Alan Lee
EE 393
1228254

Equation 1: Per unit base impedance

$$Z_{base} = \frac{V_{base}^2}{S_{base}} \tag{1}$$

Under a given base voltage and base power, you can use equation 1 to solve for the base impedance of that portion of the circuit. For example, a circuit with a base voltage of 34.5 kV and a base power of 100 MVA has a Z_{base} of 11.9025 Ω.

Equation 2: Per unit Impedance

$$Z_{pu} = \frac{Z_{acutal}}{Z_{base}} \tag{2}$$

Using equation 2, it is possible to evaluate the per unit impedance value of an element as long as the actual impedance, Z_{actual}, and the base impedance, Z_{base}, is known.

Equation 3: Change of base: impedance

$$Z_{pu\_new} = Z_{pu\_old} * \frac{Z_{base\_old}}{Z_{base\_new}} \tag{3}$$

The nominal per unit impedance value of a circuit element might use a base impedance that is different from the base impedance of the circuit being designed so a change of base operation must be done. Equation 3 shows how to obtain the new per unit impedance value.

Equation 4: Estimated power rating of a transmission line

$$S_{rated} = Ampacity * V_{base} \tag{4}$$

The approximated power rating of a transmission line can be evaluated using equation 4, where ampacity is the current carrying capacity of the line and V_{base} is the base voltage for the line.

Equation 5: Magnitude of apparent power

$$|S| = \sqrt{P^2 + Q^2} \tag{5}$$

Using equation 5 the magnitude of apparent power consumption can be evaluated if the real power consumption, P, and the reactive power consumption, Q, is known.