Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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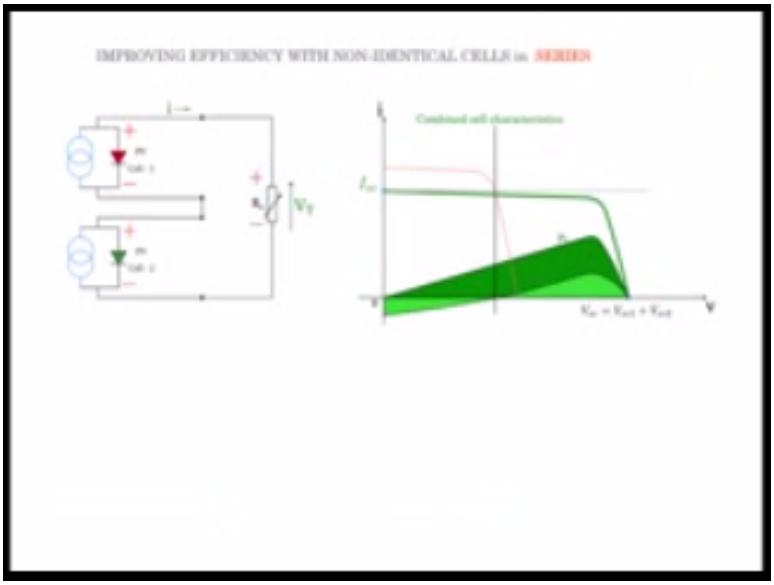

Non identical PV cells when connected in series have some issues the two PV cells as connected here are now acting as sources. Notice the polarity +-, +- both are the same direction and they aid each other and both are acting as sources. They are operating in this region of the IV characteristics where power from both the cells are positive. Now if one of the cell is partially shaded we see that during a portion of the IV characteristic of the combine cell one of the PV cell, PV cell 2 here for this example shows negative power indicating that the PV cell 2 is acting like a sink.

Under that condition this +- polarity will get reversed like this, so now PV cell 2 is acting like a sink or not is acting like a sink PV cell 1 alone is a source. Now we can slightly modify this circuit so there it is much more convenient to read in this fashion it is still the same circuit this PV cell 1 is a source and you have a load or not +- are shown here you have another PV cell 2 acting like a load additional load +- the same direction of the load are shown here.

Somehow the PV cell 2 here is acting like a sink or a load means that it is in operating in this portion of the IV characteristic we can as well replace this PC cell 2 by a air resistive item like this. So in affective PV cell 2 is the hearing like a resistor during the time when it is sinking. Now the question is the PV cell 2 if it is sinking it is dissipating and it is becoming hot can we avoid that, can we bypass the power, can we bypass the PV cell 2 or any cell which is sinking such that it does not consume any power during the time when it is normally suppose to behave like a resistor in this region.

So this can be achieved by putting a diode across like this, so whenever the PV cell this gets a PV cell 2 reveres polarity and operates like a sink a + and – so we have putted diode here and the diode will get horror basin conduct. Note here for the sake of simplicity right now I am considering this diode to be ideal, it is cut in voltage are not voltage is 0 volts or very, very less compared to the PN junction voltages of 0.7 volts of a single cell.

This is very important I will explain that a bit more later, for now consider that this diode is ideal and the cut in voltage is 0, so the moment the PV cell 2 reverses polarity the diode cuts in and bypasses the PV cell 2. Thereby you will not have any power dissipation within the cell and the cell would not get hot and detariate. Now let us look at this characteristic what happens when we put this diode there will not be this negative power so that portion will wash.

So which means all the powers are positive the PV cell 2 will only source power during this time and during this time it does during the time when it was sinking earlier because of the presence of the diode it will get effectively bypass by the diode. Now if you convert this characteristic during this portion of the characteristic we see that both cell1 and cell 2 are sourcing and at this point, at this critical junction where there this vertical line, this point PV cell 2 contribute 0 power all the power is contributed by PV cell 1.

And if you take all these regions less than this vertical line point PV cell 2 does not contribute it is effectively bypass by this ideal diode so only PV cell 1 is sourcing. So the characteristics the operating point characteristic will be such that it will not take this path but it will take this path, because that is the path IV current path of the PV cell 1 and as PV cell 2 is effectively out of picture this is the path now it will take.

So if you redraw this portion such that the operating point takes this path in this region it will look something like this, so this portion this dark thick line portion is actually now the IV characteristic of the combine cell with an ideal diode put in place like this. The advantage in putting this ideal diode is that PV cell 2 is bypassed whenever there is a voltage inversion or the PV cell 2 acts like tries to act like a sink.

Under such condition this diode will save this PV cell 2 and it will look as so PV cell 1 alone is in the circuit delivering load 2 or not, now PV cell 1 will deliver the full power to R0, R0 alone and no dissipation occurs here, so that is the advantage of putting this diode you will be improving the efficiency slightly and the characteristic also kind of takes this shape as indicated. Now this is the portion where PV cell 2 contributes power and the remaining portion PV cell 1 contributes the power and together of course will be the power contribute power of the combined cell. So here you see that the contribution is only from PV cell 1.