A comparative study of degradation and performance of thin film photovoltaic generators versus a multi-crystalline generator

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1. Abstract
Thin film solar cells (TFSC) are supposed to have higher energy yield rates than crystalline silicon (Si-x) mainly possible by some enhancements like lower temperature coefficient and higher absorption of diffuse light. Although many studies have been carried out on this topic, there are uncertainties and there is no conclusive outcome to their performance compared to Si-x. This work aims to contribute to the state of the art on this topic providing experimental data of degradation and performance of several commercially available TFSC generators (CdTe, CIGS, a-Si, a-Si/µSi) and a conventional Si-x. The energy yield of the TFSC generators during two years is compared to the Si-x one which is supposed to be the standard.

2. Experimental

2.1 System characteristics

Modules deployed outdoors at a 30° tilted generator in December 2010.

2.2 Data acquisition system characteristics

Each generator is connected to a 2.5 kW commercial inverter. As the total power of each generator is lower than 2.4 kW, the inverters will never limit the power. Thus, PDC can be directly considered. DC powers are measured by means of two wattmeters, which give IDC and VDC values. Data is measured every second but recorded as 10 minutes averages.

3. STC Power Degradation

3.1 Voltage

4. Energy Yield

4.1 Energy yield referred to the Si-x generator from March 2011 to February 2013:

5. Conclusions

Six different currently commercially available generators of different manufacturers have been analyzed under field conditions.

STC Degradation:
- Both the Si-x and the CIGS generators have no pattern of measurable degradation.
- a-Si generator has a rapid initial degradation (35%) overlapped by a seasonal variation in PSTCexp (18%). Similarly, a-Si/µSi generators have a rapid initial degradation (ranging from 15% to 21%) overlapped by seasonal variations in PSTCexp (ranging from 10% to 13%).
- CdTe generator seems to have a seasonal variation in PSTCexp but smaller than in the a-Si and a-Si/µSi generators (ranging from 6% to 9%).

In terms of energy, the performance of the TFSC generators without regard to the initial degradation shows that all of them have lower energy yield than the Si-x generator.

An experimental STC power has been measured to remove the effect of having different PSTCexp. Taking into account this PSTCexp, TFSC perform similarly to the Si-x in this location.

Differences in energy yield between manufacturers were mainly due to the difference between their real STC power and the nameplate power given by the manufacturers except in the case of CIGS generator where it had the same performance when taking into account the measured PSTCexp.

Location characteristics
Location chosen was 42° 04’N, 1° 36’W.

α STC, PDm, B, and Tp are registered by means of a meteorological station with a horizontal pyranometer, a horizontal pyranometer with shadowing, a pyrheliometer and a thermocouple.