A Performance Evaluation by Only One Monitoring Data Item for Citizens' PV House Project

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ABSTRACT

An evaluation method which can reveal the performance of operation such as the performance ratio with a very few kinds of data is important. The authors have developed an available method to estimate performance ratio monthly using only system output power data item with Japanese weather observation data. For demonstrating to be availability of this method, in this paper, we evaluated monitoring data obtain from citizens' projects for installing PV systems.

1. Introduction

Beside the government subsidizing system to residential PV installation (120,340 houses by FY 2002), environment-conscious citizens have been introducing renewable energy to their life under several independent original projects with monitoring performance data. Those activities are worthwhile projects, and data are necessary to be effective utilization. Most of monitoring systems, however, are simplified equipments that measure only one parameter, system output power (AC power), because precise equipments - radiometric sensors - seem to be expensive, and measuring several data exactly is difficult - especially irradiation data. In this case, evaluations using monitoring data are restricted, and only observe the fluctuation of system output power under the natural condition. Consequently, the evaluation method which can reveal the performance of operation such as the performance ratio with a very few kinds of data intends to be important. The authors have developed an available method as the part of the sopsisticated verification method [1] to estimate performance ratio monthly using only system output power data item with Japanese weather observation data. For demonstrating to be availability of this method, in this paper, we evaluated monitoring data obtain from citizens' projects for installing PV systems.

2. Movements of citizens for introducing PV systems in Japan

In Japan, green citizens activize diffusing PV systems to their life under their original projects with monitoring performance data. As one of such movements, in 1997 the Seikatsu Club Consumers' Cooperative (SCCC) commenced subsidizing system for residential PV in the Tokyo Metropolitan area by a fund from an electric utility, Tokyo Electricity Power Company (TEPCO). A large number of houses have introduced PV systems from 1997 through 2000: (The total of 77 houses in FY1997 and 55 in FY 1998). Subsidy is given 1.5 million yen to PV capacity of 2.5 kW or larger and 1 million yen to 2-2.5 kW according to 1998 rule. These experiences are now co-owned by Renewable Energy Promoting People's Forum (REPP), joint organization among relating citizen's institutions, and which have been collecting monitored data for 4 years. In REPP's case, each PV systems are monitored by two kinds of measuring system, *i.e.*, simplified monitoring and precise monitoring. The simplified monitoring is specified by the following data for measured every 10 seconds and collected every 30 minutes: PV system output; energy to utility, and energy from utility. The precise monitoring consists of data for every 2 seconds and collected 10 minutes including irradiation, module temperature, inverter real power, inverter apparent power, inverter rms voltage, inverter rms current, inverter reactive power, inverter power factor, utility real power, utility apparent power, utility rms voltage, utility rms current, utility reactive power, utility power factor, inverter power factor, load real power, load apparent power, load rms voltage, load rms current, load power factor, load reactive power, inverter output energy, energy from utility, energy to utility, load energy, and overall efficiency. Presently, operational data are available from systems, 10 precise sites and 112 simplified sites in 8 prefectures around Tokyo up to now. Renewable Energy Promoting People's Forum in West Japan (REPW) plays an active role part in West Japan and support to establish PV system to their houses in collaboration with the electric utility company, Kyushu Electric Power Co., Inc. The monitoring systems are the same as REPP has two kinds of systems and collect data using remote communication tool, PHS. The total of 63 systems - 15 precise one and 48 simplified one - have established from FY 1998 through FY 2001.

3. The evaluation method by using only system output power as monitoring data item

The authors have developed the available method to estimate the performance ratio monthly everywhere in Japan using system output power data with Japanese weather

observation data such as Automated Meteorological Data Acquisition System (AMeDAS) and surface weather observation administered by Japan Meteorological Agency (JMA) that are obtainable via CD-ROM every month. Although the monitoring data is available for only system output power, this method can demonstrate the performance ratio monthly, which needs irradiation data with system output data. In this method, the essence is that the irradiation data is alternated by estimated data from AMeDAS and actual measuring data from JMA. The estimation model of irradiation from AMeDAS adopts the Akasaka and Ninomiya model, which can estimate hourly irradiation data by using duration of sunshine data. This model facilitates to obtain extremely precise data under the fine weather condition, but under the fluctuating weather and clouding are necessary to improve the model or consider the new estimation method. On the other hand, JMA observes actual measuring data of horizontal irradiation every hour, but there are 64 observation stations for JMA in spite of 860 stations for AMeDAS around Japan. Both of them has somewhat lack of utility to alternate irradiation data; however, combining data of each benefit under available weather conditions can afford to estimate irradiation all over the site in Japan. For AMeDAS, the rate of possible sunshine reveals accuracy for estimating irradiation, and which separated the condition bound 0.4. While the rate of possible sunshine is under the condition of less than 0.4, hourly data would rather let actual data in JMA alternate than estimate by using AMeDAS. **Figure 1** shows the flow chart of estimating irradiation method as mentioned above. **Figure 2** gives the estimation result for certain previous sites under REPP project, which measure irradiation data each, so that the result estimated by this method is compared with actual measuring data of performance ratio. The result demonstrates that the relative error of performance ratio between estimation and actual in almost all of the months are under 10 % intends to be available to estimate it.

4. Results and discussion

Figure 3 displaies results of flatulency distribution for performance ratio, which are estimated in regard to the simplification measuring systems - REPP (53 sites) in FY 2000 and REPW (34 sites) through 2001/10 to2002/3 - by the method developed in our lab. The mean of performance ratio is around 60 - 70%, but certain sites has under 50 % of it, and seem to be something trouble, which has been indiscoverable until this point. While those systems collect only system output power, the result elucidates significant information about the operational status of PV systems. In fact, only the performance ratio cannot manifest their problem; nevertheless, the information is useful for the early detection of component fault and helpful for improving system reliability. Once PV systems are established on site, the performance of them has been unapparent with observing only system output power due to the fact that irradiation and temperature influence on PV systems saliently and are unpredictable factors. According to this method, PV systems can be observed themselves operating and intend to be able to drive on for 20 or 30 years sufficiently.

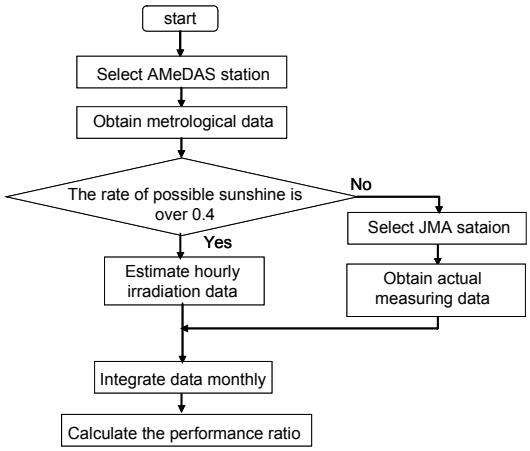

Figure 1: The flow chart of the estimation method for monthly performance ratio

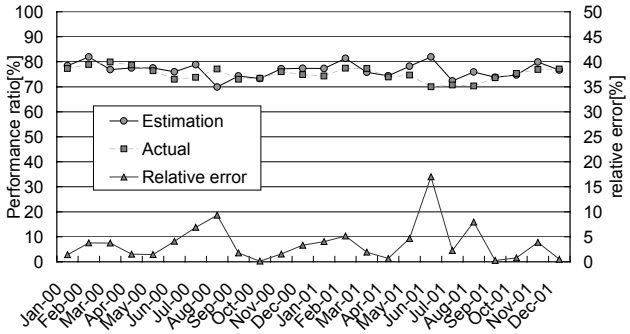

Figure 2: Comparing the performance ratio of estimation data with actual data for monthly performance ratio

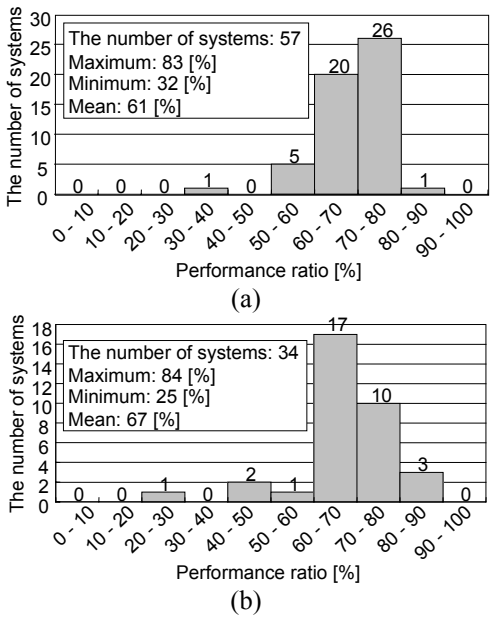

Figure 3: Flequency distribution for estimated performance ratio for REPP(a) and REPW(b) sites from 2001/10 to 2002/3

REFERENCE

[1] T. OOZEKI, K. KUROKAWA, et al: "An Evaluation result of PV system field test program", WCPEC-3rd (2003)