

HW9

Tuesday, November 18, 2025 2:07 PM

6.1

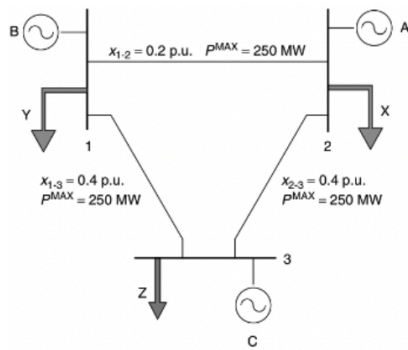


Figure P6.1 Three-bus power system for Problem 6.1

Sample set

B → Z (600 MW)

$$F_{1-2} = 60 \times \left(\frac{0.4}{1}\right) = 240$$

$$F_{1-3}^B = 600 \times \left(\frac{0.6}{1}\right) = 360$$

A → Z (200 MW)

$$F_{2-3}^A = \frac{0.4}{1} \times 200 = 80 \text{ MW}$$

$$F_{2-3}^A = \frac{0.6}{1} \times 200 = 120 \text{ MW}$$

$$F_{1-2} = 240 - 160 - 80 = 0 \text{ MW}$$

$$F_{1-3} = 360 + 80 - 40 = 400 \text{ MW}$$

$$F_{2-3} = 240 + 120 + 40 = 400 \text{ MW}$$

excess 250 MW

NOT FEASIBLE

	F_{1-2} (MW)	F_{1-3} (MW)	F_{2-3} (MW)	Feasible?
Set 1	-120	20	80	Yes
Set 2	0	400	400	No
Set 3	80	-180	-220	Yes

6.2

a) Line Disconnected:

$$P_A = 2000 \text{ MW}, P_B = 1000 \text{ MW}$$

$$\pi_A = 20 + 0.03(2000) = \$80/\text{MWh}$$

$$\pi_B = 15 + 0.02(1000) = \$35/\text{MWh}$$

$$\text{Flow AB} = 0 \text{ MW} \text{ — DISCONNECTED}$$

b) Line connected, unlimited capacity.

$$MCA = MCB$$

$$20 + 0.03(3000 - P_B) = 15 + 0.02 P_B$$

$$P_B = 1900 \text{ MW}$$

$$P_A = 3000 - 1900 = 1100 \text{ MW}$$

$$\pi_A = \pi_B = 15 + 0.02(1900) = \$53/\text{MWh}$$

$$\text{Flow}_{AB} \rightarrow 1100 - 2000 = -900 \text{ MW}$$

c) Line unlimited, max $P_A = 1500 \text{ MW}$

$$P_A = P_B = 1500 \text{ MW}$$

$$\pi_A = \pi_B = 20 + 0.03(1500) = \$65/\text{MWh}$$

$$\text{Flow}_{AB} = 1500 - 2000 = -500 \text{ MW}$$

d) $P_A = 900 \text{ MW}$, $P_B = 2100 \text{ MW}$

$$\pi_A = \pi_B = 15 + 0.02(2100) = \$57/\text{MWh}$$

$$\text{Flow}_{AB} = 900 - 2000 = -1100 \text{ MW}$$

e) $F_{AB} = -600 \text{ MW (max)}$

$$F_{AB} = P_A - D_A \rightarrow -600 = P_A - 2000$$

$$P_A = 1400 \text{ MW}, P_B = 1600 \text{ MW}$$

$$\pi_A = 20 + 0.03(1400) = \$62/\text{MWh}$$

$$\pi_B = 15 + 0.02(1600) = \$47/\text{MWh}$$

$$\text{Flow}_{AB} = -600 \text{ MW}$$

6.3

consumer payments

$$*E_A = D_A \cdot \pi_A = 2000 \cdot \pi_A$$

$$*E_B = D_B \cdot \pi_B = 1000 \cdot \pi_B$$

Gen Rev:

$$*A \rightarrow R_A = D_A \cdot \pi_A$$

$$*B \rightarrow R_B = P_B \cdot \pi_B$$

doing part A from 6.2

$$E_A(\$) = 2000 \times 80 = 160000$$

$$E_B(\$) = 1000 \times 35 = 35000$$

✓ 12.71

$$R_A(\$) = 2000 \times 80 = 160\,000$$

$$R_B(\$) = 1000 \times 35 = 35\,000$$

* Typo in Book

gen at B and demand at A
benefit from the line, as price at B increases
and lowers at A

Case:	a	b	c	d	e
E_A (\$)	160 000	106 000	130 000	114 000	124 000
E_B (\$)	35 000	53 000	65 000	57 000	47 000
R_A (\$)	160 000	58 300	97 500	51 300	86 800
R_B (\$)	35 000	100 700	97 500	62 700 119 700	75 200

6.4

$$\text{Flow} = 600 \text{ MW } (B \rightarrow A)$$

$$\pi_A (\text{price receiving}) = \$62 / \text{MWh}$$

$$\pi_B (\text{price sending}) = \$47 / \text{MWh}$$

Surplus

$$600 (62 - 47) = \$9\,000$$

congestion surplus is 0 when flow is 0.

