SolarPACES NEWS

Issue Ten: October 2001

update on solar power and chemical energy systems

The invitation to write this editorial came at the right moment. As some may know, KfW (the German Development Bank) has been committed to the development of a CSP (concentrating solar power) project in India for nearly a decade, in close co-operation with our Indian partners in the renewable energy sector, the Rajasthan State Power Corporation Limited and the Indian Ministry of Non-Conventional Energy Sources. After delays and set-backs, the project "140 MW Integrated Solar Combined Cycle Power Plant" (ISCC) at Mathania near Jodhpur in Rajasthan has made great progress in the last two years, and construction on site is now set to begin in 2002.

The plant will consist of a trough-field with 220,000 m² aperture area, which will deliver via a synthetic thermal fluid - as in the existing Californian plants - the collected solar energy to a steam-generator, whose steam is finally superheated in and mixed with steam from a waste heat recovery boiler behind one or two gas turbines and then converted to power in a steam turbine-generator. Recently the fuel of the gas-turbines has been - for economic reasons - switched from naphtha to re-gasified liquid natural gas (R-LNG).

The feasibility studies, project appraisal and contracts have now been performed or drafted. The Power Purchasing Agreement and FSA are at an advanced stage of negotiation. Project financing has been pledged by a composite loan from Germany, by grants from the GEF, as well as equity and loan contributions from the Governments of India and of Rajasthan. The loan agreement for the German contribution is being negotiated between the Government of India and KfW. The next steps will be the issue of the Request for Proposal to the qualified International Consortia (by November 2001) and the selection of the best bid. This project may be the first one to get off the ground out of the four GEF-sponsored projects of similar size (Morocco, Egypt, Mexico, India).

Meanwhile, the other good news is that the German Government has recently launched a 10,5 million R&D-program on high temperature solar-thermal power generation technologies (trough, tower, dish), which is being managed by KfW. I see it starting at the right time, when the industry is now asked to invest substantially into this promising technology. Demonstration of large scale solar-thermal energy storage and substantial cost reduction in production and installation of troughs are now, in my view, the most urgent objectives apart from further technological improvements. Hopefully the industry will catch the impetus of the moment.

Helmut Ernst
Senior Power Engineer, KfW

Dash for solar power in Italy

Italy's venture to develop concentrating solar power will start with a 4MW demonstration plant at a new ENEA laboratory, Laboratoria Solare Avanzato at Latina, 70 km south of Rome. Here a a range of innovative concepts will be tested. This will lead the way to the development of an industrial scale plant in Southern Italy.

In the race to build the first commercial concentrating solar power plant (CSP) in Europe a recent entrant is rapidly driving ahead. The development of an industrial scale CSP plant in Italy, now firmly underway, is spearheaded by ENEA, the Italian National Agency for New Technologies, Energy and the Environment. And with a budget of two hundred billion lire (approximately $95 million) for a development programme between 2001-2003, the Agency clearly have the level of government support needed to secure complementary private investment.

ENEA are currently planning the international "dream team" of industries who will take part in the development and construction of the plant or will be suppliers of subsystems and components. A September 2001 deadline for application to participate in the programme resulted in a wide range of initial offers currently under consideration. The development programme is to run in two phases, beginning with the construction of a 4 MW demonstration plant at a new ENEA laboratory, LASA (Laboratorio Solare Avanzato) near Rome. This will be followed by the construction in Southern Italy of an industrial scale plant made up of several 40 MWe modules - a prototype for future commercial plants both in Italy and overseas.

Looking ahead, ENEA are also committed to a full investigation of hydrogen production using CSP as an energy source for dissociation. In hydrogen production, the temperatures involved exceed those available from parabolic trough technology, so an extensive programme of R&D will precede further developments. Long term benefits, however, are considerable: ENEA foresee hydrogen playing a role similar to natural gas in the future energy economy.

Behind the vigorous initiative to develop CSP systems lies an in-depth analysis of Italy's medium and long term energy interests. There is a recognition that in the long term solar energy is one of the resources with the potential and durability to match mankind's future needs. While Italy is at present strongly dependent on foreign primary energy supplies, it's geographical location, especially the Southern tip of Italy, is favourable to the exploitation of direct sunlight. Consequently ENEA has embarked on a very substantial renewed effort towards the realization of large demonstration systems with innovative characteristics.

It seems that CSP been selected for particular attention for a number of reasons. First, there are the benefits of integration. Solar concentration has been preferentially selected because it offers the possibility of extending many existing industrial technologies, thus allowing a relatively smooth transition from conventional to renewable energy sources. CSP has also gained acceptance because of the promise of relatively low cost. Internal analysis by ENEA showed that each square metre of solar collector in an optimal location may deliver yearly about the energy equivalent of one barrel of crude oil.

Considerable background work on the prototype plan has already been completed. At ENEA, decisions have been made on the main characteristics of a plant based on parabolic trough technology. Initial analysis has been carried out for a 40 MW plant in the Gela area of Sicily, where solar radiation is particularly high.

One of the innovative features of the prototype plant will be the mirror design. ENEA mirrors are to be made of highly rigid and low weight sandwich panel materials with a thin reflecting glass surface, bonded on one side. The sandwiches are made of a central layer made of aluminium honeycomb, on which two skins are bonded in order to provide adequate rigidity and shape to the whole structure. This design aims to improve thermal efficiency while reducing costs at all levels: in production, installation and maintenance.

The prototype plant will differ from existing Californian plants in the choice of thermal fluid. Given concerns with the dangers associated with the use of mineral oil, the plant instead will use a mixture of sodium and potassium nitrates. An important advantage of molten salts is that they can be used both as heat transfer fluid and as storage medium. This removes the need for a heat exchanger and the associated temperature losses. Consequently a significant part of the system will be the hydraulic circuit for the molten salts which will connect the solar field with the heat storage unit. The ENEA team is convinced that the storage technology envisaged will be extremely cost-effective. Other benefits foreseen include 99% efficiency and little or no environmental impact or hazard, as well as the ability to reach higher operative temperatures (290-550^{o}C) with an increase in the performance of the circuit using solar heat.

For further information see www.enea.it

INDUSTRY *focus*

Duke Solar Energy

Duke Solar Energy, based in North Carolina, is a joint venture between experienced energy, design and construction partners brought together by a shared commitment to renewable energy alternatives. The company is perhaps best known for applying the science of non-imaging optics - developed by Dr. Roland Winston at the University of Chicago - to the commercialization of a new range of high-performance CSP (concentrating solar power) products.

The company's Power Roof^{TM} system is a south-facing high temperature solar energy collector with a fixed reflector and tracking evacuated tube receiver, and north-facing natural daylighting glazing. The system includes a radiant barrier, an insulating system, an optional means to capture passive solar heat in the winter, an infiltration barrier, the building roof structure, and a waterproof roofing system all-in-one. It enables collection temperatures up to 385^{o}C at efficiencies between 40% and 45%. This energy can be utilized in the form of steam for electric power generation, industrial processes, double-effect absorption cooling, desalination and water purification as well as secondary space heating and domestic hot water uses. The first Power Roof^{TM} installation, with a collecting area of 600 m^{2}, is nearing completion in Raleigh, NC at an office and warehouse complex.

Meanwhile the Duke Solar team has developed an advanced non-tracking collector, the Integrated Compound Parabolic Concentrator (ICPC) evacuated tube collector. This device uses a copper or steel pipe with a selective coating containing a fluid that transports the thermal energy to the end-use. This tube is encased in an evacuated glass tube to limit heat loss. While evacuated tube collectors have been available for many years, Duke Solar enhances the efficiency of these tubes by including reflectors, with unique patented optical designs. Absorption cooling is an important application for the ICPC collector notes Gilbert Cohen, who is Duke Solar's Vice President, Engineering: *"With the increased efforts to reduce the release of CFC's into the atmosphere, interest in heat-driven absorption cooling is also growing. Because of this, a new generation of absorption chillers is now starting to come into the market. Duke Solar works closely with major absorption chiller vendors to design the best system for the particular application."*

It also seems that out that Duke Solar have a significant "world first" to their credit. The first solar HVAC system with ICPC collectors and a 2E absorption chiller was designed and installed by Duke Solar staff in 1997 in Sacramento, CA. This system is completing its fourth summer of successful operation. Meanwhile recent business includes the sale of a large solar absorption cooling system in Las Vegas. Here a 440-ton Trane hot water fired 2E absorption chiller will be driven by an array of VAC2008 collectors manufactured for Duke Solar by Solel Solar Systems.

For further information contact: dukesolar@cs.com

Beam-down optics at the Weizmann Institute

The installation of beam-down optics at the Weizmann Institute's solar power tower in Israel marks an exciting step forward for the development of a novel solar tower concept by Israel's ConSolar consortium.

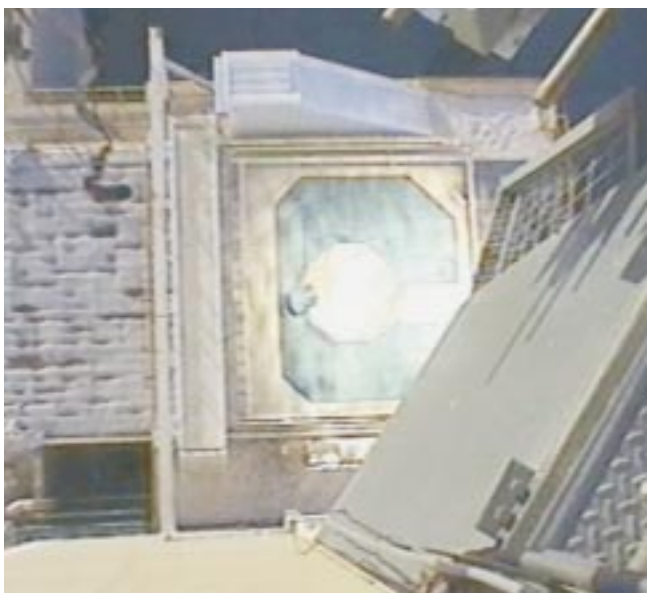
Beam-down optics are part of a total solution aimed at increasing system annual efficiency, such that less heliostat area is required for a given power output. The placement of receivers and power block on the ground also simplifies operations and leads to considerable cost reduction. This configuration, first proposed in the 1970s, was originally considered impractical - but thanks to technological developments this assessment has changed. Given modern high-reflectivity surface technology and the application of non-imaging high concentration principles, this design approach is now seen as a promising concept for large-scale, high-performance solar applications.

The Weizmann Institute's solar tower, on which the optics is installed, is one of the five research solar towers existing in the world. Experiments at a megawatt scale can be performed in the tower at five levels, using highly concentrated solar energy. The new optical system installed on the tower is a 70 m^2 reflector shaped as hyperboloidal section, with its upper focus coinciding with the heliostat field's aim point (top right). The reflector redirects the solar radiation from the heliostat field towards the lower focus of the hyperboloid, near ground level. Final concentration non-imaging devices and receivers are installed below the lower focal point (centre and bottom right). Magnification of the sun image by the hyperboloidal mirror is compensated by the ground secondary concentrator and overall a higher concentration is achieved.

This novel project is an "information sharing" task within Task 1 of the IEA SolarPACES program - the Task which focuses on the ultimate application of complete solar systems and the needs associated with getting them to the marketplace. The ConSolar consortium directly responsible for the initiative is an Israeli industrial consortium specifically created to develop and commercialize Concentrated Solar energy applications. ConSolar members taking part in this Israeli government sponsored project include ORMAT Ind., ROTEM Ind. and the Weizmann Institute of Science. The project is financially supported by the Ministry of Industry and Commerce.

The novel optics are just one part of a solar combined-cycle electricity generation system under development, also incorporating high-performance air receivers and a solar-to-gas turbine interface. The realization of the project follows a detailed technical and economic feasibility study completed in 1995. This study confirmed the high added value of effective concentration technology, indicating significantly higher annual efficiency and significantly lower costs.

For further information:
contact Michael Epstein - jhlang@wis.weizmann.ac.il
or visit http://magnet.consortia.org.il/ConSolar



RIGHT: three recent photos of the solar optics at the Weizmann Institute, Rehovot, Israel, known also as the "Beam-down Optics" or " Tower Reflector". TOP: the reflector illuminated by heliostats. CENTRE: A view of the ground concentrator (CPC) from the reflector. BOTTOM: A zoom into the ground CPC, showing the multi facets of the CPC illuminated by the sun.

Bulletin *board*

CSP "Call for Proposals" in Italy
Italy's multimillion dollar commitment to commercializing a CSP plant led earlier this year to the issuing of a "Call for Proposals" aimed at relevant high-tech industries. With a deadline of 15 September 2001, the Call invited businesses to submit expressions of interest in the development of a 40 MW prototype plant in Southern Italy, preceded by a 4 MW test installation near Rome. (see pg. 1)

New opportunities for CSP in the US
Prospects are good for additional CSP plants being developed in California, Nevada and Arizona, reports Craig Tyner, SolarPACES Executive Committee member for the US. According to Tyner, these opportunities are related to the current energy issues in the Southwest US, especially California. Here shortages of peaking power in both summer and winter have been aggravated by drought in the Pacific Northwest (which provides summer peaking capacity for California) and deregulation of the power industry (which has had a variety of impacts). There is significant interest by the states in renewable power, and the CSP industry in the US is actively pursuing one or more large projects. The next step would involve signing of a power purchase agreement (for renewable, peaking power) for such a plant.

Renewable Energy Directive expected to improve CSP opportunities in the EU
The publication of a Renewable Energy Directive, due this month, is eagerly awaited by businesses working in the field of renewable energy in the European Union. Directives are binding upon each member state to which it is addressed. National authorities, however, may choose the form and methods needed to achieve the results. The SolarPACES Secretariat was involved in scrutinizing the draft Directive and proposed alterations which would improve prospects for CSP.

Solar tariff prospects in Spain
A premium price for solar electricity in Spain is expected to pave the way for new solar business opportunities for CSP. With the legislation now in place, businesses are positioning themselves to take advantage of new markets which will emerge when the "solar tariff" is launched. The German-based company Flabeg, involved in CSP projects around the world, has responded by opening a new office in Aguadulce in Andalucia.

New German R&D programme for CSP
The German government has launched a 21 million DM research and development programme focusing on CSP technologies. The programme, warmly welcomed by the German CSP teams in research and industry, will be administered by the German Development Bank, KfW. The deadline for submitting proposals was September 10th; first contracts are expected to start in November 2001.

SolarPACES Diary
The SolarPACES Task meetings of took place on June 19th and 20th at DLR in Cologne and were lively attended by participants from research and industry. The 5th Cologne Solar Symposium on was held on June 21st Solar Thermal Power Plants and Solar Chemical Processes - Advances and Perspectives for International Cooperation- at DLR in Cologne.

The 61st meeting of the SolarPACES Executive Committee due to be held in Johannesburg in September was postponed to 13 and 14 November in Brussels. In addition to the meeting, ExCo members will update representatives of the Commission on the progress of the international CSP projects and R&D programs. They will also receive information about the CSP perspectives in current and future R&D programmes, in the newly published Renewable Energy Directive and in any updates of the White Paper on Renewable Energy. The 62nd meeting will be held in Madrid on March 19 and 20th, 2002

SolarPACES Symposium 2002
The biennial SolarPACES Symposium will take place next year in Switzerland from 4-5 September 2002. This international conference provides the largest and most comprehensive forum for the latest technological advances in the field of solar thermal electricity production as well as on solar chemical conversion. The symposium will be held at the University of Zurich, Switzerland, overlooking the lake of Zurich and within walking distance from the heart of the city. For further information contact Aldo Steinfeld at solarpaces2002@psi.ch, or visit www.solarpaces2002.ch

NOTE: The SolarPACES Secretariat has changed address - see bottom of the page for details of new contact information.

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SolarPACES is a program of the **International Energy Agency** focusing on concentrating solar power and solar chemical energy systems. As of October 2001 the participating members are:
Australia, Brazil, Egypt, European Commission, France, Germany, Israel, Mexico, Russia, South Africa, Spain, Switzerland, United Kingdom, United States.
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