EFFECT OF AMBIENT CONDITIONS ON MONTHLY PERFORMANCES OF THREE DIFFERENT PV ARRAYS

Summary

Solar PV cells may be mainly divided into two parts as crystalline and thin film. Mono-crystalline silicon (Mono-Si), microcrystalline based amorphous silicon (a-Si/µc-Si) thin film and Cadmium Telluride (CdTe) thin film solar cells are widely used PV cells in the arrays. The outdoor performances of the systems depend on some climatic parameters and conditions, and it is important to understand how the monthly efficiencies vary with these parameters (Bhattacharya et al., 2014; Dubey et al., 2013; Skoplaki and Palyvos, 2009). In the present study, the data obtained from three grid connected PV arrays of Mono-Si, a-Si/µc-Si and CdTe thin film that were operated for 3 years in Ankara-Turkey is analyzed. The results showed that Mono-Si array performance depends on the outdoor climatic conditions while a-Si/µc-Si and CdTe thin film arrays performances are not significantly affected by the variation of the climatic parameters.

Key words: photovoltaic system, climatic parameters, efficiency

1. Brief Introduction and Results

The specifications of the systems are as follows: The first one is Mono-Si array of 1.14 kWp and its total area is 7.584 m^2; the second one is µc-Si / a-Si array (thin film) with installed capacity of 1.26 kWp and its total area is 14.4 m^2 and the last one is CdTe thin film of 1.215 kWp and its total area is 12.96 m^2. There are three inverters connected to each PV array. The inverters are identical and the outputs are directly connected to the grid.

Their performance and degradation analysis were carried out and presented before (Ozden et al., 2015). As mentioned above, we analyzed the variation of the monthly performances of the arrays with respect to different climatic parameters. These parameters are monthly averages of ambient temperature (T_a, °C), relative humidity (RH, %), air mass (m), solar irradiation on tilted arrays (H_t, kWh/m^2), wind speed (v, m/s) and angle of incidence at the noon of the average day (θ). In this extended abstract we present only the effects of two of these parameters: T_a and H_t.

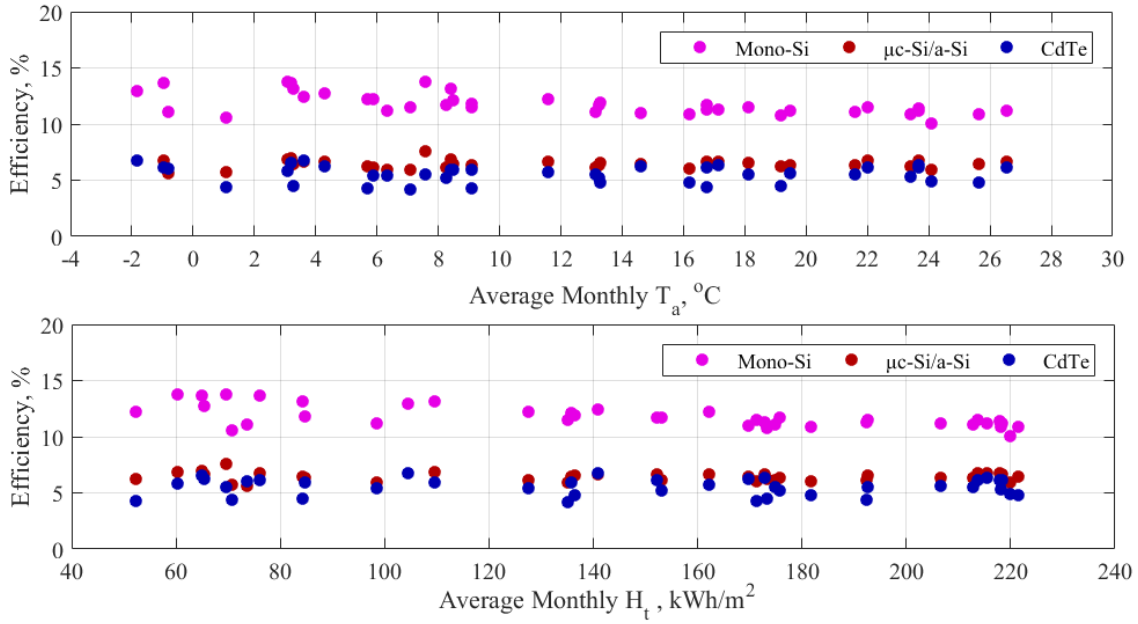

Fig. 1: Variation of efficiency for Mono-Si, micro-crystalline based amorphous silicon and CdTe grid connected PV systems.

As mentioned above, Mono-Si array performance depends on the outdoor climatic conditions while a-Si/μc-Si and CdTe thin film arrays performances are not significantly affected. Above figures demonstrate this finding for the efficiencies of the PV arrays with respect to monthly average T_a and H_t. Although one would expect decrease in efficiency with increasing temperature, as can be observed from this figure, a-Si/μc-Si and CdTe thin film array efficiency seems independent of T_a, while a decrease in the efficiency can be clearly observed for Mono-Si array. Similarly, H_t value affects the efficiency of Mono-Si while does not effect a-Si/μc-Si and CdTe thin film array efficiencies. In fact, Pearson's correlation coefficients are in accord with these findings that for a-Si/μc-Si and CdTe thin film array efficiency does not correlate with these parameters as can be observed from the below table.

Tab. 1: Coefficient of Pearson Correlation for grid connected PV systems.

Module Brand	Module type	Pearson Cor. Coef.		Significant of Cor.		Type	Connection
		H_t	T_a	H_t	T_a		
IBC	190 MS	-0.682	-0.637	0.0005	0.0004	mono-Si	6 series
Kaneka	U-EA105	-0,067	0.027	0.6830	0.8680	μc-Si / a-Si	4 series x 3 parallel
Abound	AB1-67B	0.071	-0.054	0.6690	0.7460	CdTe	6 series x 3 parallel

In this work, we analyzed the effects of all aforementioned parameters and discuss the possible reasons of obtained correlations or disconnections. The results are important in planning and deciding the large scale PV installations to the regions with dry continental climate as in Central Anatolia. Further analysis of efficiency, performance and degradation of some larger number of different types of PV modules in the outdoor conditions of Ankara-Turkey are our future prospects.

2. References

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