Demonstration results of High Penetration Remote Microgrid on a Korean Island

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Abstract

Global temperature is getting warmer and warmer due to the use of the fossil fuel. Electrical power system is one of the largest consumption part of the fossil fuel. To reduce the consumption of the fossil fuel, most governments and the utilities are trying to adopt the renewable energy into their power system including the isolated small power system.

Power supply in isolated regions far from land, including islands, is typically provided by small capacity diesel power plants. To overcome the high cost of diesel fuel in these small-capacity electrical power systems, and to prevent environmental pollution, a hybrid power system has begun to be applied, including in Alaska (USA). A hybrid power system is a diesel power plant system interconnected with a wind-turbine generator (WT) and photovoltaic (PV) array [1]. However, a restriction on renewable energy capacity that can be interconnected with a diesel power plant is still applied on account of the output variances of WTs and PVs. An attempt has been made to add a large capacity battery to the hybrid power system to solve the above problem owing to the sharp decline in battery prices in recent years. Such a system is called a remote Microgrid (Figure 1) or hybrid Microgrid [2–5]. However, renewable energy or batteries remain expensive, therefore, it is necessary to have an appropriate combination to construct an economically feasible system.

To construct a remote Microgrid, it is necessary to have an optimal system design that considers the power reserve ratio to both ensure the system economic feasibility and maintain the stable operation and rated voltage and frequency of the system. In addition to the above considerations, an appropriate system structure should be considered. The system should be constructed according to the design results; moreover, the design procedure should be validated and fed back through comparisons with long-term operation results. However, no studies have provided such a series of procedures.

This paper presents the demonstration results of high penetration remote Microgrid in Korean island. Schematic of system and long-term operation results are included. We could reduce about 78% of the fuel consumption and 607t of CO2 emission during 2015 year.