Area: Area 7 Performance and Reliability of PV Modules

RELIABILITY INVESTIGATION OF FIVE PV TECHNOLOGIES UNDER ACTUAL OPERATING CONDITIONS FOR SIX YEARS

Tetsuyuki Ishii[1], Sungwoo Choi[2], Ritsuko Sato[2], Yasuo Chiba[2], Atsushi Masuda[2]

[1]Central Research Institute of Electric Power Industry, Japan,
[2]National Institute of Advanced Industrial Science and Technology, Japan

The total cumulative PV installations in Japan were approximately 35 GW at the end of 2016. The large market indicates that PV systems are recognized as certain power generation systems. The reliability of PV systems are very important aspects of these PV power generation systems that provide electricity to the national electric power grid. PV modules are the most important components converting solar photons to electricity. Therefore, the investigation of the reliability of PV modules is very important.

Against such a background, the reliability of five kinds of PV modules has been investigated under actual operating conditions in National Institute of Advanced Industrial Science and Technology (AIST) Kyushu Center located in Saga Prefecture in Japan (33.2 °N and 130.3 °E) since October 2010. Five kinds are composed of sc-Si, mc-Si, a-Si:H/μc-Si:H, CIGS, and a-Si:H. In this study, we investigate the reliability of these PV modules based on the outdoor measurements and indoor measurements under STC.

The nominal capacity of each kind of the installed PV modules is approximately 5 kW, which is composed of four or five PV arrays. Every PV array has been connected to an electric power grid through a multi-string power conditioning system. However, every PV array is separated from the electric power grid to measure the *I-V* curves once every 10 min. Here, we used the sum of the P_{MAX} values calculated from the *I-V* curves of the four or five PV arrays. In addition, in-plane global solar irradiance, in-plane global solar spectrum, and back-surface module temperature have been also measured at 10 min interval.

Annual energy production from each kind of the PV arrays, which is normalized by that from the sc-Si arrays (E-1A), is shown in Fig. 1. Therefore, the normalized annual energy production for the sc-Si arrays is one always. We have confirmed that the E-1A performance show no degradation in our previous study[1]. In addition, the annual energy yield is further normalized by each nominal capacity to evaluate the performance properly. The performance of the mc-Si arrays (E-2A) shows little degradation, although the annual energy production is about 3% smaller than that of E-1A. Whereas the performance degradation of the CIGS arrays (M-2A) is not so large from 2011 to 2015, about 2% performance degradation is observed from 2015 to 2016. This may be due to a failure module with broken cover grass shown in Fig. 2. We have not identified the cause of the failure yet. However, we confirmed that the power of the failure module was nearly zero by indoor measurement under STC. The performances of the a-Si:H/μc-Si:H and a-Si:H arrays (M-1A and M-3A) show the initial light-induced degradation in the first two years[2]. Then, the performances were stabilized. Further investigation will be presented at PVSEC-27 based on the indoor powers under STC and EL images.

Acknowledgment

This study was supported by the New Energy and Industrial Technology Development Organization (NEDO) under the Ministry of Economy, Trade and Industry (METI).

References

[1] T. Ishii and A. Masuda, Prog. Photovoltaics, in press.
[2] D. L. Staebler and C. R. Wronski, Appl. Phys. Lett. 31, 292 (1977).

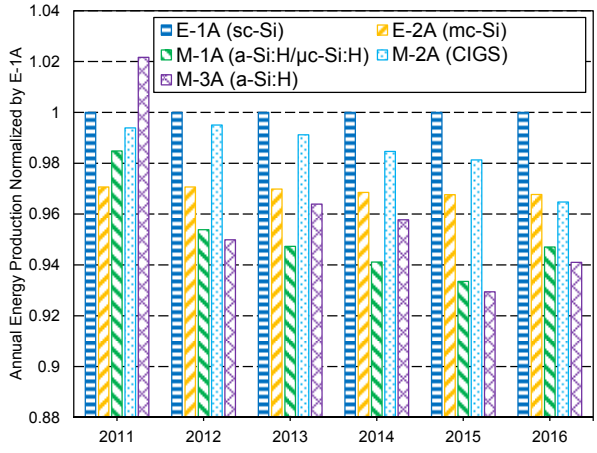

Figure 1: Annual energy production normalized by E-1A.

Figure 2: CIGS module with broken cover glass.