 100 km long has the following constant

Resistance /km/ phase = 0.1 Ω

inductive reactance /km /phase = 0.2 Ω

Capacative Susceptance /km/ phase = 0.04 × 10^{-4} Seimen

Determine (i) the Sending end current (ii) Sending End voultage (iii) Sending end power factor and (iv) transmission effective when Supplying a balanced load of 10000 kW at 66 kV. pf 0.8 lagging use nomminal T method.

Q.2 A (medium) Sigal phase transmission line 100 km long has the following constant.

Resistance/km = 0.25 Ω ; Reactance /km 0.8 Ω

Susceptance /km = 14 × 10-6 Seimen ;

②

2

②

Recieving end line vaultage = 66000V
Assuming that the total capacitance of the line is localised at the recieving end alone determine:
(i) The Sending end current
(ii) The Sending End voltage.
(iii) Regulation and the Sapplyfing power factor.

Q:-(3) Describe Ferranti Effect why Ferranti effect occurs? Detail Explanation of the Ferranti effect by Considering a nominal Pi(π) model. How to reduce Ferranti effect.

Pg 23

Q-2 A 3 phase 50 Hz overhead transmission line 100 km has the following constant.

Resistance /km /phase = 0.1 Ω

Inductive reactive /km /phase = 0.2 Ω

capacitive Susceptance /km /phase 0.04 × 10^{-4} Seimen. Determine

(i) The Sending end current (ii) Sending end voltage (iii) Sending end power factor and (iv) transmission efficiency when Supplying a balanced load of 10000 kW at 66 kV pf 0.8 lagging Use nominal T method

Solution:-

total resistance phase = 0.1 × 100 = 10 Ω total resistance phase X_L = 0.2 × 100 = 20

Capacative Susceptance y = 0.04 × 10−4 × 100 = 4 × 10−4 S

Recieving end voltage /phase, VR = 66000/√3 = 38105 V

Load current, $I_R = \frac{10000 \times 10^3}{\sqrt{3} \times 66 \times 10^3 \times 0.8} = 109$

$\cos \phi_R = 0.8$ $\sin \phi_R = 0.6$

4

Impedance per phase, $\vec{Z} = R + jXL = 10 + J20$

(i) Taking recieving end voltage as the refference phase we have

Recieving end voltage $\vec{VR} = VR + J0 = 38.105\ V$

Load current, $IR (\cos \phi R - J \sin \phi R) = 109 (0.8 - J0.6) = 87.2 - J65.4$

voltage accross C, $\vec{VI} = \vec{Vr} + \vec{IR}\ z/2 = 38.105 + 87.2 - J65.4)(5 + J10) = 38.105 + 436 + J\ 872 - J\ 327 + 654 = 39.195 + J\ 545$

charging current, $\vec{IC} = JYV_1\ 14 \times 10^{-4} (39.195 + J545) - 0.218) + J15.6$

Sending end current, $\vec{Is} = \vec{Ir} + \vec{Ic} = (87.2 - J65.4) + (0.218 + J15.6) = 87.0 - J\ 49.8 = 100 \angle\ 29^{o}\ 47 2A$

Q(3)

Sending end current = 400A

(ii) Sending voltage $\vec{V_s} = \vec{V_r} + I_s$

$Z/2 = (39.195 + j\,545) + (87.0 - j\,49.8)$

$(5 + j\,10)$

$= 39.195 + j\,545 + 434.3 + j\,870$ [3] 248

$+ 498 = 40128 + j\,1170 = 40145 \angle 1^\circ 402$ V

∴ Line value of sending end voltage.

$= 40145 \cdot \sqrt{3} = 69533\,V = 69.53\,kV$

(iii) Refering to phases-

ϕ = angle between $\vec{V_r}$ and $\vec{V_s}$

$= 1^\circ 402$

ϕ_2 = angle between $\vec{V_r}$ and $\vec{I_s}$

$= 29^\circ 4724$

ϕ_s = angle between $\vec{V_s}$ and $\vec{I_s}$

$= \phi_1 + \phi_2 = 1^\circ 402 + 29^\circ 472 = 31^\circ 272$

Sending end power $= \cos \phi_s$

$= \cos 31^\circ 27 = 0.853$ lag

(iv) Sending end power = $3 V_s I_s$

$\cos \phi_s = 3, 40145 \times 100$ 9734 $\times 0.853$

$= 10273105\,W = 10273.105\,KW$

power delevered = 101000 KW

∴ Transmission efficiency = $\frac{10000}{10027.73105}$ $\times 100 = 99.72\%$

(2) Q: A (medium) single phase transmission line 100 km long has the following constant.

Resistance /km = 14×10^{-6} Seimen's

Receiving line voltage = 6600 V

Assuming that the total capacitance of the line is localised at the receiving end alone determine

(i) The sending end current
(ii) The sending end voltage
(iii) Regulation and (iv) supply power factor. The line is delivering 15000 KW at 0.8 power factor lagging.
Draw the phasor diagram to illustrate your calculation.

Solution :→

total Resistance = $R = 0.25 \times 100 = 25$ ohms
total Reactance $= X_L = 0.8 \times 100 = 80$ ohm
Total Susceptance $Y = 14 \times 14 \times 10^{-6} \times 100$
$= 14 \times 10^{-4}$ S

Recieving end voltage $V_R = 66000$ V
Load current $I_R = \frac{15000 \times 10^3}{66{,}000 \times 0.8} = 284$ A

$\cos \phi_R = 0.8$ $\sin \phi_R = 0.6$

Taking Recieving end voltage as the referance phasor we have
$\vec{V_R} = V_R + J0 = 66000$ V
Load current $\vec{I_R} = \vec{I_R} (\cos \phi_R$
$- J \sin \phi_R) = 284 (0.8 - j0.6) = 27 - j170$

Capacitive current $\vec{I_c} = JY \times V_R =$
$j14 \times 10^{-4} \times 66000 = j92$

(i) Sending end current $\vec{I_S} = \vec{I_R}$
$+ I_c = (227 - j170 + j92 = 227 - j78$

Maugnitued of ~~j78~~ $I_s = \sqrt{(227)^2 + (78)^2} = 240$ A

(ii) valtage drop $= \vec{I_s}\vec{Z} = I_s(R + jX_L)$
$= (227 - j78)(25 + j80)$
$= 5.675 + j1816 - j1950 + 6240$

Pag 5

$= 11.915 + j\,16210$

Sending end voltage $\vec{VS} = \vec{VR} + \vec{Is}$

$Z = 66000 + 11915 + j\,16210$

$= 77915 + j\,16210$

Magnitued of $VS = \sqrt{(77915)^2 + (16210)^2}$

$= 7983\ V$

(III) % voltage regulation $= \frac{VS - VR}{VR} \times 100$

$= \frac{79883 - 66000}{66000} \times 100 = 20.58\%$

(iv) refereing exp (ii) phase angle between $\vec{VR}$ and $\vec{VS}$ is:

$\Phi_1\ \tan^{-1} \frac{16210}{77915} = \tan^{-1}(0.236) = 11.50^\circ$

Supplying power factor angle

$\Phi S = 18.96^\circ + 11.50^\circ = 30.46^\circ$

Supplying pf $\cos \Phi S - \cos 30.46^\circ$

$= 0.86$ lag.

(3) Q Describred ferranti effect. why ferranti effect occurs? Detail explanation of the ferranti effect by Considering a nominal pi(π) model. How to reduce ferranti effect.

ANS=>

Ferrantieffect:

Definition: The effect in which the voltage at the recieving end of the transmision line is more than the Sending voltage is known as the Ferranti effect. Such type of the effect mainely occurs because of lights load of open circuit at the recieving end.

Ans(b)

Ferranti effect occurs:
capacitance and inductance are The main perameters of the line heaving a length 240 KM or above. On Such transmission lines the capacitance is not concentrated at the Some defenet points. Its is the distributed Uniformly along the Hole length of the line. when the voltage is applied at the Sending end the current draw by the capacitance of the line is more than current associated with the load. Thus at no load or light load the voltage at the receiving end is quite large as Compared to the Constant voltage at the Sending end.

12

Ferranti ebbect by Considdering a nominal pi (π) model :->

Let us Consider the long transmission line in which OE represed the recieving end voltage - OH represents the current through the capacitor at the recieving end. The phasor PE represents the voltage drop accross the X (inductance). The phasor OG represend the Sending End voltage under a no load Condition.

It is Seen from phasor that OE, In other words the voltag at the recieving en is greater than the voltage at the Sending end when the line is at no load.

page(7)

For a small pi (π) replica:

$V_S = (1 + ZY/2) V_R + Z I_R$

where $I_R = 0$ at no load condition.

$V_S = (1 + ZY/2) V_R + Z(0)$

$= (1 + ZY/2) V_R$

$V_S - V_R = (1 + ZY/2) V_R - V_R$

$V_S - V_R = V_R [1 + ZY/2 - 1]$

$V_S - V_R = (ZY/2) V_R$

$Z = (r + J\omega l) S$ and $Y = (J\omega C) S$

if the transmission line's resistance is unnoticed

$V_S - V_R = (ZY/2) V_R$

Substitute $Z = (r + J\omega l) S$ and $Y = (J\omega C) S$ in the above VS

$V_S - V_R = 1/2 (J\omega l S)(J\omega C S) V_R$

$V_S - V_R = -1/2 (\omega^2 S^2) l C V_R$

Pag(8)

For the lines of overhead $1/\sqrt{LC} = 3\times108$ m/s (velocity of the electromagnetic wave transmission on the broadcast lines) $1/\sqrt{LC} = 3\times108$ m/s

$\sqrt{LC} = 1/3\times108$

$LC = 1/(3\times108)^2$

$VS - VR = -\frac{1}{2}\, \omega 2\, S2 \cdot (1/(3\times108)$

2) Vr

$\omega = 2\pi R$

The above eq ellutrates that (VS-VR) is negative, that means VR is greater than VS. This is also illustrated that this effects will also determine by electrical period of the transmission line and frequency. Generaly for each line.

$VS = AVr + BIr$

On no load state.

$Ir = 0,\ Vr = Vrnl,\ VS = AVrnl$

$|Vrnl| = |VS|/|A$

page3)

How to reduce Ferranti effect in transmission line →
Electrical machine work on Specific electrical energy. If the voltage is far above the ground at the consumer end thier device get damaged and the wedding of the device also burn due to high electrial energy. Ferranti effect an extinsive transmission line is no-load status. than the voltage will increase at the collecting end.
This can be restriced by keeping the shunt reactor next to the collecting end of the transmission lines.

The reactor allied between the lines alongs with natural to give back the capacitive current as of transmission lines. As the outcomes happens in lengthly transmission lines? These reactor pay off the transmission lines and thus the voltage is regulated with in the set limits.