Function Definitions:

Equivalent resistance , two parallel resistances: $R_{par}(r1, r2) := \dfrac{r1 \cdot r2}{r1 + r2}$

Line current: $I_L(p) := \dfrac{p}{\sqrt{3} \cdot V_{LL}}$

Balanced delta to wye conversion: $R_{\Delta Y}(r_\Delta) := \dfrac{r_\Delta}{3}$

Balanced wye to delta conversion: $R_{Y\Delta}(r_Y) := 3 \cdot r_Y$

Variable Definitions:

Heating element resistance $\quad R := 5 \ \Omega$

Nominal system voltage $\quad V_{LL} := 208 \ V$

Calculations:

Nominal line-to-neutral voltage $\quad V_{LN} := \dfrac{V_{LL}}{\sqrt{3}} \qquad V_{LN} = 120 \ V$

Line current, each phase:

Delta, parallel heating elements $\quad P_{\Delta p} := 3 \cdot \dfrac{V_{LL}^2}{\left(\dfrac{R}{2}\right)} \qquad P_{\Delta p} = 51.92 \ kW \qquad I_L(P_{\Delta p}) = 144.11 \ A$

Define this as the base power.

Percentage of base power:

Delta, single heating element $\quad P_\Delta := 3 \cdot \dfrac{V_{LL}^2}{R} \qquad P_\Delta = 25.96 \ kW \qquad \dfrac{P_\Delta}{P_{\Delta p}} = 50 \ \% \qquad I_L(P_\Delta) = 72.05 \ A$

Delta, series heating elements $\quad P_{\Delta s} := 3 \cdot \dfrac{V_{LL}^2}{2 \cdot R} \qquad P_{\Delta s} = 12.98 \ kW \qquad \dfrac{P_{\Delta s}}{P_{\Delta p}} = 25 \ \% \qquad I_L(P_{\Delta s}) = 36.03 \ A$

Wye, parallel heating elements $\quad P_{Yp} := 3 \cdot \dfrac{V_{LN}^2}{\left(\dfrac{R}{2}\right)} \qquad P_{Yp} = 17.31 \ kW \qquad \dfrac{P_{Yp}}{P_{\Delta p}} = 33.33 \ \% \qquad I_L(P_{Yp}) = 48.04 \ A$

Wye, single heating element $\quad P_Y := 3 \cdot \dfrac{V_{LN}^2}{R} \qquad P_Y = 8.65 \ kW \qquad \dfrac{P_Y}{P_{\Delta p}} = 16.67 \ \% \qquad I_L(P_Y) = 24.02 \ A$

Wye, series heating elements $\quad P_{Ys} := 3 \cdot \dfrac{V_{LN}^2}{2 \cdot R} \qquad P_{Ys} = 4.33 \ kW \qquad \dfrac{P_{Ys}}{P_{\Delta p}} = 8.33 \ \% \qquad I_L(P_{Ys}) = 12.01 \ A$

Delta with internal wye (convert internal wye to delta equivalent; eq. is in parallel with original delta) $\quad P_{\Delta Y} := 3 \cdot \dfrac{V_{LL}^2}{R_{par}(R, R_{Y\Delta}(R))} \qquad P_{\Delta Y} = 34.61 \ kW \qquad \dfrac{P_{\Delta Y}}{P_{\Delta p}} = 66.67 \ \% \qquad I_L(P_{\Delta Y}) = 96.07 \ A$

Wye with internal delta (convert internal delta to wye equivalent; eq. is in series with original wye) $\quad P_{Y\Delta} := 3 \cdot \dfrac{V_{LN}^2}{R + R_{\Delta Y}(R)} \qquad P_{Y\Delta} = 6.49 \ kW \qquad \dfrac{P_{Y\Delta}}{P_{\Delta p}} = 12.5 \ \% \qquad I_L(P_{Y\Delta}) = 18.01 \ A$