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**Development of a Plug-in Type Synchronous Inverter for Grid Stability
Enhancement**

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Abstract;

Electric power systems are facing difficulties in system operations due to rapid increase in uncontrollable renewable energy sources, such as photovoltaic power generations (PVs). In West Japan interconnected system, the grid operation is limited by transient stability, which is an important subject to be studied from the point of view of grid operation [1]. From the point of view of demand side approach, it is known from theory that the implementation of virtual inertia into an inverter improves the system damping. However, the conventional inverters are not fully effective for the grid stability since augmented control circuit such as voltage and current control loops considerably disturbs desired behaviors of inverters.

We develop a special type of synchronous inverter (SI) which allows a direct implementation of dynamic characteristic into inverter for grid stability enhancement. This characteristic is advantageous for the stability and reliability design for the whole grid as well as for independent micro grid operation. Other advantageous characteristics are that the developed SI is a plug-in type that works connecting to a single-phase network and has a capability to constitute a single phase micro grids.

We first present an outline of the proposed SI, and then examine its dynamic performance for the enhancement of grid stability. This examination is performed by laboratory experiments. We realize the dynamics of the X_d' generator model in the developed SI, which is able to be used in conventional analysis tools for power system stability. We also study quantitatively the system damping of West Japan system assuming that a large amount of the proposed inverter is introduced.

Finally, we demonstrate an independent micro grid operation using five inverters. Low voltage distribution line of 100 [V] is used with real loads, which works successfully even when a short circuit fault occurs.

[1] N. Yorino, Y. Sasaki, "Power System Reliability Monitoring and Control for Transient Stability", The 14th International Workshop on EPCC, Wiesloch, Germany, May 14-17, 2017