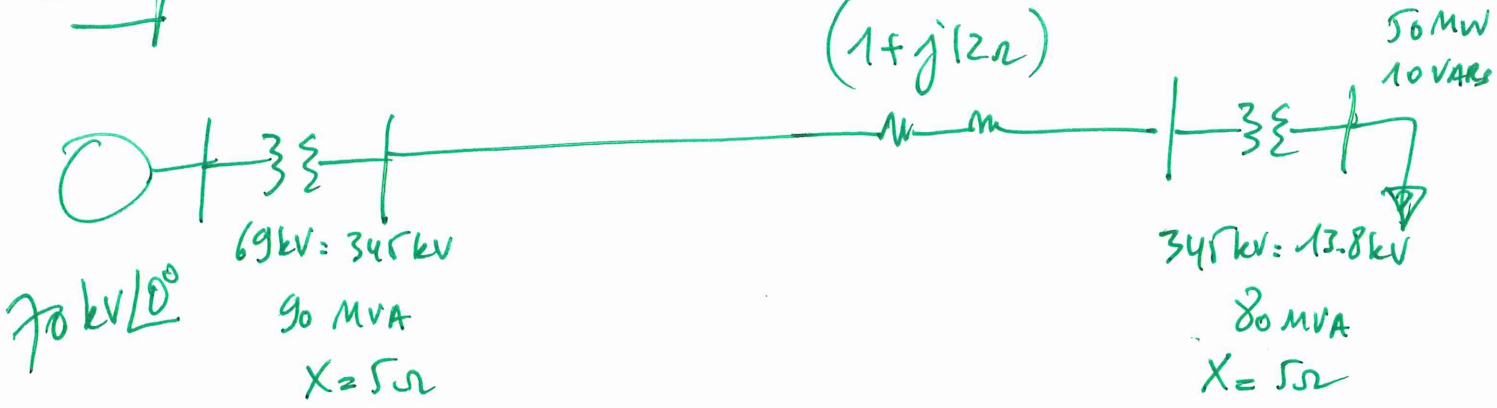
Per Unit analysis:

Advantages:

- Visual analysis of a large power system simplifies.
- Remove transformers to simplify circuit analysis.
- Historically reduced rounding errors on computers.

Example:



Session 16.

Per unit:

1/ Decide power S_{base}.

2/ Pick one voltage & calculate the voltages in the remaining zones.
(base)

3/ Each time you cross a transformer create a new zone.

$$\frac{V_{base\ zone1}}{V_{base\ zone2}} = \frac{N_1}{N_2}$$ turns ratio

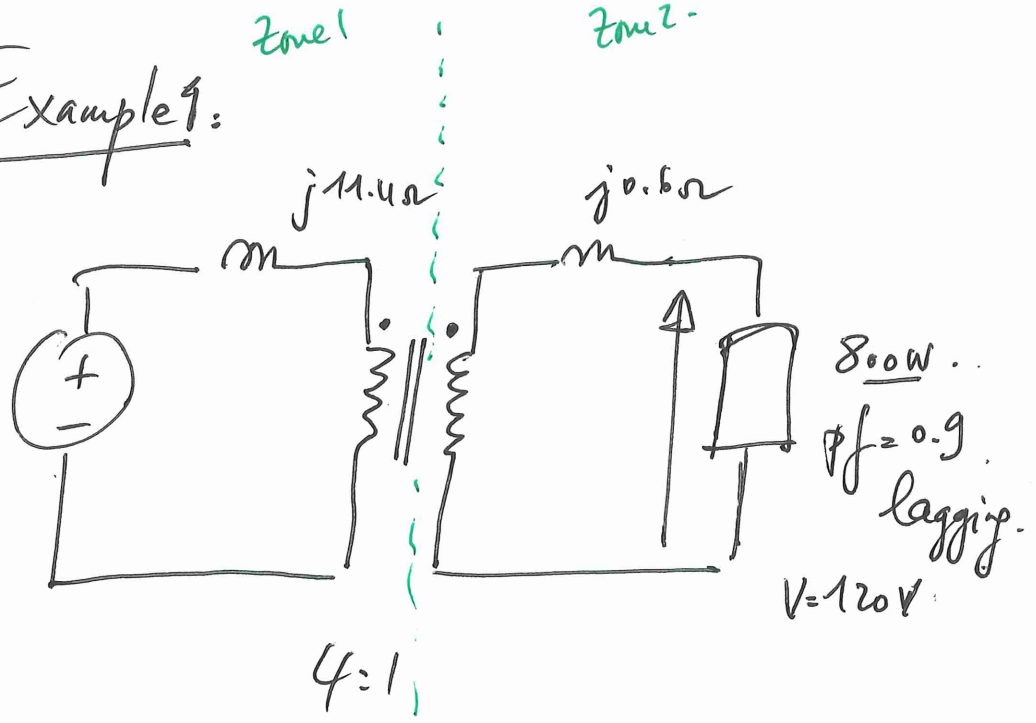
4/ Calculate Z_{base} in different zones.

4/ Change items in pu.

5/ Do circuit analysis.

6/ Change back if needed

Example 9:



Set up the pu equivalent circuit.

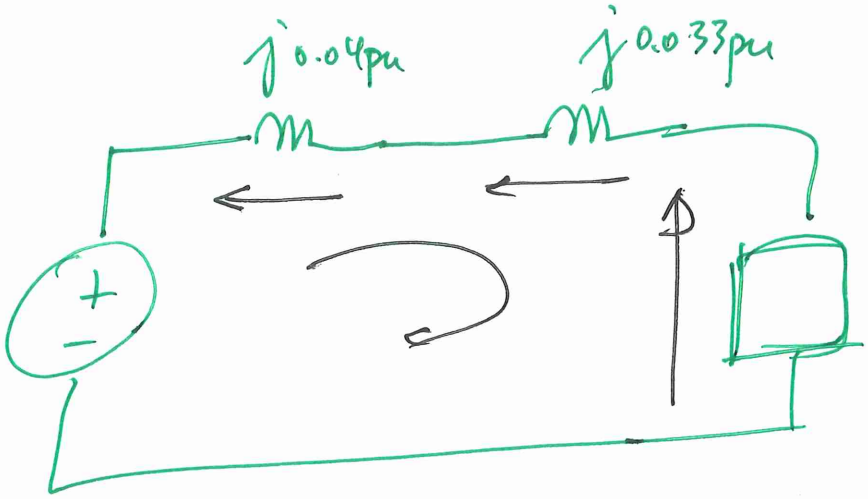
Solution:

$$\begin{cases} S_{BASE} = 800\ VA. \\ V_{base_2} = 120\ V \end{cases}$$

$V_{base_1} = 480\ V.$

$$\begin{cases} Z_{base_1} = \dfrac{(480V)^2}{800\ MVA} = 288\Omega. \\ Z_{base_2} = \dfrac{(120V)^2}{800MVA} = 18\Omega. \end{cases}$$

$$\begin{cases} jX_{1pu} = \dfrac{j11.4\Omega}{288\Omega} = j0.04pu. \\ jX_{2pu} = \dfrac{j0.6\Omega}{18\Omega} = j0.033pu. \end{cases}$$



$P = 1\,pu.$
pf = 0.9 lagging.
$V = 1\,pu$

$V = 1\,pu \angle 0°$

$\pm$

$$\bar{I} = \frac{1}{0.9} \angle -\cos^{-1}(0.9)$$

$$\bar{I} = 1.11 \angle -25°$$

$$\bar{V}_s = (1 \angle 0°) + j(0.073) \cdot 1.11 \angle -25°$$

$$\bar{V}_s = 1.037 \angle 4.1°$$