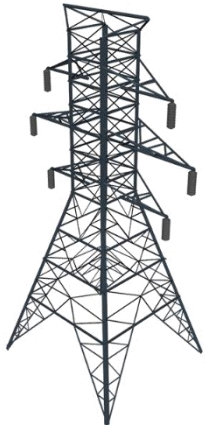
# SNS COLLEGE OF TECHNOLOGY

**(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**

# UNIT III: SPEED GOVERNING AND AUTOMATIC GENERATION

## TOPIC:LFC & ALFC



# Load Frequency Control

# Contents

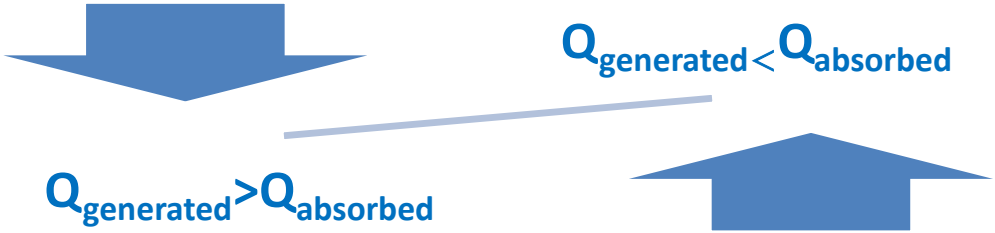
- What is Power System Control
- AVR & ALFC
- How?
- Primary & Secondary ALFC

# Power System Control

- **Maintaining Perfect Power Balance**
- The main bifurcation between frequency and voltage in power system is on the account of active and reactive power.
- The dependency of frequency is on active power whereas that of voltage is on the reactive power.
- In order to perform voltage and frequency control, usually Alternators will have two control loops namely:
  - **Automatic voltage regulator loop (AVR)**
  - **Automatic load frequency control loop (ALFC)**

# Automatic Voltage Regulator (AVR)

- It controls the magnitude of terminal voltage, |V|.
- Variation in voltage depends on **load and load p.f**

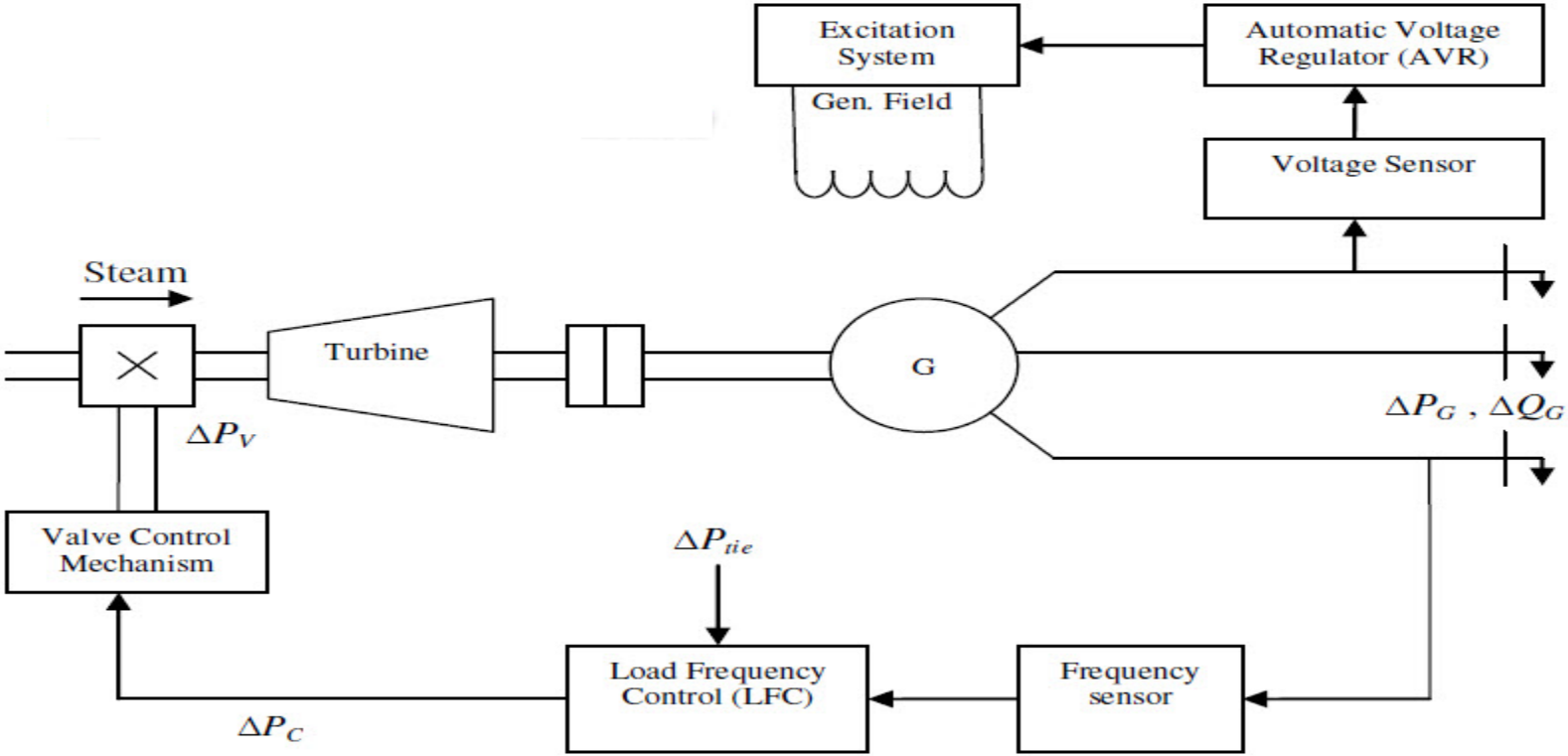


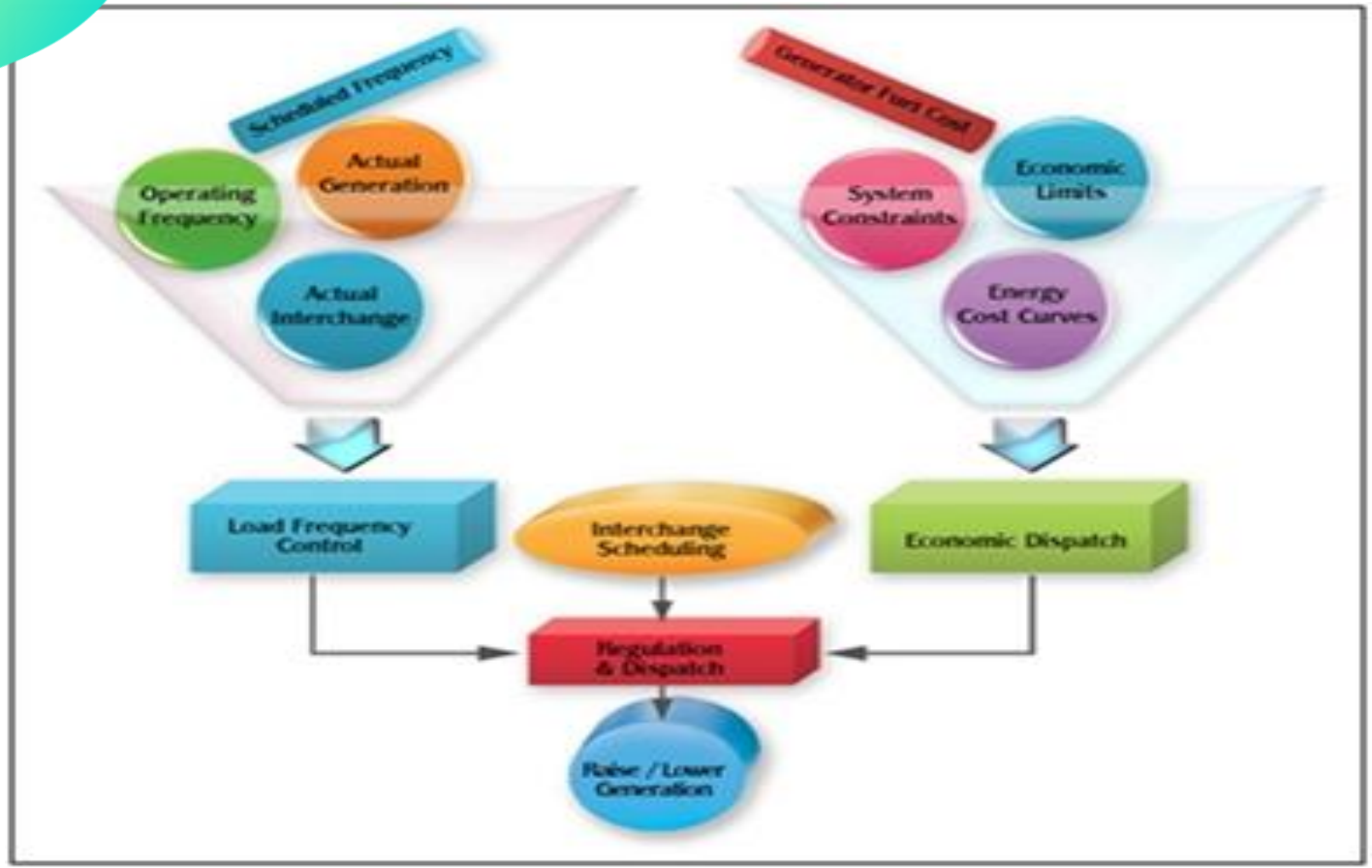

- **Excitation Control**
  - The strength of this dc signal, being proportional to |V|, is compared with a dc reference |V|ref.
  - The resulting “error voltage” after amplification and signal shaping, serves as input to the exciter, which applies the required voltage to the generator field winding, so the generator terminal voltage |V| reaches the value |V|ref.

# Automatic Load Frequency Loop (ALFC)

- **combination of active power and frequency control (P~f) is generally known as Load Frequency Control.**
- Maintaining frequency constant and Regulation of tie line power exchanger error
- **Frequency depends on speed**
- **Speed Governing system**: input to tur[illegible] is controlled

# AVR and ALFC Loop




Scheduled Frequency
Actual Generation
Operating Frequency
Actual Interchange
Generation Fuel Cost
Economic Limits
System Constraints
Energy Cost Curves
Load Frequency Control
Interchange Scheduling
Economic Dispatch
Regulation & Dispatch
Raise / Lower Generation

# How?

- **step 1: in the LFC is to form the area control error (ACE) that is defined as**

$$ACE = (P_{tie} - P_{sch}) - 10B_f (f_a - f_s) = \Delta P_{tie} - 10B_f \Delta f$$

**where $P_{tie}$ and $P_{sch}$ are tie-line power** and **scheduled power through tie-line respectively and the constant $B_f$ is called the frequency bias constant**

- **Step 2: The change in the reference of the power setting $\Delta P_{ref,i}$, of the area- *i* is then obtained by the feedback of the ACE through an integral controller of the form**

$$\Delta P_{ref,i} = -K_i \int ACE\, dt$$

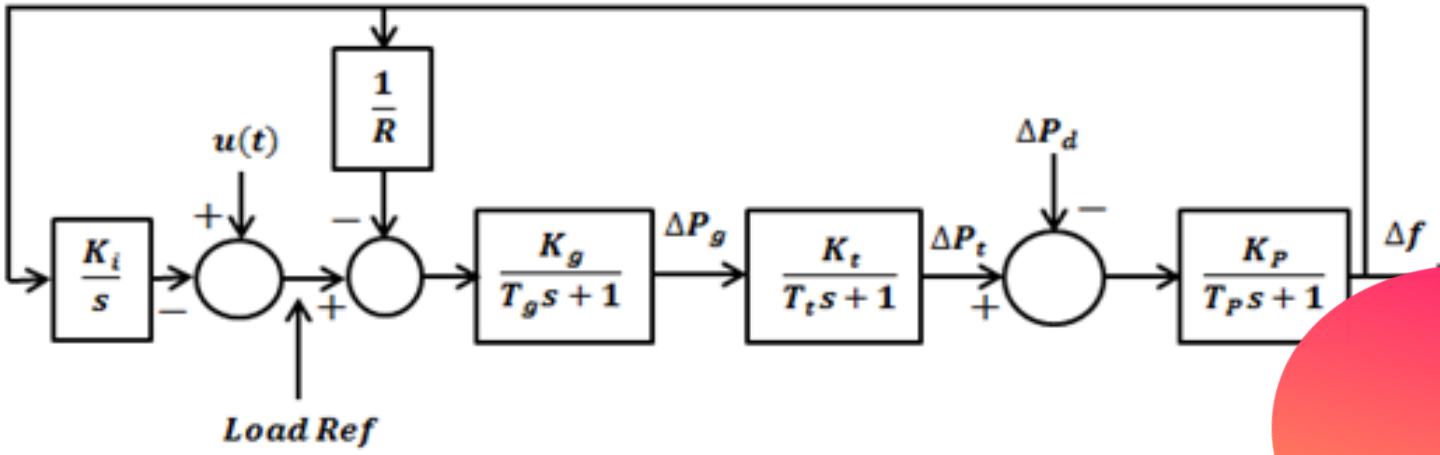
**where $K_i$ is the integral gain.**

$$\Delta P_{ref,i} = -K_i \int ACE\, dt$$

- The ACE is negative if the net power flow out of an area is low or if the frequency has dropped or both. In this case the generation must be increased.
- This can be achieved by increasing $\Delta P_{ref,\,i}$.

- This negative sign accounts for this inverse relation between $\Delta P_{ref,\,i}$ and ACE. The tie-line power flow and frequency of each area are monitored in its control center. Once the ACE is computed and $\Delta P_{ref,\,i}$ is obtained commands are given to various turbine-generator controls to adjust their reference power settings.

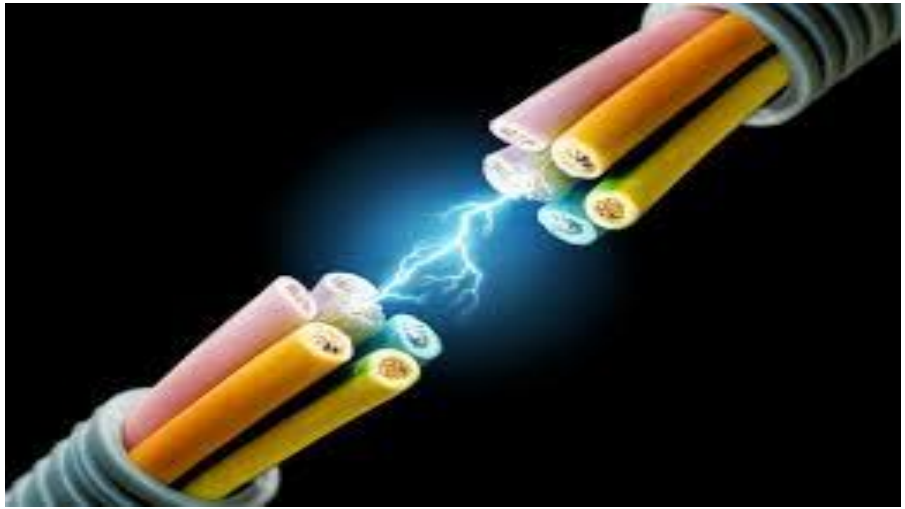
# Primary & Secondary ALFC Loop




Secondary ALFC Loop

Primary ALFC Loop

# RECAP….



# …THANK YOU