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Comparison of Performance Analysis and Operating Characteristics of 500, 600, 765 KV Transmission Line

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ABSTRACT

The power system network has of load and power flow conditions leading to problems of line capacity. In this regard power transmission systems have been investigated as potential alternative to increase transmission capacity without increasing system parameter. The system voltage has already reached extremely high level. The problems concerning power flow and stability, particularly voltage stability are of particular interest because of its sensitivity with changes in real and reactive power. Voltage stability is obtained by keeping specified voltage magnitude within the set of operating limits under steady state conditions. The problem has been studied to a great extent in case of three-phase systems.

Keywords:— *Loadability of line, SIL, characteristics curves, power circle diagram, loadability curves.*

I. INTRODUCTION

This paper deals with investigation of these aspects by using techniques of three-phase systems by increasing voltage label [5]. A number of performance characteristic curves have been obtained relating to power flow and voltage stability of such system. Several performance characteristics such as,

Load end real and reactive power operating contour maps, Voltage power characteristics (under loading conditions),

Optimal reactive power at voltage stability limit, loadability curves can be constructed as done in [6] Employing a sample system a quantitative as well as qualitative analysis is carried out to highlight relative performances of such systems as compared to their three phase counterparts. Such performance curves would be highly helpful in planning and evaluating performance of transmission line. In three phase system the analysis of reactive power requirement for voltage stability of three phase system has been carried out.

II. COMPLEX OPERATING CONTOUR IN POWER SYSTEM

The basic model is represented by equivalent pi model where the shunt capacitance of the line have been assume to be lumped and connected at two extreme end of the line [3]. T entire system reactance of the system has been assume to be connected between two buses utilizing the lumped parameter concept [5]. The system may be consider as a two area power network with longitudinal EHV transmission line transporting power form source side to load side.

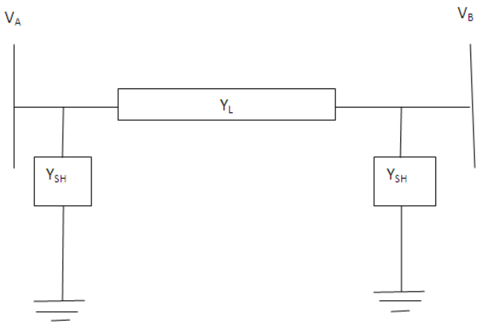

Figure 1: A pi line model

The receiving end current is given by

$$I_B = \left(\frac{S}{V_B}\right)^*$$

Utilizing the conventional equation [I]=[V][Y]

$$\begin{bmatrix} I_B \\ I_A \end{bmatrix} = \begin{bmatrix} Y_{BB} & Y_{BA} \\ Y_{AB} & Y_{AA} \end{bmatrix} \begin{bmatrix} V_B \\ V_A \end{bmatrix}$$

Where

$$Y_{AA}=Y_{BB}= Y_L+Y_{SH}$$

$$Y_{AB}=Y_{BA}= - Y_L$$

Now

$$I_B= V_B.Y_{BB}+V_A.Y_{AB}$$

$$\frac{S^*}{Y_{BB}} = V_B^2 + \left(\frac{Y_{BA}}{Y_{BB}}.V_A\right).V_B^*$$

$$\frac{S^*}{Y_{BB}} = V_B^2 + v.V_B^*$$

$$S - Y_{BB}^*.V_B^2 = v^*.Y_{BB}^*.V_B$$

$$|S| - |Y_{BB}^*.V_B^2| = |v^*.Y_{BB}^*.V_B|$$

Equation shows the equation of circle with $|Y_{BB}^*.V_B^2|$ Center and $|v^*.Y_{BB}^*.V_B|$ its radius. Therefore all state having constant amplitude of (v) Lie on the circle with these parameter s on S-plane each circle represent the locus of S, the receiving end power complex power for any stable value of V_B. Figure shows a series of load bus bar voltage circles drawn on the complex power plane; all of the circles fit into a parabolic region on the plane. There are two possible bus bar voltage solutions corresponding to each complex load power within the parabola. Only one possible voltage solution exists along the edge of the parabola and no solutions exist outside the parabola [7]. of the two possible voltage solutions that can be obtained within the parabola, only the voltage with the larger magnitude is associated with a stable operating point. The smaller voltage is associated with an unstable operating point that will lead to a voltage collapse at the load bus bar. The rate of collapse is dependent on the type of load and may occur over a period of several minutes.

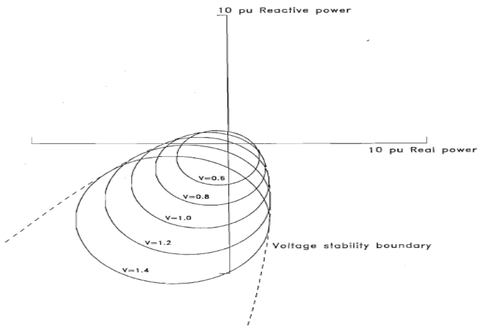

Figure 2: Power circle diagram

III. Capability of Power Transmission

The ability of power handling capacity is limited by thermal loading limit and stability limit due to real power loss the conductor temperature increased and due to this conductor is [2] stretches this will increase the sag between the towers the thermal limit is specified by current carrying capacity of conductor if current carrying capacity is denoted by $I_{thermal}$ then

$$S_{thermal}=3V_{rated}I_{thermal}$$

IV. Result and Conclusion

The locus of all point obtained by plotting P vs Q for fixed line voltage and varying load angle is a circle as the receiving end power circle diagram. A family of such circle with fixed receiving end voltage and varying sending end voltage is extremely useful In assessing the performance of transmission line.

Table 1: Data for Power Circle diagram

Line resistance in ohms per unit length, r	Line inductance in millihenry per unit length, L	Line capacitance in microfarad per unit length, C	Line conductance in siemens per unit length, g	Frequency in Hz	Line length	Receiving end line-line voltage kV
0.016	0.97	0.0115	0	50	300	500
0.016	0.97	0.0115	0	50	300	600
0.016	0.97	0.0115	0	50	300	765

Table 2: The loadability curve

Line resistance in ohms/km	Line inductance in millihenry/km	Line capacitance in microfarad/km	Line frequency in Hz	Sending end line-line voltage kV	Rated sending end power, MVA	Power factor
0.097	0.97	0.0115	50	500	1000	0.8
0.097	0.97	0.0115	50	600	1000	0.8
0.097	0.97	0.0115	50	765	1000	0.8

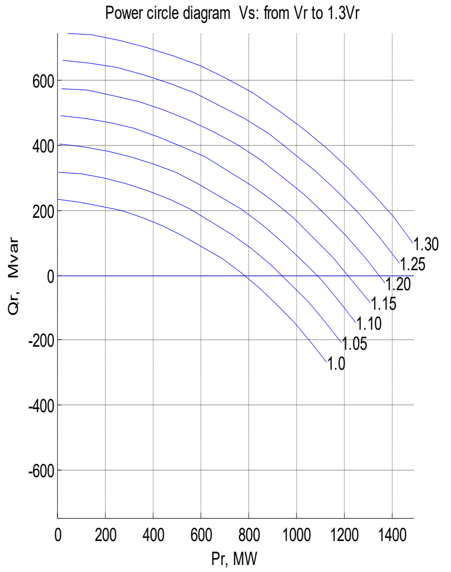

Figure 3 : Power circle diagram of 500 volt line

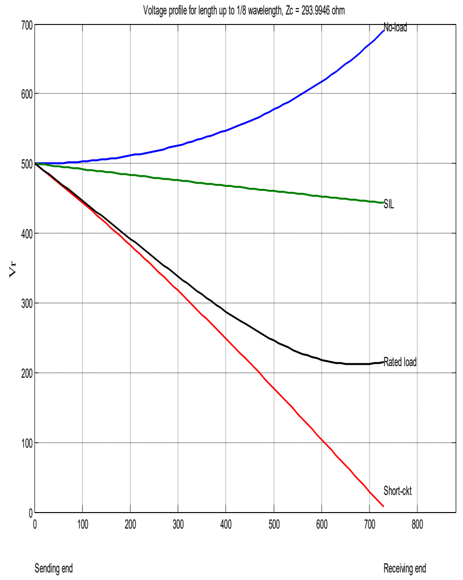

Figure 5 : Power circle diagram of 765 volt line

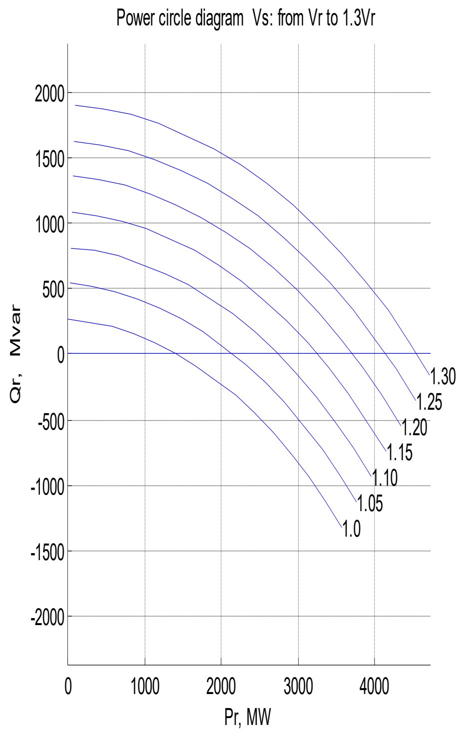

Figure 4: Power circle diagram of 600 volt line

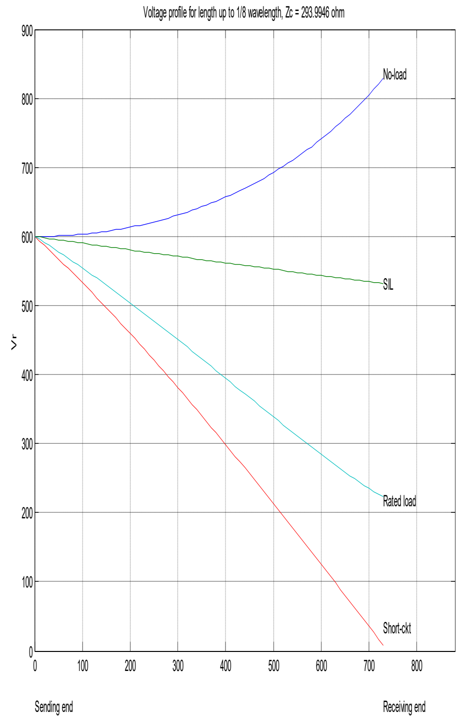

Figure 6 : Loadability curve of 500 volt line

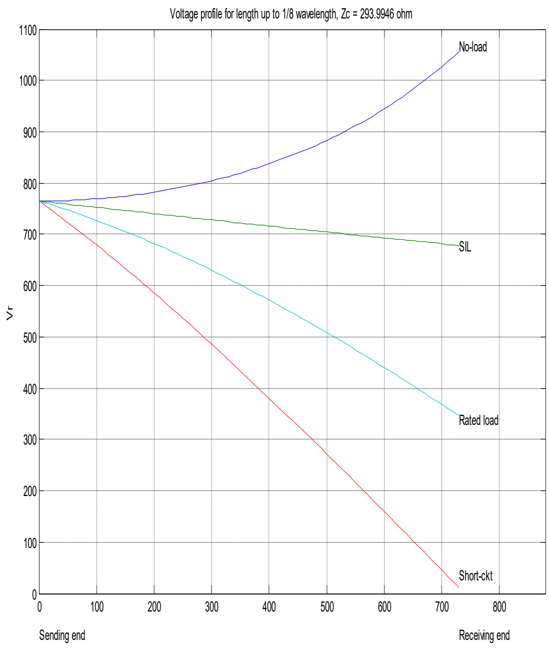

Figure 7: Loadability curve of 600 volt line

Table 3: Thermal limit Curve

Line inductance in millihenry/km	Line capacitance in microfarad/km	Line frequency in Hz	Sending end line-line voltage kV	Seceiving end line-line voltage kV	Sated line-line voltage kV	Line current-carrying capacity, Amp/phase
0.97	0.0115	50	765	500	765	3500
0.97	0.0115	50	765	600	765	3500
0.97	0.0115	50	765	765	765	3500

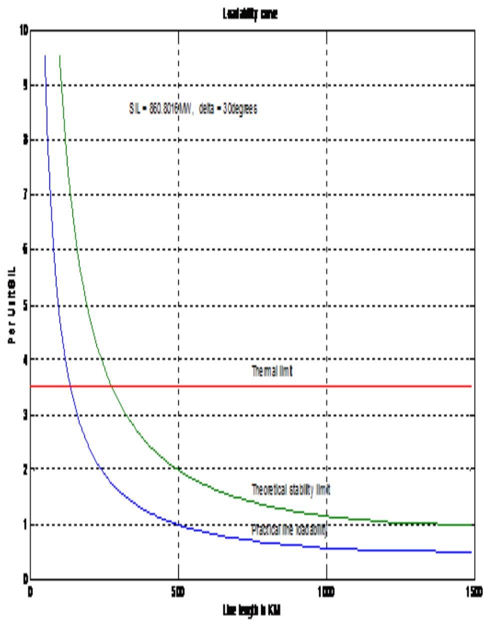

Figure 8 : Loadability curve of 765 volt line

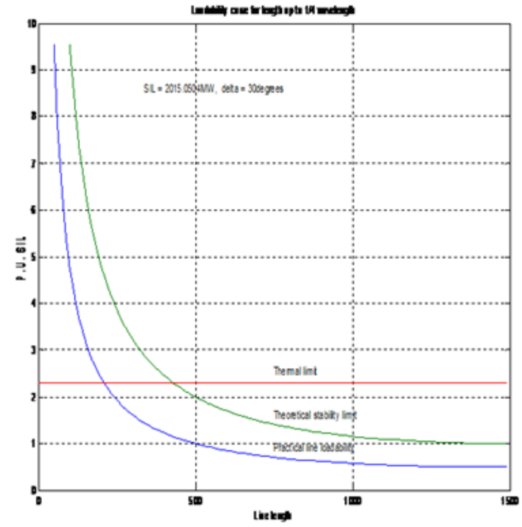

Figure 9 : Thermal limit of 500 volt line

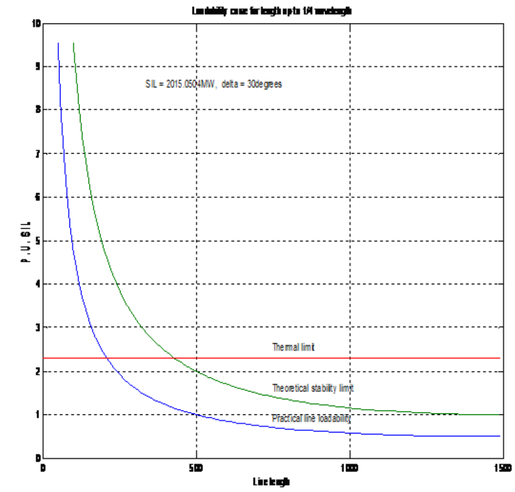

Figure 10 : Thermal limit of 600 volt line

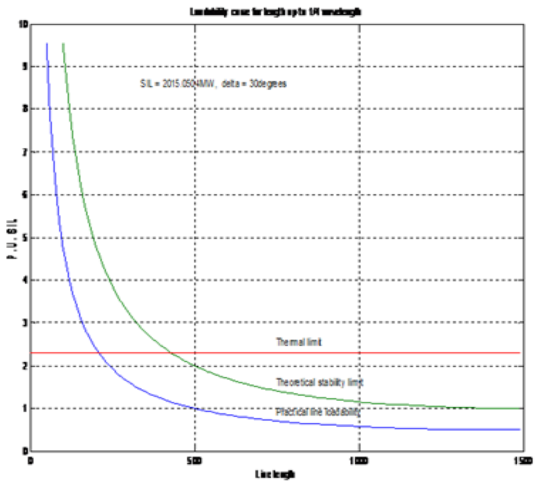

Figure 11. Thermal Limit of 765 volt line

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