EE 585 (Power System Operation and Control)

Quiz 2 Solution

A power system consists of 2 plants having the following fuel-costs:

$$FC_1 = 30 + 18P_1 + 0.035P_1^2$$

$$FC_2 = 32 + 22P_2 + 0.025P_2^2$$

The total power losses in the system is given by:

$$P_{Loss} = 5 \times 10^{-5} P_1^2 \quad \text{MW}$$

Assume P_1 = 500 MW for economic operation. Determine P_2 and P_T.

Solution:

The condition for economic operation is

$$IFC_1 = \lambda(1 - \frac{\partial P_{Loss}}{\partial P_1})$$

$$IFC_2 = \lambda(1 - \frac{\partial P_{Loss}}{\partial P_2})$$

Therefore,

$$18 + 0.07P_1 = \lambda(1 - 10^{-4} P_1)$$

$$22 + 0.05P_2 = \lambda(1 - 0)$$

Substituting P_1=500 MW,

$$18 + 35 = \lambda(1 - 0.05) \qquad (1)$$

$$22 + 0.05P_2 = \lambda(1 - 0) \qquad (2)$$

From (1) $\lambda = \dfrac{53}{0.95} = 55.8$

From (2) $P_2 = \dfrac{55.8 - 22}{0.05} = 676\,\text{MW}$

$P_T = P_1 + P_2 - P_{Loss} = 500 + 676 - 12.5 = 1163.5\ \text{MW}$