



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

www.dispower.org
info@dispower.org

Result realised by:

CESI



CESI EuroDish solar generator a new and alternative way to produce solar electricity at reduced scale

Results:

Dish-Stirling solar generators represent a new and alternative way to produce solar electricity at reduced scale. The progressive electricity market liberalisation and the demand for environmental friendly technologies could facilitate their diffusion in Italy in the next future. In view of these perspectives CESI, which acts in support of the Italian power sector on behalf of the Italian Authority for gas and electricity, decided to install and operate a sample of the Eurodish, the unique dish - Stirling generator fabricated and proved in Europe.

EuroDish is a solar thermal generator with a nominal electrical power of 10 kW_e at 1000 W/m² of Direct Normal Insolation. The power is delivered at 400 V, three phases, 50 Hz by means of an asynchronous generator running at 1500 rpm suited for grid connection.

- > EuroDish generator installed in July 2002
- > Operated progressively during the first 300 hours
- > 800 hours of operation scored at December 2003 with 2500 kWh_e produced and delivered to the low tension grid
- > Remoted surveillance implemented
- > Overall good reliability and satisfying performances
- > Max peak power at 8 kW_e net
- > Max net efficiency of solar energy to electricity of 16%.
- > Excellent reliability of the SOLO 161 Stirling generator

The EuroDish is comprised of a reflecting parabola which concentrates the direct normal solar radiation on the receiver of the Stirling motor placed on the focus. By means of the heat supplied to the receiver at temperatures in the range of 800-650 °C, a gas (helium) drives a closed Stirling ther-

modynamic cycle inside the motor, producing mechanical work, which is converted in electricity by means of the asynchronous generator.

A two axis tracking system, software driven, permits to maintain the dish pointed on sun during the day.

Eurodish has been designed to operate autonomously without direct surveillance, following the sun path day by day with automatic switch off at sunset and restart at dawn.

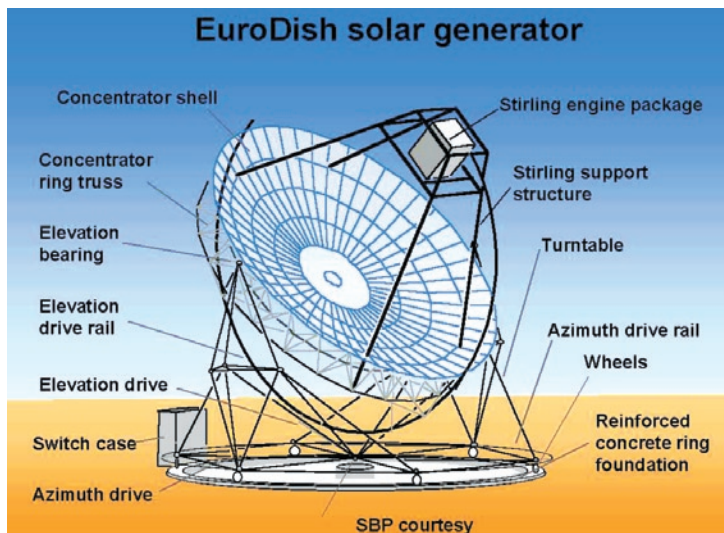


The Eurodish generator in operation at CESI Milan

Technical Details:

EuroDish is a solar thermodynamic generator capable to operate autonomously without surveillance on site. It consists of 5 main components: the concentrator, the rotating turn table, the SOLO 161 Stirling solar unit, the tracking system and the electronic control. The parabolic mirror is realised gluing together 12 pre-mirrored fiber glass sectors and it is fixed to the stiff structure of the concentrator. It has 8,5 m of diameter, a focal length of 4,2 meter and can rotate along the vertical plane following the elevation of the sun during its path. The concentrator is sustained on two bearings fixed on a "turn table" consisting in a steel frame capable to rotate along the horizontal plane to follow the azimuthal motion of the sun. A solid, precise flat concrete foundation permits the perfect horizontal movement of the turn table which moves thanks to 6 wheels. When the dish is pointed to the sun a flux of reflected radiation, equivalent to more than 2000 sun, strikes the flat tubular receiver of the Stirling motor. The receiver absorbs the radiation and is warmed at more than 800 °C.

The SOLO 161 is a Stirling engine that uses helium (or hydrogen) as working gas. When the receiver is illuminated, the helium flowing inside is heated at 600 °C and the power production becomes possible. A circulation of water cools the gas at one side of the motor closing the thermodynamic cycle. The motor is stably connected to a 400V



EuroDish components

three phases 10kW_e asynchronous generator which delivers electricity to the grid and, being phased with the grid frequency, keeps the speed motor at 1500 rpm. The regulation of the power is obtained controlling the quantity of helium inside the motor: the more the thermal input rises the more the pressure of the helium increases. The increase of the power imply an increase of the phase angle in such a way that the speed passes from 1500 rpm at 25 bar up to 1530 rpm at 150 bar.

A tracking system, software controlled, maintains the dish pointed toward the sun permitting a continue operation. A sophisticate software controls all the functions of the dish, including the motor regulation, the switching on and off, at sunset and at dawn. A severe control of the parameters permits to protect the motor

from damages that can be originated from the extreme temperatures of the receiver. The software permits the dish to operate without personnel on site, alternatively a remote control is possible.

During the first year of test Eurodish showed a good overall reliability and, despite of the whether condition of north Italy, was operated for 800 hours only during the working days. The behaviour of the motor was excellent although minor troubles emerged from some other conventional components of the system. Ordinary maintenance was very reduced, extraordinary maintenance of the motor is expected after 2000 hours. Dish Stirling technology made important progresses during the last decade and EuroDish is a clear example of them. Even though there is still room for improvement of reliability and efficiency, this system is today close to the market standards.

A limited production of hundreds of stokes per year would imply a dramatic reduction of installation cost and, as a consequence, a direct competition with the photovoltaics. In longer time dish - Stirling are expected to become competitive with the diesel generation in sunny isolated areas and small islands.



The SOLO 161 Stirling motor solar unit open before the installation

MASTHEAD

The project DISPOWER is partially funded by the European Commission, DG Research
Duration:
01.01.2002 - 31.12.2005
Contract no.
ENK5-CT-2001-00522

Co-ordination

ISET e.V.
Prof. Dr. Jürgen Schmid
Königstor 59
D-34119 Kassel
Phone: +49 561 7294-0



Fraunhofer ISE
Dr. Tim Meyer
Heidenhofstr. 2
D-79110 Freiburg
Phone: +49 761 4588-0



Liability

The authors are solely responsible for this publication, it does not represent the opinion of the European Community and the European Community is not responsible for any use that might be made of data appearing therein. Despite thorough control all information in this brochure is provided without guarantee. Under no circumstances will liability be assumed for loss or damage sustained through the use of information provided.

Authors

CESI: Centro Elettrotecnico Sperimentale Italiano Giacinto Motta S.p.A.

Contact:
Vittorio Brignoli,
Via Rubattino 54,
I - 20134 Milano / Italy,
Phone:+39 0221255721
Fax: +39 0221255626
email: brignoli@cesi.it

Date: 2004-01-08
No 08