2022Q1 REACTIVE AND APPARENT POWER

QUESTIONS

At One Energy, we use our customers' power load to help size our *Wind for Industry®* projects. This power load can be measured in two distinct ways: real power and reactive power. Real power is power that does work; it can light lamps, spin motors, and charge batteries. It's measured in watts (W). Reactive power is a byproduct of a process that uses power. Turning on some motors and changing AC power to DC power creates reactive power, but this kind of power is not usable. It's measured in volt-amperes reactive (VAR). The combination of real power and reactive power is called apparent power and is measured in volt-amperes (VA). To mathematically combine these two, we can use the following formula:

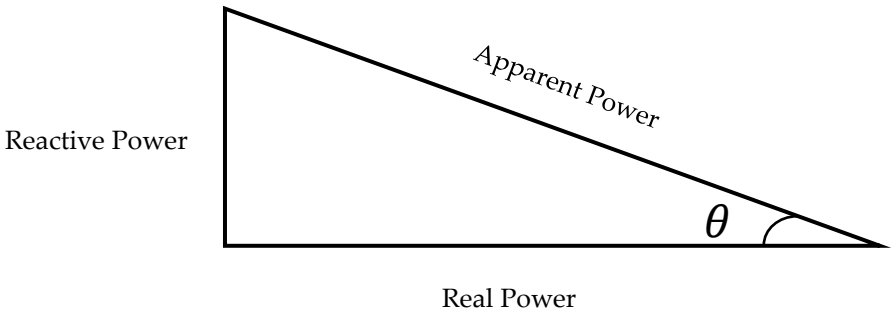
$$Apparent\ Power = \sqrt{Real\ Power^2 + Reactive\ Power^2}$$

For a visual, think about a tall glass about to be filled with soda. When you pour the drink, the soda goes in the cup, but fizz starts to build. Once the glass is full, it only contains some amount of soda while bubbles fill the rest of the glass. In this visual, the soda represents real power, and the fizz is reactive power - still present, but not drinkable.

To learn more about real power, check out our first Science Short hosted by Jessica, One Energy's Head of Project Planning and Technology. To learn more about reactive power, check out this Wind Energy Fact about Active vs Reactive Power presented by Chelsea, One Energy's Head of Construction.

Level 1: What is the apparent power of a system if its real power is measured at 15 W and its reactive power is measured at 3 VAR?

Level 2: Does the previous equation remind you of anything? It looks like the Pythagorean theorem! We can think of the three forms of power in a right triangle.



The Greek letter in the corner of the triangle is a theta. It represents the angle between apparent power and real power. The cosine of this angle is called the power factor. When the power factor approaches 1, the system is more efficient, i.e., it has very little reactive power. When the power factor approaches 0, the system is less efficient, i.e., it has lots of reactive power compared to real power.

For this question, assume there's a power factor of 0.95; therefore, θ is equal to 18.2°.

$$\cos^{-1}(0.95) = \theta = 18.2°$$

Because reactive power and real power do not affect each other, there is a 90° angle between them. We also know that the reactive power is measured to be 100 VAR.

Solve for the other two sides (apparent power and real power) and the unknown angle. Note: the triangle is not drawn to scale.

One Energy's turbines produce real power as the wind spins their rotors.