Plant management tools tested with a small-scale distributed generation Laboratory

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a b s t r a c t:

Optimization of power generation with smart grids is an important issue for extensive sustainable development of distributed generation. Since an experimental approach is essential for implementing validated optimization software, the TPG research team of the University of Genoa has installed a laboratory facility for carrying out studies on polygeneration grids. The facility consists of two co-generation prime movers based on conventional technology: a 100 kWe gas turbine (mGT) and a 20 kWe internal combustion engine (ICE). The rig high flexibility allows the possibility of integration with renewable-source based devices, such as biomass-fed boilers and solar panels.

Special attention was devoted to thermal distribution grid design. To ensure the possibility of application in medium-large districts, composed of several buildings including energy users, generators or both, an innovative layout based on two ring pipes was examined. Thermal storage devices were also included in order to have a complete hardware platform suitable for assessing the performance of different management tools.

The test presented in this paper was carried out with both the mGT and the ICE connected to this innovative thermal grid, while users were emulated by means of fan coolers controlled by inverters. During this test the plant is controlled by a real-time model capable of calculating a machine performance ranking, which is necessary in order to split power demands between the prime movers (marginal cost decrease objective). A complete optimization tool devised by TPG (ECoMP program) was also used in order to obtain theoretical results considering the same machines and load values. The data obtained with ECoMP were compared with the experimental results to obtain a broad validation of the optimization tool.