Prob 9a Power Systems Solution

a) Tie Flow

Area 1 Total Gen = $P_1 + P_2$ = 200+300 = 500 mw

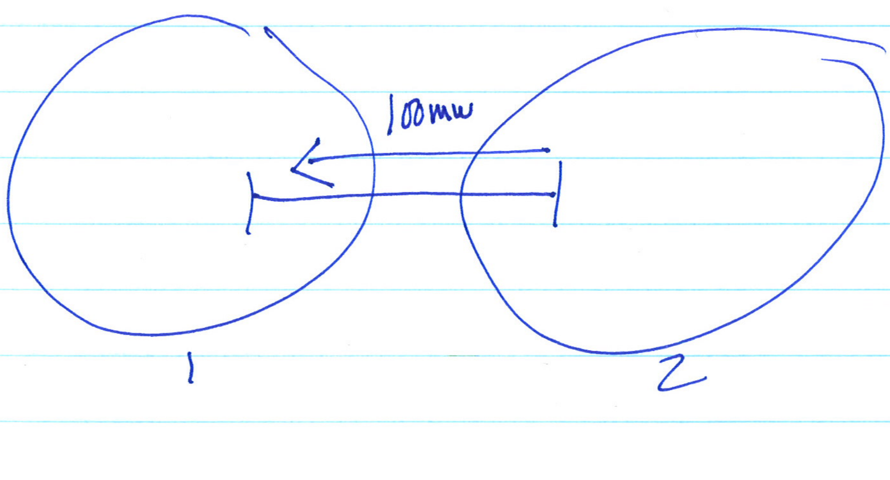
Area 1 Load = $L_1 + L_2$ = 550+50 = 600

Area 2 Gen = $P_3 + P_4$ = 300 + 300 = 600

Area 2 Load = $L_3 + L_4$ = 50 + 450 = 500

Area 1 has net deficit of 100 mw (gen < load)
Area 2 " " surplus " " " (gen > load)

Tie Flow is 100 mw area 2 to Area 1



Prob 9a Solution

b) Tie line Opened.

Area 1 has more load than Gen
so its Freq. will drop
| Load 2 will be dropped off. |

Area 2 has more gen than load
∴ so its Frequency will rise
| Load 3 will remain connected |

Result:

Area 1 $P_1 + P_2 = 500\text{MW}$
load $= L_1 = 550\text{ MW}$
Frequency will still be dropping.

Area 2 $P_3 + P_4 = 600\text{ MW}$
load $= L_3 + L_4 = 500\text{MW}$
Frequency is rising,

Area 1

$$\Delta P_{gen} = +50\text{MW} = \Delta P_1 + \Delta P_2$$

Switch ΔP's to pu. →

$$+50 = \left(\frac{-1}{R_1} + \frac{-1}{R_2}\right) \Delta f_1$$

$$\Delta f_1 = \frac{+.5}{-\left(\frac{1}{R_1} + \frac{1}{R_2}\right)} \quad (\Delta P \text{ in pu})$$

$$= \frac{.5}{-(10.66)} = -.0468\ \%$$

Prob 9a Solution

b) cont

Area 2

$$\Delta P_{gen} = \Delta P_3 + \Delta P_4 = -100 \text{ mw} = -1.0 \text{ pu}$$

$$-1.0 = \left(\frac{-1}{R_3} + \frac{-1}{R_4}\right)\Delta f_2$$

$$\Delta f_2 = \frac{1.0}{\left(\frac{1}{R_3} + \frac{1}{R_4}\right)} = \frac{1}{70} = .0142\ \%.$$

Final Generation:

$$\Delta P_1 = \frac{-1}{R_1}\left(\Delta f_1\right) = \frac{-1}{.15}\left(-.0468\%\right) = .3125 \text{ pu}$$

$$\Delta P_2 = \frac{-1}{R_2}\left(\Delta f_1\right) = \frac{-1}{.25}\left(-.0468\%\right) = .1872 \text{ pu}$$

net increase .5 pu

$$\Delta P_3 = -\frac{1}{R_3}\left(\Delta f_2\right) = \frac{-1}{.05}\left(.0142\%\right) = -.284 \text{ pu}$$

$$\Delta P_4 = -\frac{1}{R_4}\left(\Delta f_2\right) = \frac{-1}{.02}\left(.0142\%\right) = -.71 \text{ pu}$$

net decrease 1.0 pu

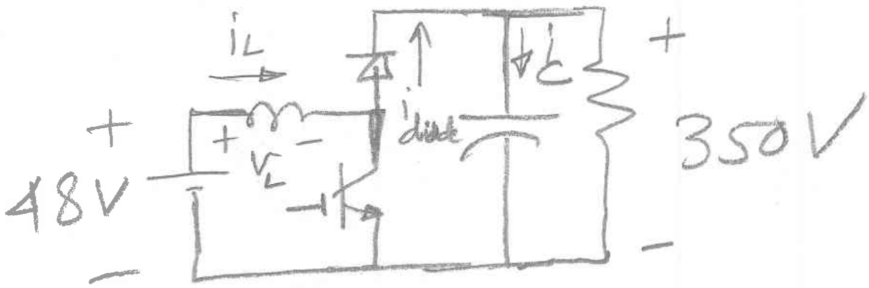
New Gen Values in MW

$P_1 = 200 + 31.25 = 231.5$ mw  $P_2 = 300 + 18.7 = 318.7$ mw

$P_3 = 300 - 28.4 = 271.6$  $P_4 = 300 - 71. = 229$ mw

# WPE Spring 2012

## Prob 9b Solution




$f_s = 200$ kHz, $T_s = 5\,\mu s$

$P_{max} = 120$ W  $P_{max}/3 = 40$ W

@ $P_{max}$: $I_{in} = \frac{120}{48} = 2.5$ A

$I_o = \frac{120}{350} = 0.3529$ A

(a) @ $P_o = \frac{P_{max}}{3} = 40$ W

$I_{L_{avg}} = I_{in} = \frac{40}{48V} = 0.833$ A

$I_{p-p} = 2 \times I_{L_{avg}} = 2 \times 0.833 = 1.666$ A

$\frac{V_o}{V_{in}} = \frac{1}{1-D} = \frac{350}{48} \Rightarrow D = 0.8629$

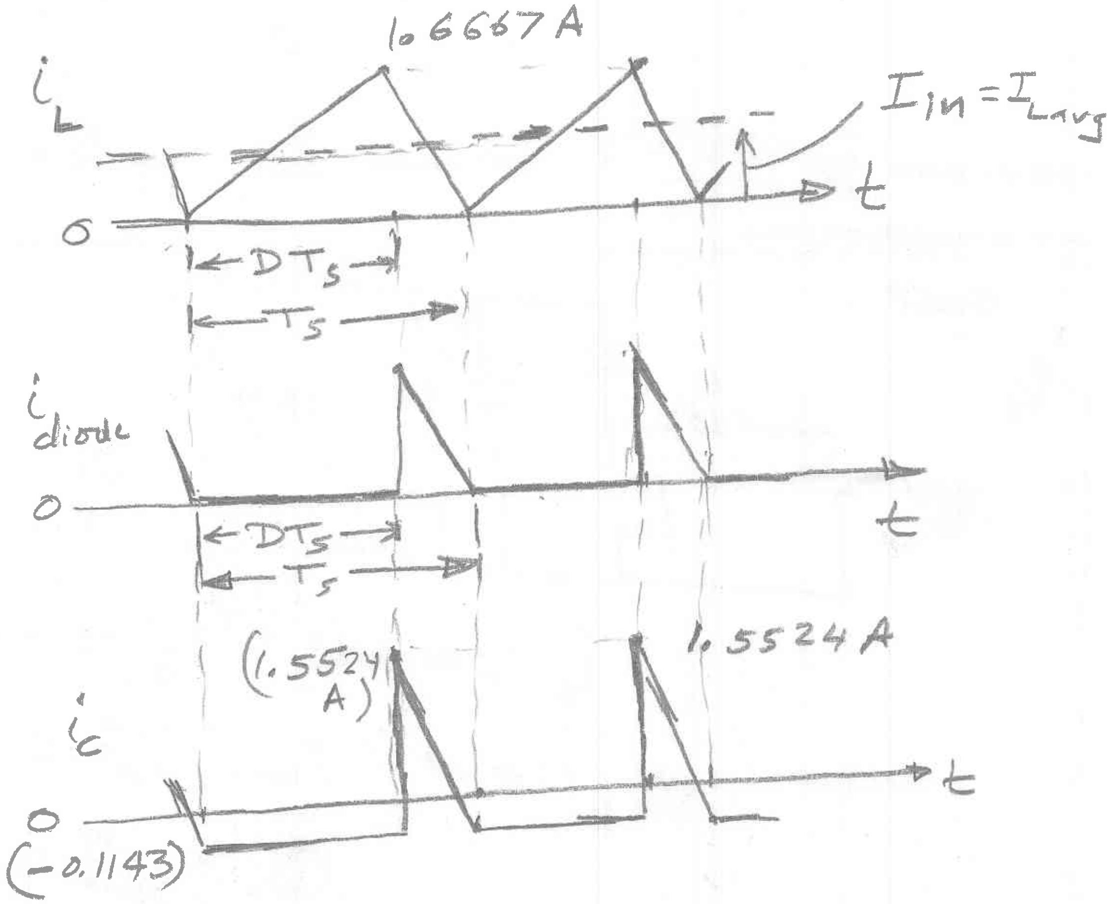
$L \frac{\Delta I}{\Delta T} = V \quad \therefore L = \frac{V_{in} D T_s}{I_{p-p}}$

$= \frac{48 \times 0.8629 \times 5}{1.666}\ \mu H$

$= 124.31\ \mu H$

$I_o = \frac{40W}{350V} = 0.1143$ A

(b)




$$I_{C,peak} = I_{diode,peak} - I_o$$
$$= 1.6667 - 0.1143$$
$$= 1.5524\ A$$