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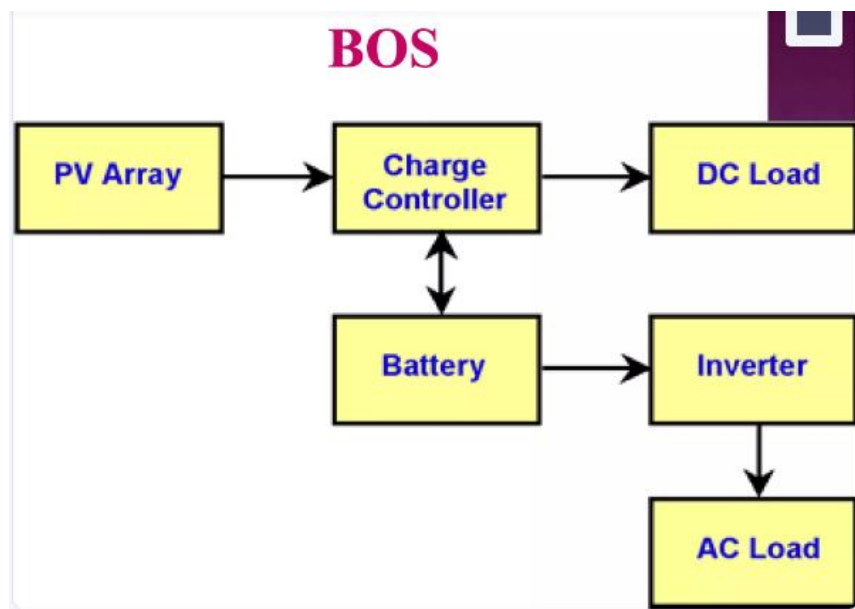
DEPARTMENT OF MECHANICAL ENGINEERING

19MEZ402 Solar Photovoltaics Fundamentals And Technology

UNIT 2-STAND ALONE PV SYSTEMS

Balance of system components for DC and/or AC Applications

In a stand-alone PV system, the "Balance of System" (BOS) components are everything in the system except the PV panels themselves. These components are crucial for ensuring the safe and efficient operation of the system, whether it's designed for DC, AC, or a combination of both applications.



Balance of System (BOS) Components for DC Applications

1. Charge Controller:

- Regulates the voltage and current from the solar panels to the battery.
- Ensures batteries are not overcharged and optimizes energy transfer (especially in MPPT controllers).

2. Battery Bank:

- Stores energy generated by the PV system for use during periods without sunlight.
- Typically designed to supply power directly to DC loads.

3. DC-DC Converter (Optional):

- Used if different DC voltages are required for various DC loads.

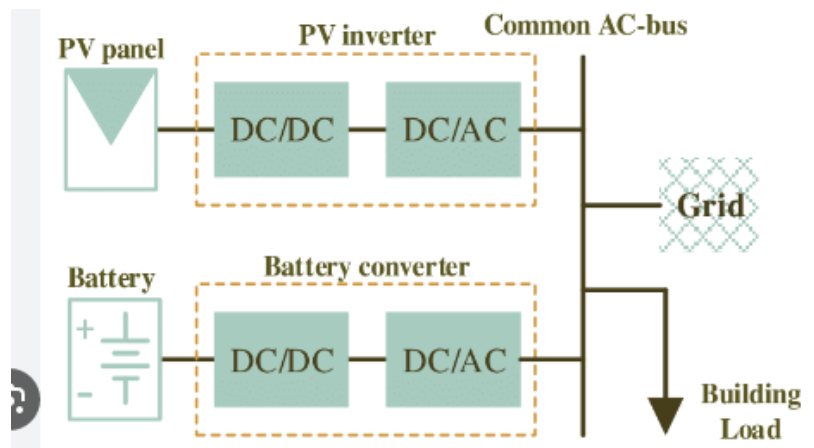
- Ensures voltage levels match the requirements of the appliances.
4. **DC Load:**
 - Appliances and devices that operate directly on DC power (e.g., LED lights, DC fans, some DC refrigerators).
 5. **Wiring and Connectors:**
 - Must be appropriately rated for the current and voltage levels of the system.
 - Includes DC-rated circuit breakers and fuses for protection.
 6. **Battery Management System (BMS):**
 - Critical for monitoring and managing the health of the battery bank, particularly for lithium-ion batteries.
 - Balances charge across cells, protects against overcharging, and monitors temperature.
 7. **Fuse Box/Distribution Box:**
 - A centralized location for all DC circuit protection.
 - Allows for easier maintenance and troubleshooting.

Balance of System (BOS) Components for AC Applications

1. **Inverter:**
 - Converts the DC power stored in the battery bank into AC power.
 - Different types include pure sine wave (for sensitive electronics) and modified sine wave inverters.
2. **AC Load:**
 - Appliances and devices that require AC power (e.g., refrigerators, air conditioners, televisions).
3. **AC Disconnect:**
 - A switch that allows for the isolation of the inverter from the AC loads.
 - Important for maintenance and in case of an emergency.
4. **Wiring and Connectors:**
 - AC wiring should be appropriately rated for the voltage and current.
 - Includes AC-rated circuit breakers and fuses for protection.
5. **Surge Protection Device (SPD):**
 - Protects the AC system from voltage spikes and surges, which can damage sensitive equipment.
6. **Grounding System:**
 - Ensures safety by providing a path to ground for any stray currents or faults.
 - Critical for both DC and AC systems to protect against electrical hazards.
7. **AC Distribution Board (Consumer Unit):**

- Centralized panel that distributes AC power to various loads.
- Includes circuit breakers and sometimes residual current devices (RCDs) for safety.

Combined DC and AC Applications



In many stand-alone PV systems, both DC and AC loads may need to be supported. In such cases, the system would include:

1. Hybrid Inverter (or Separate Inverter and Charge Controller):

- A hybrid inverter can handle both the conversion from DC to AC and manage battery charging.
- Alternatively, separate components might be used: a charge controller for the battery and a standalone inverter for AC loads.

2. Dual Busbars:

- One for DC distribution and another for AC distribution.
- Ensures proper segregation and safety of different voltage types.

3. Energy Metering and Monitoring System:

- Tracks energy production, consumption, and storage for both DC and AC circuits.
- Helps in optimizing system performance and identifying potential issues.

4. Transfer Switch:

- Used if the system can alternate between grid power (if available) and the stand-alone PV system.
- Ensures seamless transition between power sources.

In summary, the BOS components are essential for the safe and efficient operation of stand-alone PV systems, whether for DC, AC, or a combination of both. The choice of components depends on the specific application requirements, such as the types of loads being powered and the level of system integration desired.

