UNIT - 4.

Economic Load Dispatch & Unit Commitment:

① The fuel cost of two units are given by, $F_1 = 1.6 + 25\, P_{G1} + 0.1\, P_{G1}^2$ Rs/hr

$F_2 = 2.1 + 32\, P_{G2} + 0.1\, P_{G2}^2$ Rs/hr

If the total demand on generators is 250 MW, find the economic load scheduling of the two units.

$$\lambda_1 = \frac{dF_1}{dP_{G1}} = 25 + 2\times 0.1 P_{G1}$$

$$\lambda_2 = \frac{dF_2}{dP_{G2}} = 32 + 2\times 0.1\, P_{G2}$$

$$\lambda_1 = \lambda_2$$

$$25 + 2\times 0.\cancel{1} P_{G1} = 32 + 0.2\, P_{G2}$$

$$0.2 P_{G1} - 0.2 P_{G2} = 7 \quad \text{—} ①$$

$$P_{G1} + P_{G2} = 250 \quad \text{—} ②$$

$P_{G1} = 142.5$ MW

$P_{G2} = 107.5$ MW.

$$\lambda = \frac{P_D + \sum_{i=1}^{N} \frac{b_i}{2a_i}}{\sum_{i=1}^{N} \frac{1}{2a_i}}$$

$$= \frac{250 + \left[\frac{25}{2(0.1)} + \frac{32}{2(0.1)}\right]}{\frac{1}{0.2} + \frac{1}{0.2}}$$

$$= 53.5$$

$$P_{G1} = \frac{\lambda - b_1}{2a_1} = \frac{53.5 - 25}{2(0.1)} = 142.5 \text{MW}$$

$$P_{G2} = \frac{\lambda - b_2}{2a_2} = \frac{53.5 - 32}{0.2} = 107.5 \text{ M}$$

$$P_{G1} + P_{G2} = 250 \text{ MW.}$$

Solution by λ - iteration method without loss.

case i) Operating limits for power generation are not specified.

Step 1.

$$\lambda = \frac{P_D + \sum_{i=1}^{N} \frac{b_i}{2a_i}}{\sum_{i=1}^{N} \frac{1}{2a_i}}$$

Step 2. Compute P_{Gi} corresponding to λ

$$P_{Gi} = \frac{\lambda - b_i}{2a_i} \quad ; \; i = 1, 2, \ldots N.$$

Step 3 Compute $\sum_{i=1}^{N} P_{Gi}$

Step 4. check $\sum_{i=1}^{N} P_{Gi} = P_D$

Then power balance is satisfied

Step 5 $\sum_{i=1}^{N} P_{Gi} < P_D$ increment λ & Step 2

$\lambda = \lambda + \Delta\lambda$

$\sum_{i=1}^{N} P_{Gi} > P_D$ decrement λ & Step 2.

$\lambda = \lambda - \Delta\lambda$

$$\Delta\lambda = \frac{\Delta P}{\sum_{i=1}^{N} \frac{1}{2a_i}}$$ ΔP is change in demand

Problem 2

(2) A power plant has three units with the following cost characteristics

$$C_1 = 0.05 P_{G1}^2 + 23.5 P_{G1} + 700 \text{ Rs/hr}$$

$$C_2 = 0.2 P_{G2}^2 + 20 P_{G2} + 850 \text{ Rs/hr}$$

$$C_3 = 0.09 P_{G3}^2 + 18 P_{G3} + 960 \text{ Rs/hr}$$

Maximum & minimum loading available on each unit are 150 MW & 40 MW. Find the optimal scheduling for a load of 275 MW.

$$\lambda = \frac{P_D + \sum_{i=1}^{N} \frac{b_i}{2a_i}}{\sum_{i=1}^{N} \frac{1}{2a_i}}$$

$$\lambda = \frac{275 + \left[\frac{23.5}{2\times 0.05} + \frac{20}{2\times 0.2} + \frac{18}{2\times 0.09}\right]}{\left[\frac{1}{2\times 0.05} + \frac{1}{2\times 0.2} + \frac{1}{2\times 0.09}\right]}$$

$$\boxed{\lambda = 36.55}$$

$$P_{g1} = \frac{\lambda - b_1}{2a_1} = \frac{36.55 - 23.5}{2 \times 0.05}$$

$$= 130.5 \text{ MW}$$

$$P_{g2} = \frac{\lambda - b_2}{2a_2} = \frac{36.55 - 29}{2 \times 0.2}$$

$$= 41.375 \text{ MW}$$

$$P_{g3} = \frac{\lambda - b_3}{2a_3} = \frac{36.55 - 18}{2 \times 0.09}$$

$$= 103.055 \text{ MW}$$

$40 < P_{g1} < 150.$

$40 < P_{g2} < 150$

$40 < P_{g3} < 150.$

$C_1 =$

$C_2 =$

$C_3 =$