Calculations

161 kV

Crow (given)

GMD = 5 m

Outside Diameter = 1.036 in.

GMR at 60 Hz = 0.0349 ft.

Resistance at 50°C = 0.1482 Ω/mi

R = 0.1482 Ω/mi

X = 0.746592 Ω/mi

B = 5.68194×10^{-6} Mho/mi

Condor

GMD = 5 m

Outside Diameter = 1.093 in.

GMR at 60 Hz = 0.0368 ft.

Resistance at 50°C = 0.1378 Ω/mi

R = 0.1378 Ω/mi

X = 0.740034 Ω/mi

B = 5.73363×10^{-6} Mho/mi

$GMR = 0.0368 ft \times \left(\frac{1 m}{3.28 ft}\right) = 0.01122 m$

$L_a = 2 \times 10^{-7} \ln\left(\frac{5m}{0.01122m}\right) \left[H/m\right] \times \left(\frac{1609.344 m}{1 mi}\right) = 0.001963$

$X = (2\pi \cdot 60)(0.001963) = 0.740034 \ \Omega/mi$

$r = \frac{1.093 in}{2} \cdot \frac{0.0254 m}{1 in} = 0.013881 m$

$C_m = \frac{2\pi(8.854 \times 10^{-12})}{\ln\left(\frac{5m}{0.013881m}\right)} = 9.45039 \times 10^{-12} F$

$B = (2\pi \cdot 60)(9.45039 \times 10^{-12}) \times \left(\frac{1609.344}{1}\right)$

$= 5.73363 \times 10^{-6}$ Mho/mi

Cardinal

GMD = 5m

Outside Diameter = 1.196 in.

GMR at 60 H_z = 0.0403 ft

Resistance at 50°C = 0.1128 Ω/mi

$R = 0.1128\ \Omega/mi$

$X = 0.729104\ \Omega/mi$

$B = 5.82271 \times 10^{-6}$ Mho/mi

$GMR = 0.0403\ ft \times \left(\frac{1m}{3.28ft}\right) = 0.012287\ m$

$L_a = 2\times10^{-7} \ln\left(\frac{5m}{0.012287m}\right)\left[H/m\right] \times \left(\frac{1609.344m}{1\ mi}\right) = 0.001934\ H/mi$

$X = (2\pi \cdot 60)(0.001934) = 0.729104\ \Omega/mi$

$r = \frac{1.196}{2} \cdot \frac{0.0254m}{1\ in} = 0.015189m$

$C_m = \frac{2\pi(8.854\times10^{-12})}{\ln\left(\frac{5m}{0.015189m}\right)} = 9.59722 \times 10^{-12} F$

$B = (2\pi \cdot 60)(9.59722 \times 10^{-12}) \times \left(\frac{1609.344}{1}\right)$

$= 5.82271 \times 10^{-6}$ Mho/mi

Pheasant

GMD = 5m

Outside Diameter = 1.382 in.

GMR at 60 H_z = 0.0465 ft

Resistance at 50°C = 0.0840 Ω/mi

$R = 0.0840\ \Omega/mi$

$X = 0.71174\ \Omega/mi$

$B = 5.97163 \times 10^{-6}$ Mho/mi

$GMR = 0.0465\ ft \times \left(\frac{1m}{3.28ft}\right) = 0.014177\ m$

$L_a = 2\times10^{-7} \ln\left(\frac{5m}{0.014177}\right)\left[H/m\right] \times \left(\frac{1609.344m}{1\ mi}\right) = 0.001888\ H/mi$

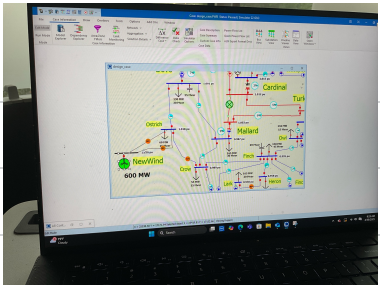
$X = (2\pi \cdot 60)(0.001888) = 0.71174\ \Omega/mi$

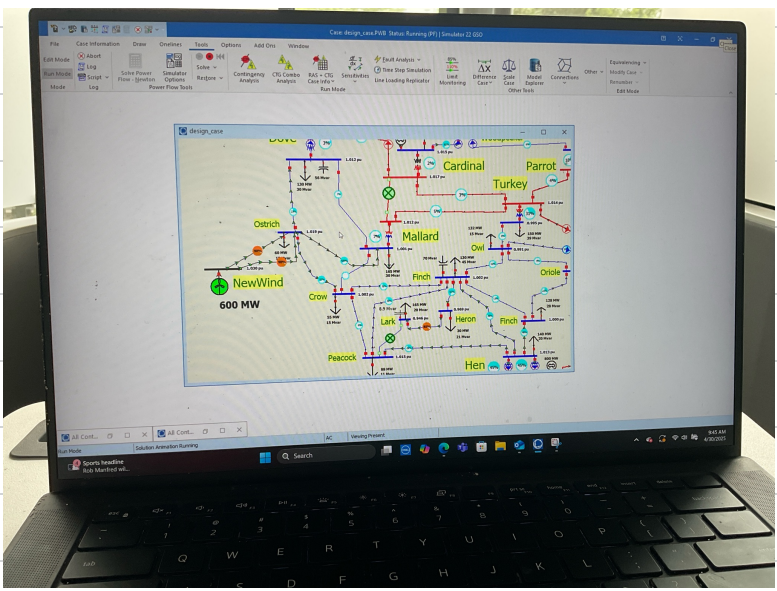
$r = \frac{1.382in}{2} \cdot \frac{0.0254m}{1\ in} = 0.017551\ m$

$C_m = \frac{2\pi(8.854\times10^{-12})}{\ln\left(\frac{5m}{0.017551}\right)} = 9.84266 \times 10^{-12} F$

$B = (2\pi \cdot 60)(9.84266 \times 10^{-12}) \times \left(\frac{1609.344}{1}\right)$

$= 5.97163 \times 10^{-6}$ Mho/mi





- 2 Phasesnt lines from NewWind to Ostrich
- 1 Phasent line from Ostrich to Mallard
- Added Shunt Capacitance at Lark Bus

NW to Ostrich

430000 $/S = 6.45 M

x 2 lines

$12.9 M

Ostrich to Mallard

430000 x 45 = $19.35 M

Construction Cost for Design 1

12.90

+19.35

$ 32.25 M

System Losses: 57.91 MW with New Wind = 600 MW

45.19 MW with New Wind = 0 MW

51.92 MW w/ NW @ 600

45.08 MW w/ NW @ 0

New Wind to Dave

Crew

390,000 × 55

Newwind to Ostrich

Pheasant

430k ×15

Newwind to Crew

Pheasant

430k × 30

Construction cost for Design 2

$40.8 M

Design 2 cost

System Losses: 51.92 MW

$$51.92\ \text{MW} \times 8760\ \text{hrs/yr} = 454819\ \text{MWh/yr}$$

$$454819\ \text{MWh/yr} \times 5\ \text{yr} = 2274095\ \text{MWh}$$

$$2274095\ \text{MWh} \times \$50/\text{MWh} = \$113704800$$

Total Cost for Power Losses (5 yrs)

$\approx \$113.7$ M

$+ \quad 40.8$ M for transmission lines

$\$154.5$ M TOTAL COST

Design 1 Cost

System Losses : 57.91 MW

$57.91\ MW \times 8760\ hrs/yr = 507292\ MWh/yr$

$507292\ MWh/yr \times 5\ yr = 2536455\ MWh$

$2536455\ MWh \times \$50/MWh = \$126822750$

Total Cost for Power Losses (5 yrs)

$\approx \$126.82\ M$

$+ \quad 32.25\ M$ for transmission lines

$\$159.07\ M$ TOTAL COST