REAL-TIME OPTIMIZATION AND EXPERIMENTAL VALIDATION OF SMART POLYGENERATION GRIDS WITH THERMAL STORAGE DEVICE

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ABSTRACT

The experimental plant developed by TPG for studies on distributed generation systems was used for optimization tests. The facility is based on two co-generation prime movers, a 100 kWe gas turbine (mGT) and a 20 kWe internal combustion engine (ICE) connected to an innovative thermal distribution grid. The piping layout was developed to obtain the highest flexibility level for connection with thermal storage devices. The resulting test rig constitutes an experimental hardware platform for assessing, on a real basis, the performance of different optimization tools able to choose, in real-time mode, the "best" operative conditions. Therefore, a real-time software was developed to calculate marginal costs of plant operation and to optimize the polygeneration grid management.
In the initial experimental campaign only the individual generators were considered. Standard management (electrical load following thermal demand) and optimized operation with thermal storage approach were compared. The main results are related to the optimization tests using the real-time software. Both electrical and thermal demand values were considered for operation with the mGT, the ICE and the grid. A result comparison was performed for the grid operated at constant storage set-point value and with a constrained optimization approach.

Keywords: smart grids, distributed generation, thermal storage, optimization, real-time software