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Islanding prevention performance test of Japanese manufacturers inverters

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Abstract

Popularization of PV systems is accelerating by the powerful policies of government and effect of cost reduction in Japan. As a result, it is feared that PV systems will be connected with high density in some local areas. In this situation, most important issues are the safety and stability of PV systems, especially because dangerous islanding phenomenon could easily occur. To clear the problems, performance tests of islanding prevention, as the safety and durability to daily fluctuation of voltage phase on utility grid or frequency swing in power system accident depends on the stability, were conducted with six types of inverters from the market in Japan at the Akagi testing center of CRIEPI. As a result of the islanding test, it was confirmed that there is no problem in the combination of passive and active islanding prevention method. On the other hand, stability test showed that most inverters are over sensitive as a power source of utility grid. The work has been promoted by NEDO as a part of New Sunshine Project in Japan. © 2001 Published by Elsevier Science B.V. All rights reserved.

Keywords: PV system; High density; Islanding prevention performance; Safety; Stability

1. Introduction

The goal of introducing 5000 MW PV systems was set by the government of Japan. Assuming a reduction in costs, there is a possibility of high-density connection of PV systems in local areas. In this situation, islanding phenomenon may easily happen by mutual interaction of each islanding protection of PV systems. To clear the present status of performance on islanding prevention in high-density connection of PV

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systems, a total of 36 inverters obtained from six manufacturers were tested at the Rokko Test Center for Advanced Energy Systems of Kansai Electric Power Company. In paralleling with the activity mentioned above, detailed in-house tests have been conducted using the performance test facility for PV inverter at the Akagi Testing Center of CRIEPI. For the performance evaluation of islanding prevention, inverters were tested on single operation at various load conditions. For understanding stability in power system swing, the response tests for steep change of voltage phase and frequency swing were conducted.

2. The samples of PV inverter and test method

2.1. The samples of PV inverter

Samples of applied PV inverter are as shown in Table 1. Range of rated power is around 3–5 kW. All inverters have obtained the certificate based on the guideline in Japan. All inverters are equipped with islanding prevention method.

2.2. Islanding prevention performance test

(1) *Test method*. Schematic diagram of islanding prevention performance test is as shown in Fig. 1. The circuit is composed of PV array simulator, PV inverter applied for testing, LCR loads, induction motor with flywheel as a regenerative load, and utility power source simulator. The test is conducted by releasing the switch "S" on various effective and reactive power flow condition to the utility source. In this situation, the length of the run-on time is measured as a scale for evaluation.

Table 1
Samples of PV inverter

Manufacturer	Rated power (kw)	Islanding prevention method	
		Passive islanding prevention method	Active islanding prevention method
(1) Company of A	4.0	Steep change of frequency detection: ± 3.0 Hz	Reactive power variation: $\pm 7\%$ detection: Δf 0.2 Hz
(2) Company of B	3.5	Steep change of voltage phase detection: 8.0°	Frequency shift: ± 5.0 Hz Detection: —
(3) Company of C	4.0	Steep change of voltage phase detection: 3.0°	Frequency shift: ± 0.2 Hz Detection: —
(4) Company of D	4.0	Steep change of voltage phase detection: 8.0°	Frequency shift: ± 3.0 Hz Detection: —
(5) Company of E	4.5	Steep change of voltage phase detection: 5.0°	Reactive power variation: $\pm 5\%$ detection: Δf 1.4 Hz
(6) Company of F	3.3	Steep change of voltage phase detection: 3.0°	Frequency shift: ± 0.1 Hz Detection: —