**EXPERIMENT 5**

**AIM:** To verify the Ferranti effect in a transmission line.

**SIMULINK BLOCKS REQUIRED**

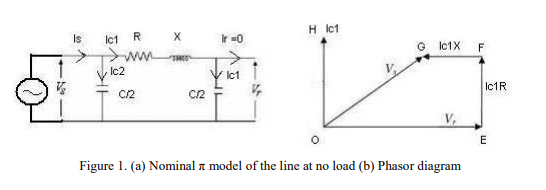
* AC Voltage source, single-phase, 50 Hz, 326.598 kV peak
* Series RL element (R=1.85 Ohms, L=0.0486735H)-6 Nos.
* Capacitors (C=0.2996 μF)-12 Nos.
* Voltage measurement blocks
* RMS Calculator block
* Displays
* Powergui

Note: We have considered a 400 kV, 300 km transmission line. Each pi section represents a 50 km length. Six such pi sections are cascaded to represent a physical line length of 300 km.

**THEORY:**

The ferranti effect is an phenomenon where the steady voltage at the open end of an uncompensated transmission line is always higher than the voltage at the sending end.It occours as a result of the capacitive charging current flowing through the inductance of the line and resulting over voltage increases according to the increase in line length .

Ferranti Effect can be explained by considering a nominal π model of the line. Figure 1(b) shows the phasor diagram of Figure 1(a).Here OE represents the receiving end voltage Vr.OH represents the current Ic1 through the capacitor C/2 at the receiving end.The voltage drop Ic1R across the resistance R is shown by EF.it is in phase with Ic1. The voltage drop across X is Ic1X.It is represented by the phasor FG which leads the phasor Ic1R by 90°.The phasor OG represents the sending end voltage Vs under no-load condition.It is seen from the phasor diagram that the voltage at the receiving end is greater than the voltage at the sending end when the line is at no load.



For a nominal π model of a line

Vs = (1+ ZY/2) Vr + ZIr

At no load, Ir = 0

Vs = (1+ ZY/2) Vr

Vs – Vr = (ZY/2) Vr

Z = ( r + jωl)S, Y = (jωc)S

If the resistance of the line is neglected,

Z = jωl S

And Vs – Vr = ½( jωl S) (jωcS) Vr = - ½ (ω 2 s 2 )lc Vr

For overhead lines

1/ √lc = velocity of propagation of electromagnetic waves on the line = 3x 108 m/s

Vs – Vr = - ½ (2 π f) 2 S 2 . 1/ (3x 108 ) 2 Vr = - (4 π 2 / 18 x 1016) f2 S 2Vr

This equation shows that (Vs – Vr) is negative. That is, Vr > Vs. This equation also shows that Ferranti effect depends on frequency and electrical length of the line. The conductor diameter and spacing have no bearing on Ferranti effect.

In general, for any line Vs = AVr + BIr

At no load,

Ir = 0, Vr = Vrnl

So, Vs = AVrnl, |Vrnl | = |Vs | / |A|

For a long line A is less than unity and it decreases with the increase in length of line. Hence Vrnl > Vs . As the line length increases the rise in the voltage at the receiving end at no load becomes more predominant.

**PROCEDURE:**

1. Build a SIMULINK model as shown in the circuit diagram.

2. Set a voltage in the AC source.

3. Run the simulation and note down the input and output voltage.

4. Measure voltages at the end of different pi sections of the line (to represent voltages at different points in the line).

5. Draw the graph between VR and distance.

6. Repeat same for other values of voltages.

**RESULT:** Ferranti effect has been plotted and observed the graph between receiving end voltage voltage and distance.