Notes:

(13-Feb-2024)

- **Power System:** *Generation → Transmission → Distribution → Consumption*
- **Types of transformers:**
  - Power transformers (*3-phase*) and distribution transformers (*single and 3-phase*)
  - Instrument transformers, Autotransformers, Isolation transformers, etc.

A. High Voltage AC Transmission (HVAC): High Voltage Direct Current (HVDC) technology is commonly used as a method to isolate two independent Alternating Current (AC) power grids while permitting the exchange of power between both AC grids**.**

- *Transmitting large amounts of power over long distances.*
- *Ability to transmit a greater amount of power versus AC-based transmission systems with the same conductor size.*
- *Transmitting power between asynchronous systems.*
- *Enabling stronger, smarter, and more flexible grids by controlling power flow.*
- *HVAC remains the primary medium for general transmission and distribution of electrical energy, however, HVDC has proven to be an economic medium of power transmission in different applications such as for a long distance overland overhead line transmission (above 800 km), Long submarine cable crossings (up to 80 km), and Interconnections between asynchronous networks.*

a. Types of Losses:

i. Ohmic Losses (I^2R *loss*)
ii. Loss due to the Skin Effect
iii. Loss due to the Proximity Effect
iv. Corona Loss

b. Classification based on Voltage Level:

Types	Voltage Levels
• **High Voltage**	35kV to 220kV
• **Extra High Voltage**	330kV to 1000kV
• **Ultra-High Voltage**	Above 1000kV

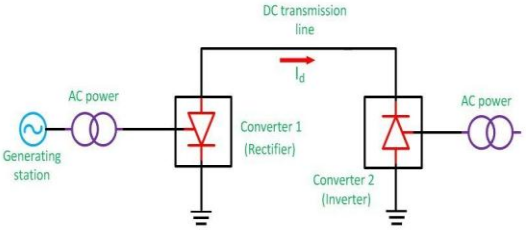
c. Length of Transmission Lines:

i. Short Transmission lines (< *80km*)
ii. Medium Transmission lines (*80km to 280km*)
iii. Long Transmission lines (*>280 Km*)

B. **High Voltage DC Transmission (HVDC)**

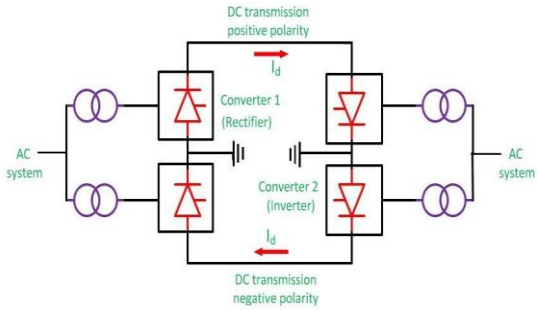
Types of HVDC Links:

- Monopolar link
- Bipolar link
- Homopolar link



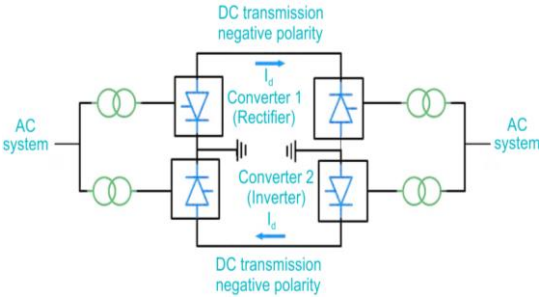
C. Types of Conductors Used for Power Transmission

a. Copper
b. Aluminum
c. AAC (All Aluminum Conductors)
d. AAAC (All Aluminum Alloy Conductors)
e. Silver
f. ACAR (Aluminum Conductors Steel Reinforced)
g. Gold



D. Qualities of Overhead Power Conductors

- High Electrical Conductivity
- High mechanical strength
- High Tensile strength
- Low Thermal TCR
- Low Thermal Expansion
- Light Weight
- Economical



E. Components of Power System:

a. Generation Plant

i. Centralized:

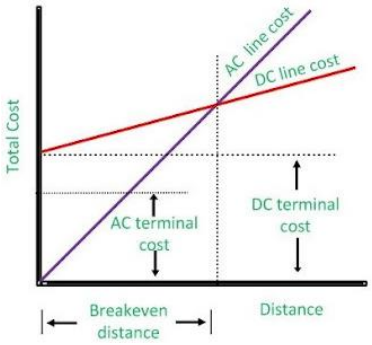
1. Hydroelectric power plant
2. Thermoelectric power plant

- Gas power plant
- Wind power plant
- Nuclear power plant

3. Nuclear power plant
4. Geothermal power plant
5. Tidal power plant
6. Biomass power plant

ii. Decentralized (Distributed Energy Resources):

1. Solar plant
    a. Islanding mode
    b. On-grid mode
2. Wind plant
3. Mini hydro
4. **Storage Technologies**
    a. Lead acid batteries
    b. Li-Ion batteries
    c. Flow batteries
    d. Fuel cells
    e. Li-Ion batteries
    f. Solid state batteries



b. Power Transformers:
    i. Step-up power transformer
    ii. Step-down power transformer

c. Transmission System

d. Switchgear
    i. Busbars
    ii. Fuses
    iii. Isolators
    iv. Lightning Arresters
    v. Protection Relays
    vi. Contactors
    vii. Circuit Breakers (CBs)

High voltage rating	**Low voltage rating**
• Vacuum Circuit breaker (VCB) • SF_6 Circuit breaker • Air break Circuit breaker (ACB) • Air blast Circuit breaker (ABCB) • Oil Circuit breaker	• Miniature Circuit breaker (MCB) • Molded Case Circuit Breaker (MCCB) • Residual Current Circuit Breaker (RCCB) • Earth-leakage Circuit breaker (ELCB) • Residual Current Circuit Breaker with Overcurrent Protection (RCBO)

    viii. Instrument transformers
        1. Current transformers and
        2. Potential transformer

e. Substations

f. Step-down Distribution transformers
    i. Primary distribution (11kV)
    ii. Secondary distribution (415V/ 220V)

g. Metering
    i. Smart meters
    ii. Energy meters and
    iii. Net meters