

LEEE news

EDITORIAL

Dear readers,
as for the www.lee.e.supsi.ch website, the LEEE news changed in structures too. Information are divided on the basis of the main LEEE activities:

- Photovoltaic
- Geothermal
- Ecology
- Solar heating
- Building energy
- Heat pump
- Energy quality retrofit

Results of the 2 years analysis project of a **heating system** exploiting both **geothermal** and **solar energy** are shown in this issue.

The LEEE shares, as expert in the environment area, in a **CTI project** for the drawing up of a **corporate social responsibility** (CSR) manual for small medium enterprises (SME).

The UFE assigned to the LEEE the task for the **translation** of the **Penta Project** documentation and of the catalogues with **u coefficients for new and renovated buildings**.

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1

Editorial
Photovoltaic

2

Geothermal

3

Ecology
Energy quality retrofit
News

4

Terminology
Calendar
Good links

PHOTOVOLTAIC

The PV modules electrical behaviour at different temperatures condition is an important aspect to take into account in the design of a PV system.

In addition to the electrical characteristic measurement at Standard Test Conditions STC (25°C and 1000 W/m²) the LEEE offers now the PV modules temperature coefficients (α and β) determination as service.

For the execution of measurements at different temperatures the module temperature has to be stable and uniform; for this reason a thermostatic chamber, specially developed for the LEEE, was acquired.

The procedure for the temperature coefficients determination has been defined as follow: measurement of the I-V characteristic at 5°C intervals, from 25°C up to 60°C (9 measurements). Measurements are performed gradually heating the module (not during its cooling), and when it has reached the required temperature for 5 minutes at least.

The LEEE is now preparing the documents required for this test

accreditation in 2005, on the occasion of the next quality audit.

6th European Framework PV Co-ordination Action (01.12.2003 - 01.03.2006)

The overall aim of the co-ordination action PV-Catapult is to strengthen the position of electricity generation by means of PV industry and PV and PVT (PV thermal systems) research within the European Union.

The consortium, composed of 18 partners, points to accelerate the PV market development by means of various strategic actions, which are defined within the single work-packages of the project. A nearer description of these actions can be found in the official internet project web-page www.pvcatapult.org.

The LEEE is involved in work-package 8 and 9 of this project. The goal of the mainly by testing laboratories and research institutes composed working group, is to identify the main problems in PV module measurement procedures and energy rating predictions of all PV technologies by

means of questionnaires, workshops and measurement inter-comparisons. The activities of this part of the project started the end of this year and first results will be published within the next European PV conference in Barcelona (Spain).

GEOTHERMAL

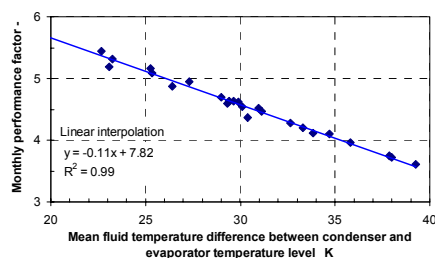
The analysis of a heating system using geothermal and solar energy in Lugano – Loreto has been performed with a monitoring campaign of 2 years and completed with detailed dynamic system simulations. The main results of the project are summarised in this edition.

A heat pump (PAC) of 14 kW thermal power (B0/W35) is coupled to 3 borehole heat exchangers of 80 m length each. It heats a single family house of about 250 m² of heated floor area. Thermal solar collectors (area of 7.8 m²), sized for hot water production, may also be used for heating. During Summer, non used solar heat is injected into the ground with the borehole heat exchangers.

The system success depends on the material quality used, professional competence of the various companies involved and a good coordination between them. After two years of measurements, the thermal performances of the system are still very high and no decrease of performance has been detected. A seasonal performance factor (SPF) of 4.1 to 4.2 is measured for the heat pump. This value is high for the heating of a house whose construction dates from the 80's. Characteristic values for the borehole heat exchangers are deduced from the measurements. These latter also confirm the heat pump thermal performances given by the manufacturer (the heat pump has a quality label). The monthly performance factor (PF) varies from 3.5 to 5.5. A linear dependence is observed between the monthly PF and the mean temperature difference between the heat carrier flu-

ids circulating respectively in the condenser and the evaporator. A sensitivity of -0.11 SPF per additional Kelvin degree is deduced from the measures.

The solar heat injected into the boreholes makes the temperature level of the heat carrier fluid rise up to about 20 °C. The corresponding heat injection rate is about 20 W/m, which is not very



large. This power is typical for a direct cooling case (also called "geocooling"), where cooling is realised without the use of a cooling machine. It is thus essential to have the possibility to fulfil a cooling requirement with a temperature level greater than 20 °C, if a geocooling system is foreseen.

The non used solar gains injected into the ground represent 20% of the annual extracted energy. The analysis of the recharge effect showed that the improvement of the heat pump SPF is small. It does not compensate for the additional electric energy consumption induced by the circulation pump when solar gains are injected into the ground. However, the overall system efficiency is only slightly decreased (1 to 2 %). The solar recharge of the ground proves to be an interesting solution to avoid overheating problems in the solar collectors.

Due to the relatively low injection power (20 to 30 W/m, corresponding to 1 m² of glazed solar collector per 30 m of borehole heat exchanger), a smaller flow rate for the recharge operation is possible. The electric consumption of the circulation pump would be smaller, leading to a neutral effect on the overall system efficiency.

The analysis of the ground solar recharge required the development of a TRNSYS simulation

model. This latter has been calibrated on the two-years measurement campaign. The measures' good quality (5-minutes timestep, temperatures and energy fluxes measured with a good accuracy, no loss of measurements), allowed us to perform an accurate calibration of the model on both the short-term system dynamic and the long-term effects in the ground. A 1-minute simulation timestep has been set for the simulation of the heat pump operation. The model has been used to assess the thermal performance's sensitivity to main system parameters. Two parameter categories were identified: the integration parameters and the sizing parameters.

The integration parameters, as the forward fluid temperature in the heat distribution, are determinant on the heat pump seasonal performance factor (SPF). They only have a modest effect on the minimum temperature of the heat carrier fluid in the boreholes. They are primarily dealing with the integration of the system and the borehole heat exchangers in the energy concept of the building. An optimal integration allows to deliver heat at the lowest temperature possible.

The sizing parameters primarily determine the technical feasibility and the long term viability of the system. They have to guarantee that the heat carrier fluid temperature in the borehole heat exchangers always remains within fixed limits, both under short-term effects, due to the dynamic evolution of the system operation, and long-term effects, after the ground temperature in the borehole zone has stabilised. By opposition to the integration parameters, they have a small influence on the SPF, but are determinant on the minimum fluid temperature in the borehole flow loop. The total borehole heat exchanger length, the initial ground temperature and the ground thermal conductivity are the most important sizing parameters (without the presence of a

ground water flow).

The thermal heat capacity of the heat carrier fluid and the borehole heat exchangers, as well as the heat transfer of the horizontal connections, did not have a sensible influence on both the SPF and the minimum fluid temperature in the borehole flow loop.

The SPF sensitivity to the temperature level showed that a 1 Kelvin decrease on the heat carrier fluid temperature in the condenser has a greater effect (0.10 SPF/K) than a 1 Kelvin increase in the evaporator one (0.07 – 0.08 SPF/K). This highlights once again the importance of the integration parameters, which require a special attention in the system concept (including the heat distribution), so that the heat pump thermal energy can be delivered at the lowest possible temperature level.

A correlation between the SPF and the performance coefficient (COP), estimated on the basis of the extreme fluid temperatures in the condenser and the evaporator, and the thermal characteristics of the heat pump, showed that the COP is usually 0.4 to 0.5 lower than the SPF. The difference is reduced to 0.1 – 0.3 if the electric energy of the circulation pumps is taken into account in the SPF. In other terms, the determination of the SPF with the extreme temperatures provides a conservative estimation of the electric energy consumption of the system, circulation pumps included, with an error inferior to 10%.

The TRNSYS simulation model has been used to perform a comparison with the simplified EED programme (Earth Energy Designer). For the studied system, EED allows the user to make a conservative and satisfactory borehole sizing. A recommendation list has been established for the determination of some calculation parameters.

The developed simulation model in this study is easily adaptable to another project. Its flexibility

makes it possible to couple it to a building simulation model which also includes the distribution of thermal energy (as concrete active plates). The model may thus be used to assess concepts of ground coupled systems with borehole heat exchangers and determine for each of them the “geocooling” potential.

ECOLOGY

Responsabilità sociale delle imprese

The interest in the corporate social responsibility subject (CSR) is increasing. Many big enterprises, both of production and services,



edit the CSR reports; investors and financial bodies are interested in ethical problems. The project aims to study some crucial points in detail.

- What does Social Responsibility mean for a small medium enterprises (SME)?
- Is this a passing business fashion or something that, in future, could influence the way to decide and operate of a company?
- Which are the requests and the attitude of PMI stakeholders?
- How is the CSR received and implemented in our economical structure prevalently constituted by PMI?
- How a PMI can improve its dialog with stakeholders?
- Which reference models on CSR can PMI use?
- In particular, have the SUP developed competences on CSR to support future managers formation?

The project want to provide valid

answers to these questions and support two PMI in formulating and implementing a CSR strategy, and to verify the results.

ENERGY QUALITY RETROFIT

EPIQR+ for the City of Lugano

The Municipality of the City of Lugano has resolved in September 2004 the proposal of execution of an order with purpose to check the potentialities of the program EPIQR+ analyzing a pattern of constructions, in sight of a possible following acquisition. For the test they have been select two buildings, a school (elementary school Lambertenghi) and a residential building (16 flats in via Trevano).

News

In **2003** the solar cells world production rose to **742 MW**, a jump of 32% in just one year! A cumulative world production equal to 3'145 MW has been reached over the last five years. Such a data represents the potential energy enough to meet the electricity needs of more than a million homes. This extraordinary growth is due to some degree by improvements in materials and technology and, above all, by market introduction programs and government incentives.

September 2004, Espenhain (Germany): the “Solapark Leipziger Land”, the world’s **largest grid connected PV plant**, has been officially opened. It consists of 33'500 modules for a total output of **5 MW**. The power generated from the solar park will be fed into the grid and will be sufficient to meet the electricity demand of about 1'800 households. The solar power station will save some 3'700 tonnes of carbon dioxide emissions annually. The modules are mounted on a special designed wooden system of robin wood, which should stand extreme weather conditions.

PVTECH 2004: First Italian PV conference for industry

The first edition of the PVTECH conference took place in Milan from the 28th to 29th October 2004. It was the first PV conference in Italy, to be entirely dedicated to Italian PV manufacturing and processing industry.

In this occasion experts and researchers of the Italian PV market meet together to present their latest news and products, ranging from raw material production and manufacturing machines for all major production steps, to the final product (PV cells, modules, connectors, inverters, systems, etc.) as well as their integration into buildings and the for industry available services.

Within the by Angelo Bernasconi chaired session on the topic "PV module production and integration into buildings" a presentation about the main PV activities of our laboratory, entitled "requirements for the production of modules has been hold.

Terminology

Temperature Coefficient of a PV device: the amount that the voltage, current, and/or power output of a PV device changes due to a change in the cell temperature.

Current Temperature Coefficient (α): the change of the short-circuit current (I_{sc}) of a PV device per °C change of cell temperature.

Voltage Temperature Coefficient (β): the change of the open-circuit voltage (V_{oc}) of a PV device per °C change of cell temperature.

Crystalline silicon devices usually have a positive α coefficient (current increases at higher temperatures), and negative β coefficient (voltage decreases at higher temperatures). The effect of temperature variation is more evident

for voltage than for current.

Good links

Since September 2004 the LEEE web site layout has changed, adapting itself to the SUPSI design. The content has been completely restructured and organized on the basis of two cross criteria: the activities carried out by the laboratory (photovoltaic energy, geothermal energy, ecology, solar heating, rational use of energy in building, heat pumps and building degradation analysis), and the different guidelines (Research, Services and Education).

Idrogeno Expo 2005

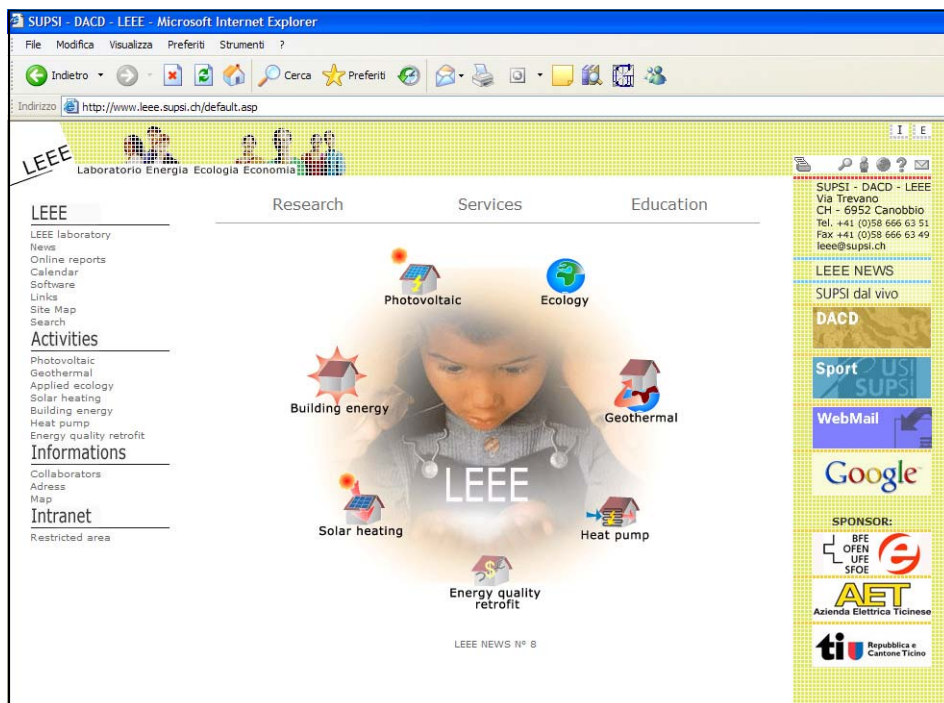
2-6 April 2005
Milan, Italia
www.idrogenoexpo.com

Solarexpo 2005

19-21 May 2005
Vicenza, Italy
www.solarexpo.com

20th European PV Solar Energy Conference and Exhibition

6-10 June 2005
Barcellona, Spain
www.photovoltic-conference.com



The LEEE website is now available both in Italian and in English.

Calendar

Clean Energy Power 2005

26-27 January 2005
Berlin, Germany
www.energy-server.com

20th Photovoltaic Symposium

9-11 March 2005
Staffelstein, Germany
www.otti.de

Sunweek 2005

16-20 March 2005
Bologna, Italy
www.sunweek.it

ACKNOWLEDGEMENTS



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