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PA3.2 Task 5: Test under real conditions of innovative products for the building sector

Performance analysis and collection of experimental data on the micro-cogeneration system based on micro turbo-gas turbines and installed in the AREA Science Park campus of Basovizza

EXECUTIVE SUMMARY

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ver. 0.1	Experimental data and software description	SA	RT, DM
Release	**Description**	**Authors**	**Review**

1. INTRODUCTION

The EU climate and energy package "20-20-20" proposes a project to support the social economy of the European market in the next decade by identifying some priority areas. Among these is sustainable growth that requires the promotion and widespread use of high efficiency energy production technologies with low emissions of carbon dioxide. Whereas, according to recent estimates, 40% of primary energy in Europe is consumed by residential building, so it appears fundamental to act in this sector with projects targeted testing of technologies for the efficient and effective use of energy resources. Furthermore, in order to increase energy efficiency in the civil and industrial sector, it appears important to increase the use of distributed energy production systems consisting of medium-small size units connected to the distribution networks of the electrical energy in order to:

- feed electrical loads in the vicinity of the generating unit itself, very frequently in co-tri-generation configuration for the exploitation of the heat;
- optimal exploitation use of local renewable energy sources;
- reduce losses in distribution and transmission of electricity with simultaneous limitation of voltage drops on the lines of the final users.

2. PILOT ACTION DESCRIPTION

The pilot action includes the valorization of ideas and innovative companies in the field of renewable energy and energy conservation through the study of demonstration plants that are also laboratories of technological development and industrial experimentation. In this way, universities, research institutions, companies and public administrations can learn and compare the results of technical, environmental and economic impacts of proposed innovations. The plant in question is a CHP (Combined Heat and Power) system consisting of two gas micro-turbines (Turbec model T100-PH) fed by natural gas. One of the two turbines (MTG2) is for experimental use, therefore, it was instrumented with additional sensors that allow to accurately calculate the efficiency in various operational conditions and with various types of fuels. The MTG2, in addition to natural gas, can also be fed by gas of different composition. These are stored at high pressure in a cylinder site in the immediate vicinity of the plant which constitutes the secondary system of the fuel supply.

2.1 OBJECTIVES

The experimental activity planned by the pilot action is addressed:

- to the evaluation of parameters of operation of the CHP unit and its components;
- to the monitoring of the factors influencing the performance in both thermal and electrical different conditions of use;
- to compare, for the same environmental conditions, the actual performance and profitability of co-generators with internal combustion engine fueled by natural gas co-generators with those with gas micro-turbines;
- to develop simulation and analysis tools aimed at saving fuel and reducing harmful emissions in buildings (ENPAT).

2.2 PILOT ACTION'S INDUSTRIAL FALLOUT

The cogeneration plant based on micro-turbines is born, as well as for the sake of experimentation, with the intent to disseminate the findings to research institutions, companies, individuals working in the sector and ordinary citizens with a realistic chance to visit the. The use of cogeneration plants of this type which are characterized by a high overall efficiency is certainly an excellent source of savings for public or private business realities that require the use of combined heat and power.

2.3 ENVIRONMENTAL IMPACT

The main environmental benefit of this pilot action (cogeneration) is:

- lower CO_2 emissions;
- lower pollutants (NO_x, CO) emissions;
- lower fuel consumptions.

3. MAIN RESULTS

As for the experimental data on the gas turbine micro-cogeneration system, the manufactures specifications have been confirmed. It has been measured that the electrical efficiency decreases with load. This behavior is completely different with that observed on the variable speed internal combustion engine micro-cogeneration system, where the efficiency continues to be high even at reduced loads.

Using the energy performance analysis tool many different scenarios have been assessed.

In particular, it has been shown that this kind of generation system can extend the grid flexibility when important amount of PV is introduced in the grid. This is because the considered micro-cogeneration system responds quickly to load changes.

4. CONCLUSIONS AND TECHNICAL-ECONOMIC FEASIBILITY

The pilot action has allowed to deepen energy issues that in the recent years have attracted attention. This work presents the main results of an experimental analysis on an innovative micro-cogeneration system confirming the usefulness of monitoring energy systems of this type and highlighting the critical aspects of the management of such facilities. The high-efficiency distributed cogeneration, that offers high values of the Primary Energy Saving Index (PES), is foreseen to be a very promising technology in order to reduce primary fuel consumption. The experimental data collected during the tests have been used also to implement an energy performance analysis software design tool that allows to identify the optimal system configuration and operating strategy in order to minimize fuel consumption, both in the residential building sector and in industrial premises.

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