How a VFD Affects Torque and Horsepower

HP or torque will change depending on the change in frequency when the speed of an AC motor is controlled by a VFD. Figure 1 below visually illustrates these changes. The X axis is motor speed from 0 to 120 hertz. The Y axis is the percent of HP and torque. HP and torque are both 100 percent at 60 hertz (base motor speed). When the VFD reduces frequency and motor speed, it also reduces voltage to keep the volts/hertz ratio constant. Torque remains at 100 percent, but HP is reduced in direct proportion to the change in speed.

At 30 hertz, the HP is 50% of the full HP at 60 hertz. The reason this occurs is because the total torque produced per unit of time is also reduced by 50 percent because of fewer motor rotations. The HP and torque equations can be used to verify this relationship.

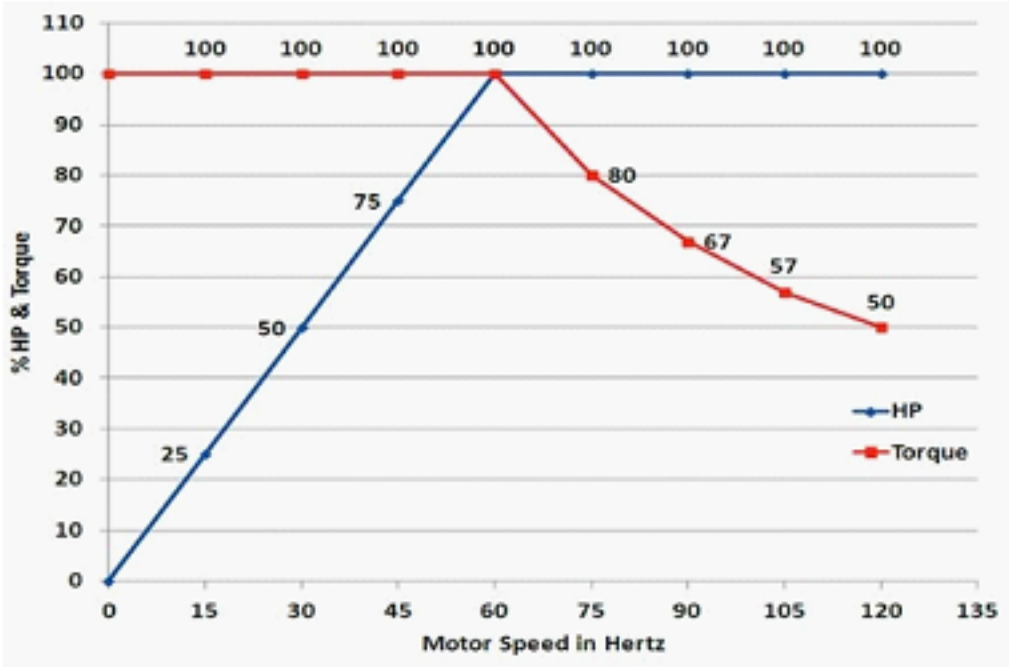

Figure 1. HP and torque changes with different frequencies

HP and torque flip situations when a VFD increases frequency above 60 hertz. , and torque decreases as frequency increases above 60 hertz, while HP remains at 100%. The torque reduction occurs because motor impedance increases with frequency increases. A VFD cannot increase the voltage above its supply voltage. This causes the current to decrease as frequency increases, thus decreasing the available torque.