SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

19EEB302/ POWER SYSTEMS – II

III YEAR / VI SEMESTER

UNIT-III : UNIT COMMITMENT AND ECONOMIC DISPATCH

CONSTRAINTS IN UNIT COMMITMENT

Objective Function

- Minimization of Total Cost including:
  - Fuel Cost

$$FC_i(P_i(t)) = A_i + B_i P_i(t) + C_i P_i^2(t)$$

  - Startup Cost
  - Shutdown Cost

$$SU_i(t) = \begin{cases} 0 & \text{if } u_i(t-1) = u_i(t) \\ H\,\text{cost}_i & \text{if } X_i^{OFF}(t-1) \le Chour_i \\ C\,\text{cost}_i & \text{if } X_i^{OFF}(t-1) > Chour_i \end{cases}$$

    - Shutdown Cost is Constant and is zero in Typical Systems
- Total Cost

$$TC = \sum_{t=1}^{H} \sum_{i=1}^{N} \{FC_i(P_i(t)) + SD_i(t) + SU_i(t)\}$$

Constraints

Definition:

Constraint is limitations in power system avoiding it cause serious problem.

This limitation can be technical for unit or technical limitation for power system or can be environmental limitations.

We can classified into

- **Unit constraints.**
- **System constraints.**
- **Environmental constraints.**
- **Network constraints.**
- **Cost constraints.**

Unit commitment constraints

- **Unit constraint :**

1. Maximum generating capacity.
2. Minimum stable generation.
3. Minimum up time.
4. Minimum down time.
5. Ramp rates.
    1. Ramp up rate.
    2. Ramp down rate.
    3. Start-up ramp rate.
    4. Shut down ramp rate
    5. Running-up ramp rate
    6. Running down ramp rate.

Unit commitment constraints

- **System constraints:**
  - 1- Load / generation balance / system power balance.
  - 2- Spinning reserve constraint.
- **Network constraint:**
- **Environmental constraint:**
- **Cost constrain:**
  - 1- Start-up cost.
  - 2- Running cost.

Unit commitment constraints

- **Maximum generating capacity:**

That constraint state that the power generated from the unit must not exceed specific value because of thermal stability of the unit exceeding this constraint cause damage to the unit.

Mathematical formula.

$$X(i,t) < P\ max$$

X (i,t) is the output power of the unit i, in the time t.

- **Minimum stable generation:**

As the above constraint the power outage from the unit must not fall down specific value because of technical limitation like flame stability in the gas and steam units.

Mathematical formula.

$$X(i,t) > P\ min$$

The maximum and minimum generated power of each scheduled unit must not be exceeded

$$p\ min < X(i,t) < p\ max$$

Unit commitment constraints

- **Minimum up time:**

This constraint state that once the unit is running must not shunt down immediately due technical limitation and mechanical characteristic of the unit.

Mathematical formula:

$$\text{If } u(i,t)=1 \text{ and } t_i^{up} < t_i^{up,\min} \text{ then } u(i,t+1)=1$$

Where

u(i, t) : status of unit i at period t.

u(i, t) = 1 unit i is ON during period t.

u(i, t) = 0 unit i is Off during period t.

Unit commitment constraints

Minimum down time:

This constrain state that once the unit is running must not shunt down immediately due technical limitation and mechanical characteristic of the unit.

$$\text{If } u(i,t)=0 \text{ and } t_i^{down} < t_i^{down,\min} \text{ then } u(i,t+1)=0$$

Ramp rates:

Definition:

To avoid damaging the turbine, the electrical output of a unit cannot change by more than a certain amount over a period of time.

RECAP….

…THANK YOU