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Effect of Dust, Shadiness and Faulty CS10 Sensor on the Performance of Solar Photovoltaic Thermal System (SPVT)

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Abstract – *Solar Photovoltaic Thermal (SPVT) advanced method of producing electrical as well as thermal energy. In India SPVT is mainly going to use in Educational Institutions, Cold Storages, Large commercial retail ,manufacturing – textile. There are a lot of reasons for the production of losses in SPVT like electrical disconnections, ageing, and dust deposition, and Maximum power point tracking error, electrical losses. CS10, V40 malfunctioning. In this paper effect of Dust, Shadiness, and Faulty CS10 have analyzed. All these faults will affect the electrical as well as thermal power generation this is illustrated in this paper.*

***Key Words*: Solar radiation (H), Thermal and electrical energy, Photo voltaic thermal (PVT), Heat Quantity (Q), voltage (V), Monocrystalline (MC)…**

1. INTRODUCTION

Solar Photovoltaic thermal (SPVT) system of 2 units each having a capacity of 10kW are installed on roof top of Hostels, Government College of Technology, Coimbatore, India .This SPVT performance analysis done by observing the readings of 10 KW roof top plant of Girls Hostel. For analysing effect of dust deposition readings have taken for 7 days before and after cleaning the panels, Performance during shadiness has analyzed by using solar PV analyzer, system mal function due to CS10 has analyzed by using Delta Resol Controller.

2. FAULTS IN SOLAR PHOTOVOLTAIC THERMAL (SPVT)

These are all the possible faults in SPVT system like absence of grid supply or main supply, optical flow meter faults, CS10 irradiation sensor faults, Thermostat failures lockage of air inside the storage tank, flow meter faults .In this paper effect of three faults have analyzed those are dust deposition ,shadiness,CS10 Faults .

2.1 Effect of Dust on the performance of SPVT

Dust deposition mainly effects the performance of SPVT in many ways like reduction in thermal generation, electrical generation.

Effect of dust on thermal power generation is illustrated in this paper by analysing data for 7 days before and after the cleaning .All values are tabulated below.

Table -1: Comparison of solar panel parameters before and after cleaning the panels.

S.No	S1	S2	S3	S4	FlowRate (m)	Heat Qunatity (Q)	Solar Radiation (H)	Condition
1	41.87	33.16	35.82	35.46	866.42	5679.44	127.34	Before Cleaning
2	44.5	38.9	39.3	38.9	359.6	7286.4	360.2	After Cleaning
Difference	**2.63**	**5.74**	**3.48**	**3.44**	**-506.82**	**1606.96**	**232.86**	

Where

S1=Panel Temperature in ^{0}C.

S2=Heat Exchanger Input in ^{0}C.

S3=Heat Exchanger Output in ^{0}C.

S4=Storage Tank Temperature in ^{0}C.

m=Flow rate in litre/hour.

Q=Heat Quantity Generated per Day in wh.

H=Solar Radiation in watts/m^2.

All Sensor's outputs are high after cleaning the panels. Average panel temperature (S1) is increased by 2.63 ^{0}C, heat exchanger output (S3) increased by 3.48 ^{0}C, per day heat quantity is increased by 1606 wh, radiation falling on the panels is increased by 232 watts/m^2 .Flow rate is less after cleaning, this is due opening of the relay of motor R1 which is responsible for flow rate due to thermostat at 45 ^{0}C. Despite low flow rate all sensor values are high, thermal generation is high.

Periodical cleaning of the panel will increase thermal as well as electrical efficiency .Periodical monitoring of panels will increase performance of the panels.

Only way to clear the faults due to dust is to clean the panels periodically.

2.2 Effect of Shades on performance of the SPVT

Fig-1: Set up to find the effect of Shadiness

Solar PV analyzer is used to measure the voltage, solar radiation during shading. Open circuit voltage of the panel is 39.15 V at 1000 watts/m^2.

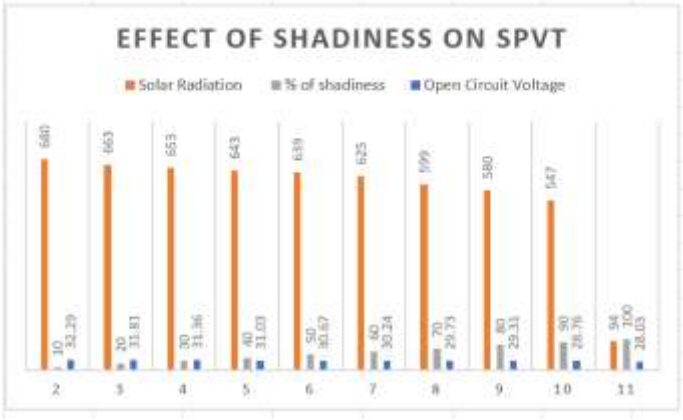

Chart-1: Effect of shadiness on Voltage.

Chart -1 shows the effect of shadiness on voltage, voltage value is getting reduced as shading increases.

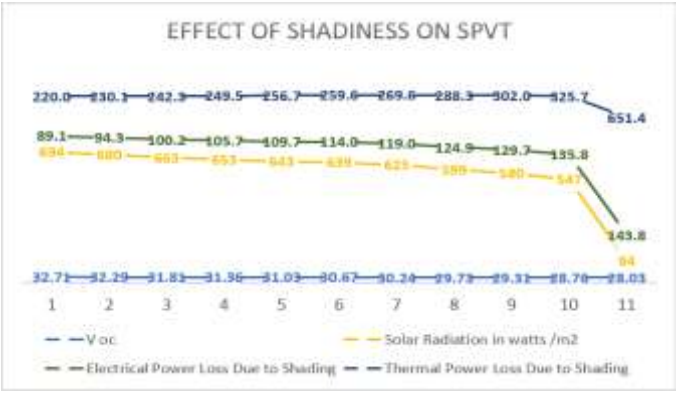

Chart-2: Effect of shadiness on power

Chart -2 shows the effect of shadiness on electrical as well as thermal power generation, both powers reduced due to shading.

2.3 Effect of faulty CS10 on performance of the SPVT

The CS10 is used for measuring the irradiation intensity. The short circuit current rises with increasing irradiation intensity. The short-circuit current is proportional to the irradiation intensity.

2.3.1 Performance of SPVT at Faulty CS 10 Sensor

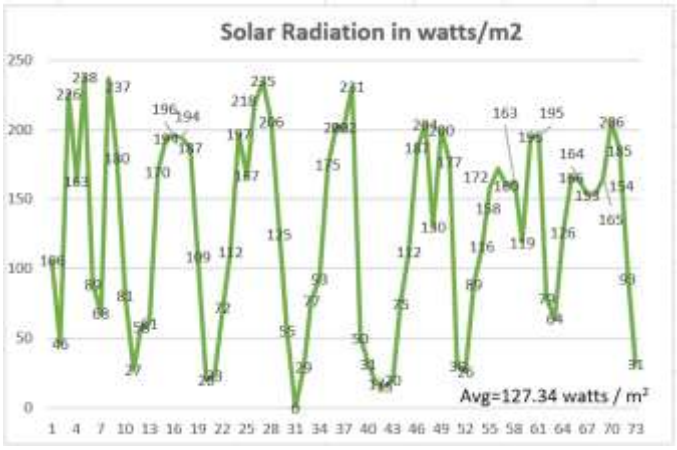

Chart-3: Faulty CS10 Performance.

2.3.2 Performance of SPVT at Faulty CS 10 Sensor

Maximum solar radiation will be varying in the range of 1000-1100 watts/m^2, but due to faulty CS 10 Sensor is showing a maximum of 238 watts/m^2 .Hybrid pump may get stopped due to this fault, this is the main consequence of faulty CS10 irradiation sensor. Values of CS10 at different timings have shown in chart -3, where X-axis is timing from 5:30AM to 5:30 PM, Y – axis is Solar Radiation (H).

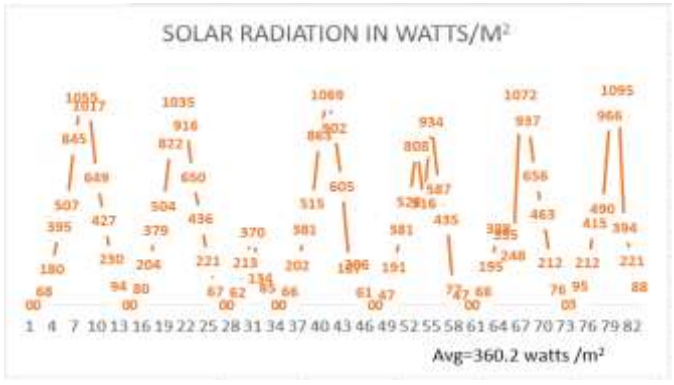

Chart-4: Healthy CS10 Performance

Fig -1: Name of the figure

Under healthy operating conditions CS10 can show a reading of 1000-1100 watts /m^2.Chart -4 showing the reading of CS10 under healthy operating conditions. In this maximum solar radiation is 1095 watts/m^2, Average solar radiation for 7 days is 360.2 watts/m^2.

So it is necessary to monitor the condition of CS10.

3. CONCLUSIONS

From this analysis it has conclude that dust deposition will effects the thermal and electrical power generation ,so regular maintenance is required. Shading will effects the voltage as well as irradiation ,it is observed that 13.19% voltage is dropping due to shading , by avoiding shadows, hot spots on solar panel we can minimize the effect of shading. Similarly maintenance of CS10 irradiation sensor is also very important as it effects the operation of Hybrid motor.

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