**Designing Stand Alone Solar Electric Systems**

**Step One: Load Analysis:** List out the loads to be powered by Solar Suitcase noting the following: Specific Equipment, Power Usage, Number of pieces, Number of hours in use per Day, number of hours in per Night.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Equipment | Power Usage | # of pieces | Hrs/day | Day: watt-hrs | Hrs/night | Night: watt-hours |
| *LED light* | *5 watts* | *4* |  |  | *4 hours* | *80 w-hrs* |
| *Cell Phone* | *5 watts* | *6* | *2 hours* | *60 w-hrs* |  |  |
| *Lap top* | *40 watts* | *1* | *3 hours* | *120 w-hrs* |  |  |
| ***Total*** |  |  |  | ***180 w-hrs*** |  | ***80 w-hrs*** |

**Step Two: Size Battery:** For Lead Acid battery the procedure is:

1. Add up all of the night time loads
2. Double this number to allows for the fact that lead acid batteries have much longer life when they are only discharged 50%.
3. Change value from watt-hours to volts and amp-hours. We do this because batteries are typically specified in terms of voltage and amp-hour ratings. To determine the amp hours of a battery we divide the watt-hours by 12 volts. (Watt-hours ÷ volts = amp-hours)

Battery size = (Night time energy usage x 2) ÷ system voltage

 = (80 watt-hours x 2) **÷** 12 volts

 = 13.3 amp hours

So, the battery should be a approximately 13 amp hours, and be a 12 volt battery. If you cannot find a 13ah battery, choose one that is 14 or 18 ah.

**Step three: Size Solar Panel:** To determine the size of the solar panel we need to

1. Add up both the daytime and nighttime loads;
2. Multiply by two; (The reason we multiply the loads by 2 is in order to allow for all of the inefficiencies in stand alone solar electrical systems such as dust on the panel, inefficiency of charging batteries and to allow a margin for when it rains or the system is over-used)
3. Divide by the number of sun hours (daily equivalent of full sun (1000 watts/m2) hitting the solar panel directly). Sun hours may vary by season and by geographical location.

**Solar Panel Size =** $\frac{day and night time energy use x 2\frac{}{}}{Sun Hours}$

 = [(180 w-hrs + 80 w-hrs) x 2 ] ÷ 5 sun hours

 = 104 watts

So, the solar panel size should be at least 100 watts (12 volt nominal, 18 volt maximum power)

**Step Four: Size Charge Controller:** Charge Controllers are rated in voltage and amperage. Your charge controller should be at least 125% of the total solar amps and load amps that you calculate will go through your system.

Charge Controller Size = (Solar panel Wattage ÷ Maxpower voltage) x 1.25

 = (100 watts ÷ 18 volts ) x 1.25

 = 10 .4 amps

Charge Controller: 12 volts, 10.4 amps (or larger) So Choose Next Available size of type of Charge Controller you want for you system. In our case, Morningstar Prostar 15 amp.

**Step Five: Draw Single Line Diagram of System**



**Step 6: Choose actual components and note prices**