Area 8: PV Systems Including BOS Components

PERFORMANCE LOSS OF 5-YEAR-OLD GRID CONNECTED PHOTOVOLTAIC SYSTEM IN THAILAND

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This paper presents the performance loss analysis of 10 kWp grid connected photovoltaic (PV) system operating under Thailand's climate. This system consists of five different PV arrays and one power conditioner containing maximum power point tracking separately in every array. The weather parameters and electrical parameters have been collected every 5 min. The first 5-year data has been used for this work. Special attention has been given to the seasonal variations in losses and the loss trends with increasing operation time. Three types of losses; 1) Thermal capture loss (L_{ct}), 2) Miscellaneous capture loss (L_{cm}) and 3) System loss (L_s) derived according to IEC standard 61724 have been used as performance loss indicators. The annual average of in-plane solar insolation at this test site was 4.8 kWh/m^2/day. The final yield (Y_f) ranged from 1.9 to 5.3 h/d, and annual average performance ratio (PR) was about 75%. Although ambient temperature and humidity throughout the year in the tropics are relatively constant, we found remarkable seasonal variations in performance loss of the PV system. As shown in Figure 1, the analysis of seasonal-dependent loss indicated that in summer and dry season the L_{ct} was severe. In dry season, the L_{cm} was found to be slightly larger, while the L_s tended to be smaller than that of the other two seasons. Relatively large L_{cm} in dry season can be explained by increased soiling loss since there is no natural cleaning by rainfall. Figure 2 shows trends of three losses as a function of operation time. It is obvious that the L_{cm} increased with increasing age of this PV system, while the other two losses varied within a narrow range. These results indicated that the loss due to module temperature and inverter throughout 5 years of operation were relatively constant. On the other hand, the losses generated by energy conduction in the PV modules and mismatch among the modules tended to increase year by year. Degradation analysis of the PV modules in this system is described elsewhere [1]. The overall absolute average daily capture loss (L_{ct} plus L_{cm}) increased from 0.42 h/d in the first year to 0.94 h/d in the fifth year of operation. The database of this case study is useful for a further study on PV performance loss in the tropics and a comparison study with other environmental conditions.

Reference

1) A. Limmanee et.al," Degradation Analysis of Photovoltaic Modules under Tropical Climatic Conditions and Its Impacts on LCOE," Renewable Energy 102, pp. 199-204, (2017).

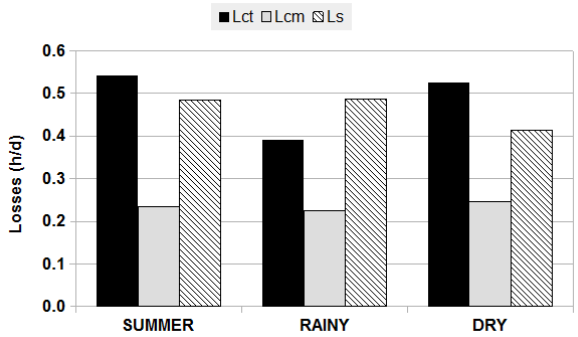

Figure 1: Seasonal variations in energy losses of the PV system in Thailand. Summer (Mar-May), Rainy season (Jun-Oct), and Dry season (Nov-Feb)

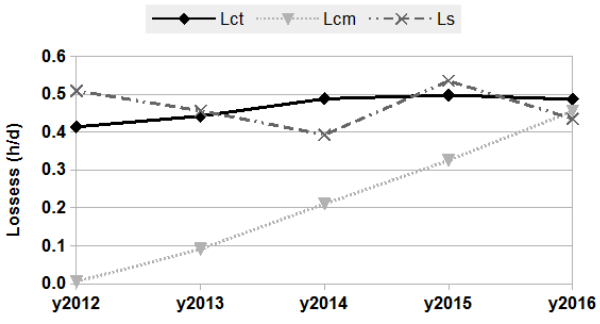

Figure 2: Trends of energy losses of the PV system with increasing operation time.