EE 228 Spring 2007

PROBLEM SET #31

#12.44

Step 1 $P_{Load,3P} = 12kW \quad Q_{Load,3P} = 5kVAR$

Step 2 $S_{Load,3P} = \sqrt{P_{Load,3P}^2 + Q_{Load,3P}^2} = 13kVA$

$$I_{L,Load} = \frac{S_{Load,3P}}{\sqrt{3}V_{L,Load}} = \frac{13kVA}{\sqrt{3}(240V)} = 31.27A$$

Step 3 $P_{cable,3P} = 3 I_{L,Load}^2 R_{cable} = 2.934kW$

$Q_{cable,3P} = 3 I_{L,Load}^2 X_{cable} = 8.802kVAR$

Step 4 $P_{source,3P} = P_{Load,3P} + P_{cable,3P} = 14.934kW$

$Q_{source,3P} = Q_{Load,3P} + Q_{cable,3P} = 13.802kVAR$

Step 5 $S_{source,3P} = \sqrt{P_{source,3P}^2 + Q_{source,3P}^2} = 20.335kVA$

Step 6 $$V_{L,source} = \frac{S_{source,3P}}{\sqrt{3}I_{L,Load}} = \underline{\underline{375.45V}}$$

Step 7 $$pf = \frac{P_{source,3P}}{S_{source,3P}} = \underline{\underline{0.734 \text{ leading}}}$$ since it supplies reactive power

#12.45

Step 1 $P_{Load,3P} = 450kW$ $S_{Load,3P} = \frac{P_{Load,3P}}{pF}$

$S_{Load,3P} = 635.59kVA$

$Q_{Load,3P} = \pm\sqrt{S_{Load,3P}^2 - P_{Load,3P}^2} = +448.86kVAR$

↑ since lagging

Step 2 $I_{L,Load} = \frac{S_{Load,3P}}{\sqrt{3}\, V_{L,Load}} = \frac{635.59kVA}{\sqrt{3}(440V)}$

$= 834A$

Step 3 $P_{cable,3P} = 3 I_{L,Load}^2 R_{cable} = 1.04mW$

$Q_{cable,3P} = 3 I_{L,Load}^2 X_{cable} = 4.17mVAR$

Step 4 $P_{source,3P} = P_{Load,3P} + P_{cable,3P} = 1.49mW$

$Q_{source,3P} = Q_{Load,3P} + Q_{cable,3P} = 4.619mVAR$

Step 5 $S_{source,3P} = \sqrt{P_{source,3P}^2 + Q_{source,3P}^2} = 4.853mVA$

Step 6 $V_{L,source} = \frac{S_{source,3P}}{\sqrt{3}\, I_{L,Load}} = \underline{\underline{3360V}}$

This result is ridiculous and underscores why we would place a transformer in this system!