Economics

Hydrothermal Coordination
Optimal Power-flow

1

Optimization

Minimize total costs (minimize losses)

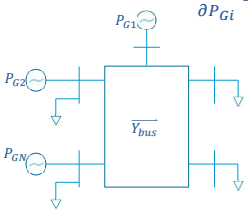
- Generation costs – Economic dispatch
  - Lossless and lossy formulations
- Optimal power-flow
- Hydrothermal coordination

2

Economic dispatch

$$f_i = \frac{a_i}{2} P_{Gi}{}^2 + b_i P_{Gi} + c_i \quad (\$/h)$$

$$\frac{\partial f_i}{\partial P_{Gi}} = IC_i = a_i P_{Gi} + b_i \quad (\$/MWh)$$



How to change $P_{G1}, \ldots, P_{GN}$ so that the generation meets the demand plus losses

3

Optimal power-flow

$$\textbf{\textit{Minimize}} \quad \sum_{i=1}^{N} f_i(P_{Gi})$$

$$P_{Gi},\ i=1,\ldots N_G+1$$

subject to:

$$P_{Gi} - P_{Li} - \sum_{j=1}^{N} Y_{ij}\, V_i\, V_j\, cos\left(\delta_i - \delta_j - \theta_{ij}\right) = 0$$

$$Q_{Gi} - Q_{Li} - \sum_{j=1}^{N} Y_{ij}\, V_i\, V_j\, sin\left(\delta_i - \delta_j - \theta_{ij}\right) = 0$$

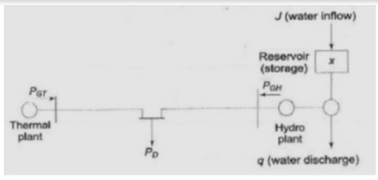
$$P_{Gi,min} < P_{Gi} < P_{Gi,max}$$

$$V_{i,min} < V_i < V_{i,max}$$

$$I_{ij,min} < I_{ij} < I_{ij,max}$$

4

Hydrothermal coordination

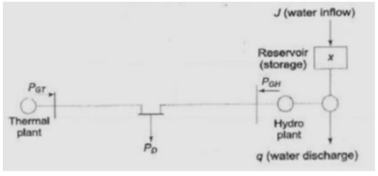


Hydro plant generation $P_{GH}(q,x)$ depends on q and reservoir water level x.

dx/dt = J - q

5

Hydrothermal coordination



Min $f(P_{GT})$ over a season
while meeting constraints on q and x, and
making sure that $P_{GT}+P_{GH} = P_D$.

6