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"Shading Analysis, OFF Grid & ON Grid PV Systems Discussion"

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- this laboratory work provided a very good opportunity to understand the behavior and characteristic of a real PV module. The solar modules simulations have been examined in different situations. At low irradiance where the PV panel was acting as a diode and it has I-V characteristic of the diode. With deferent irradiances, and shading, how they are paralleled to the grid, and how charge controller distributes the load current and charging current to the battery and so on. This experiment was intense, it covered much of the aspects regarding PV systems, on grid off grid, and on-grid with load.
- significant efficiency gains could be realized if the operating points for resistive, dc motor, and battery loads could somehow be kept near the knee of the PV I–V curves throughout the ever-changing daily conditions. Devices to do just that, called *maximum power trackers* (MPPTs)
- The ac output of a grid-connected PV system is fed into the main electrical distribution panel of the house, from which it can provide power to the house or put power back onto the grid as. In most cases, whenever the PV system delivers more power than the home needs at that moment, the electric meter runs backwards, building up a credit with the utility. At other times, when demand exceeds that supplied by the PVs, the grid provides supplementary power.
- Grid-connected systems consist of an array of modules and a power conditioning unit that includes an inverter to convert dc from the PVs into ac required by the grid.
- Since grid-connected systems use the utility for back-up, there is no need for battery storage unless power outages are a problem. This makes them relatively simple and relatively inexpensive. Having the grid right there, however, means that they have to compete with relatively inexpensive utility power, which makes it hard to justify the PV system unless significant subsidies are provided. When the grid isn't nearby, electricity suddenly becomes much more valuable and the extra cost and complexity of a totally self-sufficient, stand-alone power system can provide enormous benefit
- The output of a PV module can be reduced dramatically when even a small portion of it is shaded. Unless special efforts are made to compensate for shade problems, even a single shaded cell in a long string of cells can easily cut output power by more than half. External diodes, purposely added by the PV manufacturer or by the system designer, can help preserve the performance of PV modules. The main purpose for such diodes is to mitigate the impacts of shading on PV I–V curves. Such diodes are usually added in parallel with modules or blocks of cells within a module.
- The voltage drop problem in shaded cells could be to corrected by adding a *bypass diode* across each cell,. When a solar cell is in the sun, there is a voltage rise across the cell so the bypass diode is cut off and no current flows through it—it is as if the diode is not even there. When the solar cell is shaded, however, the drop that would occur if the cell

conducted any current would turn on the bypass diode, diverting the current flow through that diode. The bypass diode, when it conducts, drops about 0.6 V. So, the bypass diode controls the voltage drop across the shaded cell, limiting it to a relatively modest 0.6 V instead of the rather large drop that may occur without it.

- Bypass diodes help current go around a shaded or malfunctioning module within a string. This not only improves the string performance, but also prevents hot spots from developing in individual shaded cells. When strings of modules are wired in parallel, a similar problem may arise when one of the strings is not performing well. Instead of supplying current to the array, a malfunctioning or shaded string can withdraw current from the rest of the array. By placing *blocking diodes* (also called *isolation diodes*) at the top of each string as shown in , the reverse current drawn by a shaded string can be prevented.