2022Q6 REACTANCE

QUESTIONS

Large industrial facilities, like many of One Energy's customers, use both real power and reactive power. Remember from Wind Study 1 of this year that real power does work, and reactive power is a byproduct of a process that uses power. Oftentimes, customers want to minimize that reactive power. To lessen the consumption of reactive power, it's important to know what creates reactive power.

In almost all powered circuits, there are two tiny pieces of equipment: capacitors and inductors. A capacitor holds a tiny amount of electrical energy, and an inductor holds a tiny amount of magnetic energy. A capacitor has capacitance which determines how much electrical charge it can hold. An inductor has inductance which determines how much magnetic energy it can hold. Because they hold some energy, they have a reactance which creates reactive power. The reactance is measured in ohms, just like resistance! The following equations allow us to calculate reactance.

The capacitive reactance, X_c, is calculated with the frequency of the circuit, f, and the capacitance, C, measured in farads.

$$X_c = -\frac{1}{2\pi f C}$$

The inductive reactance, X_L, is calculated with the frequency of the circuit, f, and the inductance, L, measured in Henries.

$$X_L = 2\pi f L$$

Notice how the reactance of a capacitor is negative and the reactance of an inductor is positive. With these opposite signs, we can use capacitors to take away reactive power when there's too many inductors and vice versa!

Level 1: We have a circuit with one capacitor in it. That capacitor has a capacitance of 2 microfarads or $2*10^{-6}$ farads. If the circuit uses the standard US electrical frequency of 60 Hz, what is the capacitive reactance of the system?

Level 2: A different circuit has a capacitance of 12 millifarads or $12*10^{-3}$ farads and is run with a standard international frequency 50 Hz. However, we want to have zero reactance in our circuit, so we'll add one inductor. What inductance should it have to create a zero reactance system?

One Energy's turbines contain many inductors and capacitors in their electronic components. These tiny tools can help with quick computations.