بسم الله الرحمن الرحيم

Benha University

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Renewable Energy Systems

By

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Lecture (10)

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Troubleshooting & Repair in Renewable Energy Systems

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Wind Turbine Troubleshooting

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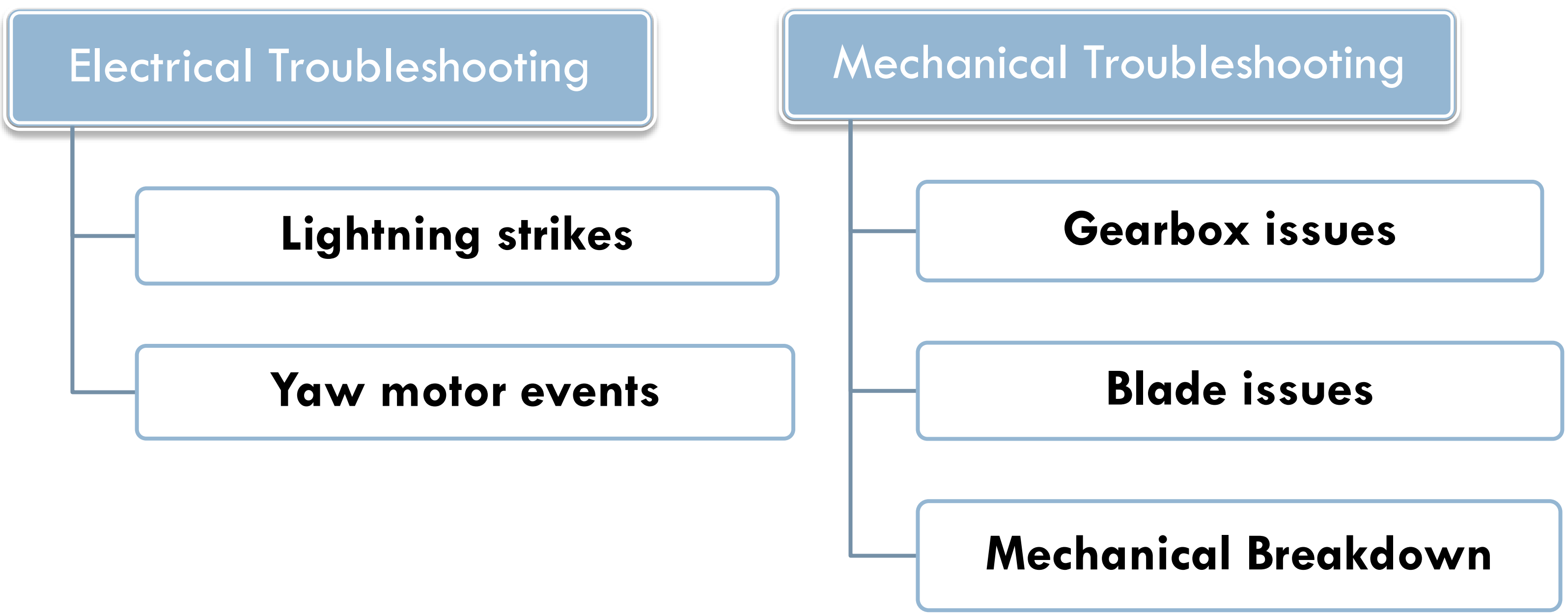
Wind Turbine Troubleshooting

- In occasional circumstances, extreme weather is also responsible for failure whereby the wind speed and the elements simply become too much for the engineering dynamics of the machine.
- There are two types of wind turbine troubleshooting, Electrical troubleshooting, and mechanical troubleshooting.



1. **The turbine spins extremely quickly and noisily but doesn't deliver any electrical current to the batteries.**

- **Causes**

a) The turbine may be running in an off-load state meaning that the circuit from the turbine to the batteries is not complete.

b) In this situation, the turbine is free spinning and the turbine may be generating higher voltages than anticipated from the turbine output cables.

2. **The rotor hub plate fixings do not correctly grip the rotor hub plate which means that the rotor hub plate can rattle slightly.**

- **Causes**

a) The rotor hub fixings have been positioned incorrectly in the drive bearing hub.

3. **The turbine never seems to reach its operating speed and does not give any or very little power output.**

- ## Causes

a) may have installed a 24V turbine on a 12V battery system.

b) This means that the turbine will reach its cut-in RPM prematurely and this in turn will stall the blades.

4. **The turbine seems to be operating correctly, but the electrical output appears to be low.**

- **Causes**

There are many reasons why the turbine may be demonstrating outputs that are lower than anticipated:

a) Turbines require clean un-turbulent laminar air flows in order to operate at their peak performances.

b) Using a cable that is too small may lead to volt-drop losses, especially on a 12V system.

c) more battery capacity can be added to increase the rate at which they can absorb power.

5. **The turbine comes frequently comes to rest in the same horizontal position, regardless of which direction the wind is coming from.**

- **Causes**

a) Turbines require that their towers are vertical. it is still recommended in all applications that the turbine tower is set to be perfectly vertical.

Photovoltaic System Problems

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Troubleshooting photovoltaic systems

1. **Troubleshooting an array problem**

- Prior to getting on the roof, check and record the inverter's input voltage and current level from the array.
- If the array is not producing DC electricity, check all switches, fuses, and circuit breakers.
- Replace blown fuses, and reset the breakers and switches.
- A spurious surge might have passed through, tripping or blowing the protective devices.
- Check for broken wires and loose or dirty connections in the inverter.

- Replace all damaged wires, and clean and tighten all connections.
- Visually check the array for obvious damage to the modules and wiring.
- Repair as needed, and replace all damaged wiring.

2. **Troubleshooting an inverter problem**

- Use a volt meter and DC ammeter to check and record the inverter's operating DC input voltage and current level.
- On the AC side, check the inverter's output voltage and current level.
- A lack of power output from the inverter could be caused by a blown fuse, a tripped breaker, or broken wires.
- Check the appropriate LEDs are lit up to indicate proper inverter operation.
- repair any ground faults.

3. **Troubleshooting a load problem**

- check all load switches.
- Check to make sure that the load is plugged in.
- check the fuses and circuit breakers.
- If there are blown fuses or tripped breakers, locate the cause and fix or replace the faulty component.
- If there are no blown fuses or tripped breakers and the load is a motor an internal thermal breaker might be tripped, or there might be an open circuit in the motor.
- In this case, plug in another load, and note its operation.

- Check for broken wires and any loose connections.
- Clean all dirty connections, and replace all bad wiring.
- With the power off, check for and repair any ground faults.
- Replace the fuses, and reset the switches. If they blow or trip again, there is a problem short, which must be located and repaired.
- If the load does not operate properly, check the system voltage at the load's connection point.

4. **The system stops working entirely. None of the appliances work.**

- If the system fails completely, the reason is usually a broken wire, poor connection or controller failure.
- The problem is to isolate the fault in the system.
- First check the battery charge using a hydrometer or voltmeter.

5. **Some appliances work normally, others do not.**

- This type of failure is rarely due to PV panel or battery failure. It may be caused by:

  * A faulty appliance switch.
  * An appliance has been wrongly connected.
  * An appliance is faulty.
  * The discharge controller is not working properly.
  * The wire size is too small or too long.
  * Connections are loose or dirty.

6. **The system works but runs out of power too quickly.**

- This is the most common problem with solar PV systems and can be caused by many things acting alone or in combination.
- This type of failure shows that there is not enough charge in the battery to operate the appliances as long as the user requires. This may be caused by:

  * Too little charge from the panels.

  * Adding more or larger appliances to the system.

  * Operating the appliances longer than originally intended.

  * Incorrect adjustment of the charge controller.

  * Incorrect adjustment of the discharge controller.

Renewable Energy Systems Efficiency

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Factors that Affect Solar PV System Efficiency

- Energy efficiency factors must be carefully considered while designing any solar PV systems if we want to get the best output.
- **There are 6 Factors that Affect Solar PV System Efficiency:**

1. Cable Thickness

- generally we have electrical appliances working at 220V which is significantly higher compared with the usual PV system DC voltages of 12V, 24V or 48V.
- For the same wattage much higher currents are involved in the PV systems. This brings into picture resistance losses in the wiring.

2. Temperature

- Solar cells perform better in cold rather than in hot climate and as things stand, panels are rated at 25°C which can be significantly different from the real outdoor situation.
- For each degree rise in temperature above 25°C the panel output decays by about 0.25% for amorphous cells and about 0.4-0.5% for crystalline cells.

3. Shading

- Ideally solar panels should be located such that there will never be shadows on them because a shadow on even a small part of the panel can have a surprisingly large effect on the output.
- The cells within a panel are normally all wired in series and the shaded cells affect the current flow of the whole panel.

4. Charge Controller and Solar Cell's IV Characteristics

- An inherent characteristic of solar silicon cells is that the current produced by a particular light level is virtually constant up to a certain voltage (about 0.5V for silicon) and then drops off abruptly.
- A solar panel with a nominal voltage of 12 volts would normally have 36 cells, resulting in a constant current up to about 18 volts.
- Above this voltage, current drops off rapidly, resulting in maximum power output being produced at around 18 volts.

- When the panel is connected to the battery through a simple charge regulator, its voltage will be pulled down to near that of the battery.
- This lead to lower watt power output from the panel.

5. Inverter Efficiency

- When the solar PV system is catering to the needs of the AC loads an inverter is needed.

- As things stand, in real world nothing is 100% efficient. Although inverters come with wide ranging efficiencies but typically affordable solar inverters are between 80% to 90% efficient.

6. Irradiance

- irradiance is a measure of the amount of sunlight falling on a given surface. The higher the irradiance on a solar cell, the more energy a cell will produce.
- **More sunlight = more electricity.**
- If only sunlight was constant. The fact is that irradiance varies throughout the day.
- The angle of the sun, passing clouds, hazy weather, and air pollution can affect irradiance levels. however, the total energy received by the system from the sun remains relatively constant from year to year.

7. Battery Efficiency

- Whenever backup is required batteries are needed for charge storage.
- Lead acid batteries are most commonly used.
- All batteries discharge less than what go into them; the efficiency depends on the battery design and quality of construction; some are certainly more efficient than others.

8. Soiling

- This is another no-brainer. Dirty solar panels produce less electricity.
- The term "soiling" sounds fancier than it is. All it refers to is dust, dirt, and other debris settling on the surface of the solar panels.
- This blocks sunlight from reaching the solar cells and reduces solar system performance.
- In areas with frequent rain, soiling is not usually significant. Areas that experience long periods of dry weather, experience more soiling during the summer.

9. Snow

- Snow blocks production of solar energy until plowed or melted.
- Because snow limits energy production, the effects of snow should be incorporated into any energy estimates.
- In general, assumptions for performance degradation may range from a minimum of 8% performance degradation to a maximum of 30% (for mid-winter months) for systems in installed in alpine regions.