

Increasing the output Power & Efficiency of Solar Panel using CPV by Water Cooling System

Manjunath¹ N. A. Ranjan² Dhavala R. K³ M. E. Tejamoorthy⁴

^{1,2,3,4}Department of Electrical & Electronics Engineering

^{1,2,3,4}Malnad College of Engineering, Hassan, Karnataka, India – 573 202

Abstract— Concentrated photovoltaic innovation (CPV) utilizes optics, for example, mirrors and focal point to concentrate daylight on sunlight based cells for producing power. CPV has advantage over non-concentrated photovoltaic as less number of sun powered cells is required for a similar power yield. Alongside span and force of daylight, temperature additionally has extraordinary impact on the execution of PV module as high temperature altogether decreases yield control. This undertaking discloses a handy way to deal with improve the proficiency of sun oriented board by the utilization of mirrors and cooling instrument. These reflectors are shabby, simple to deal with, sufficiently straightforward to utilize and require no additional hardware or gadgets to utilize. In any case, CPV work effectively in concentrated light as long as the sun based cells are kept cool by methods for some warmth sinks. Exploratory outcomes demonstrate calculable upgrade in general yield of sun based board. Trial readings got from a) without reflectors and without cooling b) with reflectors and without cooling c) with reflectors and with cooling are thought about. Comparing comes about acquired from various conditions indicating change in control yield and productivity up to 32% in case (b) and 44% on the off chance that (c) are tabled and plotted.

Key words: Concentrated Photovoltaic Innovation (CPV), Water Cooling System, Solar Panel

I. INTRODUCTION

The sun is the greatest abundant renewable energy source on the earth. The amount of solar irradiation radiated on earth surface is about 120 Peta watts that means all the solar irradiation received from the sun in one day can meet the worlds demand for more than 20 years. The average incident solar energy on earth's surface is 600W/m². From last few years production of energy by solar, converting solar irradiation into electrical energy become more popular, important by using PV technology. Due to the capital cost of the panel grid parity is still not achieved. The huge capital cost of panel is mostly due to materials like Si, GaAs used in the panel. For this reason (high capital cost) lots of researches have been conducting experiments on Concentrated Photo Voltaic (CPV) systems. These types of CPV technologies give more inherent advantages. One of the advantage is that reduces the working PV surface used for photo electric conversion [1]. CPV converts solar irradiation by small generating device by letting in high density light from the sun that has been concentrated with lens. To produce equal or greater energy than conventional photo-voltaic system, CPV must be located in areas that receives ample amount of direct sunlight [2]. This is typically specified as Direct Normal Irradiation(DNI) greater than 5.5-6 Kwh/m²/yr. for these multi junction compound solar cell, solar junction has recorded the world highest efficiency of 44% at 947 suns (1sun=1Kw/m²). For

light collection Fresnel lens, parabolic concentrator or V-trough arrangement can be developed [3] [4]. As of late the CPV industry need battled on contend for PV prices, hence heading CPV organizations exiting the market, same time others face tests to raising those capital needed with scale [5]. However, CPV modules keep should attain efficiencies significantly past the thing that is could be allowed for conventional flat-plate innovation organization What's more bring room with push efficiencies considerably higher in the future, giving a possibility pathway for huge diminishments for frame works [6]. That primary purpose behind CPV organizations exiting that showcase will be the prerequisite of concentrator which makes it exorbitant Furthermore likewise photovoltaic sun powered cell generates power toward accepting sun oriented irradiance in the types of photons. Photons for wavelengths over the edge need aid changed over under heat in the PV cell. This waste high temperature will be not scattered effectively Furthermore produces over the top helter skelter temperatures, which have an unfriendly impact on the electrical execution of the cell [7] [8]. When CPV module reaches its maximum temperature its efficiency decreases and hence its power output also decreases making it inefficient module as compared to conventional PV. Till now the research have been done to improve the power output of CPV[9] [10], but comparison of conventional PV output with CPV is necessary to know the percentage increase in power output of CPV as compared to PV and also building of coolants to dissipate waste heat effectively[11].

II. COMPARISON OF CONVENTIONAL PV, CPV & CPV WITH COOLING SYSTEM

A. Conventional PV

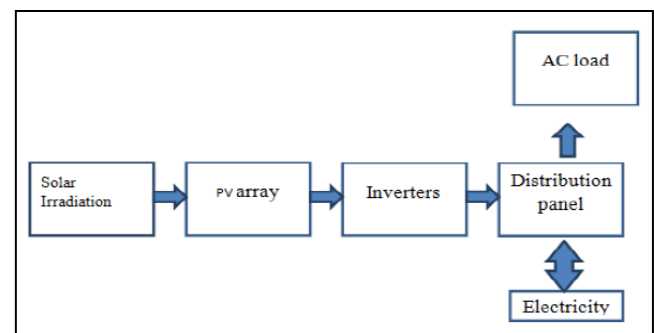


Fig. 1: Block diagram of conventional PV

Era from claiming power from sun oriented vitality might have been to start with produced conceivable eventually Tom's perusing photoelectric impact and later on by that advancement from claiming PV phones. Power preparation by sunlight based boards could broadly make seen over the individuals ranges the place development for transmission what's more conveyance lines appears to be illogical. however, it required a little measure about effectiveness.

After that, researchers began mindful investigate and began trials once enhancing those effectiveness for sun based units. They need aid succeeded clinched alongside diminishing those helter skelter costs from claiming power on just a couple pennies for every unit from claiming power notwithstanding.

B. CPV without Cooling System

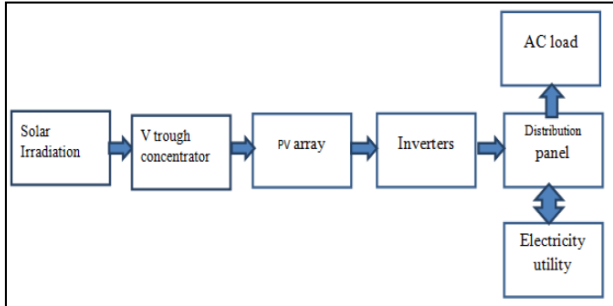


Fig. 2: Block diagram of CPV without cooling System PV Panels for fixation framework so as to include extra sunlight ahead an PV board and fixation framework might a chance to be utilized. The surface of the reflecting components a chance to be a plane mirror. Lens might be likewise utilized for those same reason yet they need aid significantly utilized. Eventually Tom's perusing including concentrating sunlight based radiation elements, mirrors or aluminum panels, those PV modules will work toward a higher viability of the traditional ones. Plane reflection components are the majority regularly utilized done frameworks with PV panels because of the valuable Straightforwardness What's more adequate proportion between effectiveness and value. Similarly as demonstrated in the figure (2) speaks to the square outline from claiming CPV without cooling framework. Relative of the PV board valuable dimensions, the fixation components might a chance to be mounted.

C. CPV with Cooling System

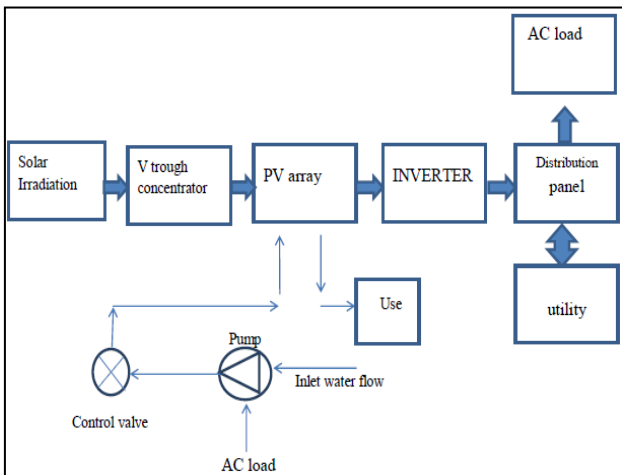


Fig. 3: Block diagram of CPV with cooling System In light of the contemplate for m Mohamed Musthafa [4], under moved sunlight based radiation the execution from claiming sun powered cell diminishes half the point when its temperature ascents starting with 46°C with 84°C. Therefore, an proficient cooling framework will be very fundamental on amplify sun oriented cell's effectiveness.

Photovoltaic panels could be cooled actively alternately passively. That Contrast the middle of animated furthermore indifferent is that dynamic framework obliges a portion outside control sourball to run same time latent framework needs no extra force wellspring. Such an arrangement as demonstrated in the square outline in the figure (3).

III. EXPERIMENTAL RESULTS

A. Solar PV performance without reflector

Those test course of action about sun based PV framework will be orchestrated without reflector on attain those greatest sun illumination through sun oriented illumination following. The estimation from claiming voltage, present Also force of sun based PV equipment course of action may be taken for the day from 06:00 with 18:00 (April, 18, 2017), and the estimation information may be provided for done table (1) separately. The way from claiming voltage, present What's more force of sun based PV board without whatever reflector would indicated on figure. Those figure (5) indicate sun oriented PV yield power (W) with respect to voltage (V) admiration to the period. Figure (6) indicates the sun oriented PV yield power output (W) with respect to time.

Column1	Column2
Maximum Power (Pmax)	10W
Voltage at Maximum Power (Vmpp)	18V
Current at Maximum Power (Impp)	0.56A
Open Circuit Voltage (Voc)	21.6V
Short Circuit Current (Isc)	0.58A
Panel Efficiency	6.73%
Power Tolerance	5%
Temperature	-40~85 °C
Quantities of solar cell	36
Panel Dimension (H/W/D)	350mm*290mm*18mm
Weight	0.9kg
Cell Type	polycrystalline solar cell

Table 2: PV panel specifications

Time(Hrs)	Voltage(V)	Current(I)	Power(P)
6	12.02	0	0
7	12.34	0.1442	1.78
8	12.47	0.1972	2.46
9	12.68	0.2112	2.68
10	12.73	0.2214	2.82
11	12.98	0.271	3.52
12	13.25	0.314	4.256
13	13.483	0.356	4.8
14	13.015	0.338	4.646
15	12.82	0.312	4
16	12.59	0.25	3.16
17	12.38	0.2	2.48
18	12.23	0.126	1.566

Table 2: Solar PV panel without reflector

B. CPV performance without cooling system

The test plan about sun based PV framework may be orchestrated for plane mirror reflector with attain those greatest sun illumination through sun based illumination following. Those estimation about voltage, current What's more force of sun oriented PV fittings course of action is taken for those day starting with 06:00 should 18:00(April,19, 2017), Furthermore estimation information may be provided for done table 2. Those ways from claiming voltage, present also force of sun oriented PV board with plane mirror reflector would demonstrated previously, figures. The figure (5) demonstrates sun oriented PV yield power (W) with respect to voltage (V) for admiration to those the long haul. Those figure indicates the sun oriented PV yield current (I) for admiration to the time, and the same figure (6) indicates the sun oriented PV yield energy (W). In this method the reflector used is plane mirror that is V-trough; two mirrors are placed at an angle of 15° plane of PV panel. By using V- trough mirror output power of panel increases as shown in the power output curve figure (6). In conventional PV system the maximum power is 4.8watt, by using mirrors the output of the CPV is increased by 6.24watt. It may be watched that those voltage, present what's more force of sun based PV board for plane mirror reflector Throughout 11:00 with 18:00 alternately crest hours for sun oriented illumination are stable also most extreme. By using plane mirror the output power of CPV is increased by 4.8 to 6.24 watt. The efficiency also increases for certain temperature, beyond the certain temperature the efficiency decreases because , by using mirrors the temperature of the solar panel increases so by providing proper cooling temperature can be maintained properly.

Time(Hrs)	Voltage(V)	Current(I)	Power(P)
6	11.47	0	0
7	11.54	0.169	1.96
8	11.67	0.272	3.18
9	11.79	0.3358	3.96
10	11.83	0.382	4.54
11	11.94	0.424	5.08
12	12.12	0.472	5.74
13	12.288	0.508	6.24
14	12.08	0.504	6.16
15	11.9	0.476	5.68
16	11.82	0.418	4.96
17	11.69	0.33	3.88
18	11.5	0.194	2.24

Table 3: CPV performance without cooling system

C. CPV performance with cooling system

Those test plan of sun based CPV framework may be orchestrated for cooling framework. Those copper tubes would set the following those CPV to stream from claiming water to correct keeping up the CPV temperature. The effectiveness of the PV cell extraordinarily relies on the temperature. The estimation for voltage, current and force of sun oriented PV fittings plan is taken all around those days starting with 06:00 to 18:00(May 2, 2017).

Time(Hrs)	Voltage(V)	Current(I)	Power(P)
6	11.02	0	0
7	11.12	0.2428	2.7
8	11.18	0.30	3.458
9	11.28	0.37	4.18
10	11.37	0.41	4.76
11	11.484	0.464	5.34
12	11.54	0.526	6.08
13	11.612	0.558	6.48
14	11.53	0.537	6.2
15	11.48	0.512	5.88
16	11.37	0.466	5.3
17	11.28	0.404	4.54
18	11.17	0.32	3.58

Table 4: Solar PV panel reflector with coolant

IV. DISCUSSIONS

As compared to the conventional PV system, CPV produce more output power as shown in the figure (6). In this figure graph contains three curves respectively, red represents output power of CPV with cooling system, green curve represents the output power of CPV without cooling, and last the blue one represents the output power of conventional PV. Table 4 shows the temperature of solar panel PV, CPV without cooling, CPV with cooling form morning 06:00 to 18:00. Figure (4) represent comparison on temperature of solar panel between PV, CPV without cooling and with cooling. In the figure (4) three temperature curves are shown respectively, the red colour curve represents the CPV with cooling system, blue curve represents the conventional PV system, and last green curve represents CPV system. From those result, it may be watched that those temperature of the sun based board for water-cooling diminishes maximally toward 40°C to also averagely by 1.7°C at two liters for every hour stream rate of water compared with standard person. It shows that efficiency of solar panel greatly depends on the temperature.

Time (hrs)	PV panel	CPV without cooling	CPV with cooling
6	27.78	34.74	25.08
7	28.92	36.84	25.72
8	31.08	38.09	26.45
9	32.84	39.37	27.03
10	34.35	41.172	28.87
11	36.23	42.16	29.43
12	37.04	44.74	31.12
13	38.34	46.37	32.74
14	36.148	45.89	32.02
15	35.078	44.32	31.27
16	33.27	42.178	29.74
17	31.04	39.92	27.23
18	28.49	37.04	26.17

Table 5: Comparisons on solar panel temperature between PV, CPV without cooling, CPV with cooling

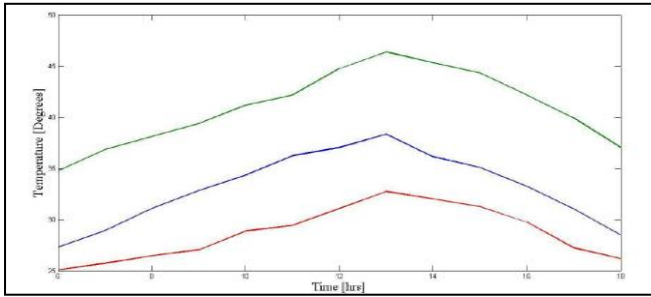


Fig. 4: Comparisons on solar panel temperature between PV, CPV without cooling, CPV with cooling.

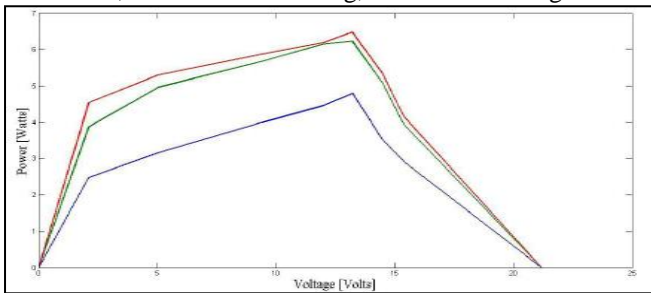


Fig. 5: Comparisons on PV characteristics of solar power of PV, CPV without cooling, CPV with cooling

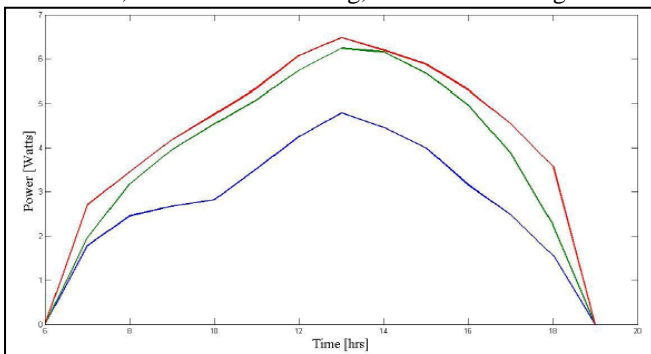


Fig. 6: Comparisons on solar power of PV, CPV without cooling, CPV with cooling

It is watched that those current Also force of sun oriented PV board with plane mirror Similarly as contrasted with the customary PV framework Throughout 11:00 should 14:00 or top hours for sun oriented illumination are stable and most extreme. It may be watched that the plane mirror may be best accessible reflector on improve the sun based force from claiming PV panel, and the rate augment from claiming yield force for basic mirror reflector may be demonstrated to figure 5 as, it may be watched from figure 6, Throughout those crest hours 11:00 on 15:00, those rate augment about sun based PV board will be typical low for plane mirror reflector in examination for without utilizing any reflector. Anyhow Throughout the time period 07:00 with 10:00 Also 16:00 with 17:00, it is watched high rate increase Eventually Tom's perusing utilizing plane mirror reflector.

V. CONCLUSIONS

In this work, test execution investigation of a water cooled CPV module has been introduced. It has been watched that the execution of sunlight based cell with cooling and focus is substantially higher than the settled sun based cell under a similar information conditions. It has been discovered that the yield power of the fixation sun oriented cell is 4.7 to 5.2

times higher than the settled cell. The pickup in the sunlight based radiation and the yield from the CPV can be expanded essentially, however it was not accomplished that much. In view of the got exploratory information, the yield power of the fixation sun oriented cell is around 4.9 times more than the settled cell amid the test day, yet its electrical effectiveness is lower than 9% and no more of the time. The primary reasons are the flaw of concentrator geometry structure, the optical loss of the intelligent mirrors, non-uniform light levels on the sunlight based cell and the effectiveness drop because of the temperature ascent of the sun powered cell. With the higher water stream rate, more warmth is extricated from the sunlight based cell and along these lines the cell temperature diminish and the cell electrical effectiveness increments. The productivity of the CPV for the most part relies upon the warmth extraction rate which helps in dealing with the cell temperature and the warmth extraction rate for the most part relies upon the cooling water stream rate.

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