



**Distributed
Generation
with
High
Penetration
of
Renewable
Energy
Sources**

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Result realised by:

CESI



The Distributed Power Generation Test Facility in CESI

The DG test facility in CESI

The first step of the construction of the test facility for the Distributed Generation has been completed in CESI. From the end of this year the first experimental activities will begin. In the test facility now two MV to LV supply points are available, from two different substations from a MV supply ring. One of the supplies is connected to a power interconnection board, which can provide a 500 KVA configurable connection between the external distribution grid and the local generation and load system. A second additional connection with the same characteristics will be available at the end of next year, when the MCFC-microturbine plant will be completed. As planned, a microturbine co-generation system has been added and has started the production of electricity and heat. For the next year further improvements are planned. A customized power inverter and

a programmable load system will be added to the test facility in order to permit, from the end of year 2004, the execution of experiments of connection and disconnection of the local LV distribution from the distribution grid. The inverter, coupled with a storage system, will maintain the stability in the micro-grid when disconnected from the grid during transient condition, while the control system of the DG will work to the long term stability

and to the optimal use of the available power generation sources. The Inverter system, built on CESI specification, will also be used to test different solution for the interconnection and the stabilization of several power sources when connected together on a low voltage DG network.

Results:

- > *The DG test facility in CESI is ready to start the work*
- > *Two MV/LV substations and a configurable interconnection board are available in the test facility.*
- > *The Microturbine cogeneration test plant has been completed*
- > *The first four generation plants (Microturbine, PV fields, dish Stirling, Battery laboratory) are ready for the first experiments*
- > *Power and control lines are available in all the generation, storage and interconnection areas*
- > *DG experiments will begin from the end of year 2003*



The dish Stirling generator

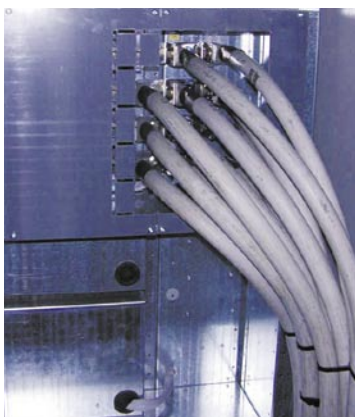


MV and LV supply, switching and interconnection boards for the test facility

Technical details:

The test facility has been built by connecting existing and new laboratories in which different generation technologies are under test. The laboratories generators and loads are connected together by mean of a LV interconnection board and LV cable lines. The interconnection board is provided with current transducer and voltage test points in order to permit the measurement of the flow of the electrical power. The interconnections can be changed manually or by mean of remote commands from a computer.

Two connection points to the internal MV distribution ring are available, by mean of two MV/LV transformers.



The main LV supply cables to the test facility

At the end of the year 2003 the test facility is composed of:

- Two supply substations each with a 800KVA MV to LV transformer
- An interconnection board with two power bus bars (500KVA each), four generator connections bus bars, four load bus bars
- 10 kW hybrid PV system
- 10 kW solar thermal dish Stirling
- 100 kW microturbine
- 45 kW vanadium redox battery
- 100 kW flywheel
- The interconnection cables between the generators, the interconnection board and the first of the supply substations
- A digital control network based on optical fiber available on each generation area and each supply and interconnection point
- A first basic control, measurement and supervision system

Further developments are planned for the test facility in the year 2004:

- The expansion of the system with new LV cables, components and connections
- The completion of the hybrid MCFC (fuel cell plus microturbine) laboratory
- The construction and installation of a 3-phase inverter system specifically designed for DG experimental applications
- The installation of a controlled 3 independent phase load system
- The installation of a new organic Rankine cycle generator from biomass combustion
- A further expansion of the microturbine co-generation laboratory
- The continuation of the development of the integrated control measurement and supervision system, with the first integration of external contribution
- The predisposition, for the integration, from year 2005 of several other generation technologies, mainly based on the utilization of different kind of fuel cells
- Power line and wireless communication will be tested and gradually integrated in the DG control system of the test facility

MASTHEAD

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