Useful Equations for Testing Generators and UPS's

Apparent Power (kVA)

$$kVA = \sqrt{kW^2 + kVAr^2}$$

$$kVA = \frac{V \times I \times \sqrt{3}}{1000}$$

$$kVA = \frac{kW}{pf}$$

$$kVA = \frac{kVAr}{\sqrt{1 - pf^2}}$$

Resistive Power (kW)

$$kW = kVA \times pf$$

$$kW = \frac{V \times I \times pf \times \sqrt{3}}{1000}$$

$$kW = \sqrt{kVA^2 - kVAr^2}$$

Reactive Power (kVAr)

$$kVAr = kVA \times \sqrt{1 - pf^2}$$

$$kVAr = \frac{V \times I \times \sqrt{1 - pf^2} \times \sqrt{3}}{1000}$$

$$kVAr = \sqrt{kVA^2 - kW^2}$$

Power Factor (pf)

$$pf = \cos \phi = \frac{kW}{kVA}$$

Current (A)

$$I = \frac{kVA \times 1000}{V \times \sqrt{3}}$$

$$I = \frac{kW \times 1000}{V \times pf \times \sqrt{3}}$$

De-rate from Nominal Voltage and Frequency

$$kW = \left(\frac{V}{V_{nom}} \right)^2 \times kW_{nom}$$

$$kVAr = \left(\frac{V}{V_{nom}} \right)^2 \times \frac{F_{nom}}{F} \times kVAr_{nom}$$

Note: All voltages are phase-to-phase values and assume a 3-phase system.