

EE531 Homework 2

Two identical 345 kV lines have the following characteristics

2-conductor Grackle bundle, 18 “ spacing

Phase horizontal coordinates 0, 27, 54’

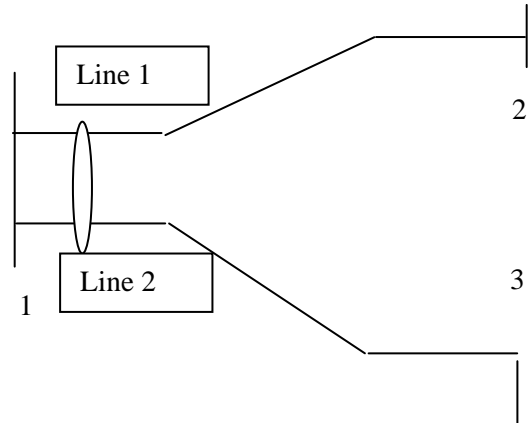
Phase vertical coordinates 70, 76, 70’

Phase sag 22’

Shield Wires, 2 , 3/8” steel

Shield horizontal coordinates 13’, 41’

Shield vertical coordinates 85’, 85’



The lines leave a substation along a common right of way on centers that are 105’ apart. After 20 miles they separate. Each line is 200 miles long.

- A. Develop the phase impedance (ohms/mi) for
 - a. Each Single (uncoupled) line
 - b. The coupled segment
- B. Develop the (total) impedance matrix for the lines. (As an approximation you can take these to be 20 miles of coupled line matrix + 180 miles of uncoupled.)
- C. Develop the sequence impedance matrix for the total line
- D. Give me the primitive impedance matrices for the coupled lines for positive and zero sequence. (They will be approximate?? Why?)

E. Formulate the following problem and solve

The sending end of the lines is bus 1 and the voltages are balanced positive sequence, 345 kV

The receiving end of line 1 is bus 2 and the receiving end of Line 2 is bus 3.

The line to ground voltages at buses 2 and 3 are also balanced. Phase a to ground voltage at bus 2 is 202 kV $/-1 \text{ deg}$ and that at bus 3 is 199 kV $/1 \text{ deg}$

- a. Find the phase currents in each line
- b. Find the per-phase sending and receiving end complex power for each line
- c. Find the negative(I_2/I_1) and zero sequence(I_0/I_1) current unbalance for each line
- d. Find the current in the shield wire

You will need to come up with the model and formula.

F. Formulate the following problem and solve

Voltages at Buses 1 and 2 are as in part D. The receiving end of Line 2 (Bus 3) is open. Then a bolted single line to ground fault occurs at bus 3, phase a. Find the phase currents in each line and the current in the shield wires.

Hint: You may ignore capacitance if you wish. No, pre-fault voltages are not 1 pu.