

IEA/SolarPACES

Task I: Electric Power Systems

Task Meeting Summaries:

Sandia, Albuquerque, USA

16 September 97

CIEMAT, Almería, Spain

3 March 98

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IEA/SolarPACES Task I Participants:

Since the last task meeting summaries published in July, 1997, we have had two IEA/SolarPACES Task I: Electric Power Systems task meetings: one at Sandia National Laboratories in Albuquerque on 16 September 1997, and one at CIEMAT in Almería, Spain on 3 March 1998. Please find enclosed my summaries of these meetings. The table below provides a snapshot of Task I at this time, including all activities currently underway and changes made in coordination with the ExCo.

Task I: Electric Power Systems (C. E. Tyner, Operating Agent)

Sector 1. Central Generation Systems (Meike, Sector Leader)

- System Operations and Maintenance Cost Reduction
- Solar Two
- Phoebus-TSA
- The DISS Project
- Solar Thermal Activities in Israel
- THESEUS Project
- Colon-Solar

Sector 2. Distributed Generation Systems (Mancini, Sector Leader)

- Dish/Brayton Project
- Dish/Engine Compendium
- Australian Activities
- Stirling Engine Exchange Program
- SAIC Utility-Scale Joint Venture Program
- Dish Engine Critical Components Project
- Distal II

Sector 3. START Missions (Geyer, Sector Leader)

Sector 4. Market Barriers and Opportunities (Williams, Sector Leader)

- Market Barriers and Opportunities
- Parabolic Trough Roadmapping
- Life Cycle Assessment of Solar Thermal Components and Systems
- STEPS Expert System for the Market Assessment of ST Power Stations
- SolWin

Thanks for your active participation in Task I activities and for helping expand our areas of cooperation.

Sincerely,

Craig E. Tyner
Operating Agent, Task I

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16 September 97

(in conjunction with Task III meeting and tours of Kramer Junction SEGS plants and Solar Two)

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CIEMAT, Almeria, Spain

3 March 98

(in conjunction with Task III meeting and tours of the Plataforma Solar de Almeria)

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IEA/SolarPACES Task I Distribution

IEA/SolarPACES Task I Meeting: Solar Thermal Electric Power Systems

3 March 1998

Playadulce Hotel, Aguadulce, Almería, Spain

Meeting Summary

An IEA/SolarPACES Task I Meeting on Solar Thermal Electric Power Systems was held in Almería, Spain on 3 March 1998. The meeting was held in conjunction with a Task III meeting and tours of the Plataforma Solar de Almería. An updated meeting agenda, attendees list, and presentation summaries are attached.

Task I Meeting

Tyner started the meeting with a review of the Annual Summary input (as an update of all current activities) and the 1997 Program of Work. The DSG solar fields project of ZSW was dropped (and will be reported in the future as part of DISS), the hybrid activity was moved to Task III, and the Tennant Creek project is completed and will be replaced with a general category of Australian activities. The KSPS project was completed. The Program of Work will only be updated every two years.

Action items from the previous meeting were discussed. The review of the Colon Solar Project remains open as the project status has changed; review of Brazilian Activity has been successfully completed; and the new START Mission selection will be addressed during the meeting.

Sector 1: Central Generation Systems (Wolfgang Meike, Sector Leader)

Israeli/Boeing Tower Project, Michael Epstein, WIS: The first phase, including installation of a tower reflector (74m², >800 facets) on the WIS tower, will be started in Nov 98; they will add the power block and start testing of a complete system in mid 99. The project is a joint program with Boeing/MDA, Ormat, Rotem, and WIS, with funding from US Department of Commerce and the Israeli Ministry of Energy.

THESEUS Project, Michael Geyer, DLR/PSA. The THESEUS project plans to build a trough SEGS-type plant on Crete. It will become an IPP because of legislation for renewable power that provides 10 cents per kWh for solar. The legislation apparently excluded hybrid power plants from the renewables but analysis showed that hybrid may be allowable if it is used only for auxiliary fuel at start up. Therefore, operation will minimize the use of fossil fuels. An environmental analysis will be prepared. 2003 is the date for deregulation in Crete. The project is eligible for Thermie grants (but no money is available); regional EU funds are possible. 20M ECU will be required on top of the 10 cents/kWh.

PHOEBUS TSA Receiver, Peter Heller, DLR/PSA: The TSA advanced air receiver test at PSA continues. 22 new, wire mesh elements are in place to evaluate the durability of a more cost-effective design; upgraded heliostat aiming strategy and grid connection are also being evaluated. Receiver flow distribution tests continued until December 1997. The automatic aim point strategy utilizes TC measurements within the receiver to alter the aim points of the heliostats. Durability of the new elements has been good; some flow distribution issues can be corrected with minor manufacturing changes.

DISS Project, Jose Ajona, PSA: The DISS project will finish Phase 1 this summer, with the installation of a 1 MW thermal string of about 550 meters (3000 m²) of LS3 collectors. Phase 2 (testing of direct

steam generation) is an additional 2 years. Phase 3 will add a second row of troughs. Installation is underway, and the system should be operational by 6/98. Additional activities include a simulation code for DSG, emergency situations analysis, and two-phase flow analysis. Cermet material based on Si and gold seems very promising as a selective absorber with > 0.85 absorptivity and 5% emissivity at 400C. New front surface mirrors are also being developed. A 250m² oil loop is also operational.

Colon Solar, Manuel Blanco, PSA: The Colon Solar project was developed to integrate a small power tower solar plant with an existing, low-efficiency fossil plant. It has been changed to integrate with a new combined cycle plant with a change in regulation that will allow new plants. Solar costs will be about 20 Pts/kWh (13¢/kWh). Funding for the design study includes 40% THERMIE funds from the European Commission for total of 3.22 M ECU (\$3.5M). The solar plant (costing about 16M ECU) will be 21.5 MWt (limited by land availability) using 486 heliostats of 70 m². They expect about one year for the cost and support issues to be resolved.

Solar Two, Craig Tyner, SunLab: Solar Two acceptance testing has been completed and the test and evaluation program is underway. Since November, the plant has been running well whenever weather has permitted. All systems are fully operational. During December, an advanced panel was installed by Boeing/Rocketdyne, and other minor changes were made during a scheduled maintenance outage. Testing is planned through 1999.

Boeing Test Panel Test, Craig Tyner, SunLab: A small molten salt receiver panel (like the new Solar Two panel) was built by Boeing/Rocketdyne to evaluate certain operational conditions (peak flux of 1.6 MW/m², rapid cycling, etc.). The panel was installed over the past several months at the National Solar Thermal Test Facility in Albuquerque, and is currently being tested. Evaluation of the panel under extreme conditions, along with testing of a full panel at Solar Two, will qualify the design and materials for the next molten salt power tower project.

Sector 2: Distributed Generation Systems (Tom Mancini, Sector Leader)

Dish/Brayton Project, Tom Mancini, SunLab. NREC problems with heat exchangers have used all available resources, and project is now on hold. Although some testing has been done on a gas-fired version, no solar testing was done. SunLab and DLR are considering using the VOBREC receiver for a test with Allied Signal.

Dish/Engine Compendium, Tom Mancini, SunLab for Bill Stine, CalPoly. An update of the compendium has been proposed to address Brayton development and other new issues. Although work has been on hold because of lack of funds, recent developments may allow a restart.

Stirling Engine Exchange Project, Tom Mancini, SunLab. Testing of a Solo 161 engine in Arizona with an old Cummins dish is underway. Controls have been modified; facets have been replaced; the engine has been installed; and testing is underway. A heat pipe receiver test is planned for future. The engine was installed in August, and various minor issues have been resolved over past few months. The dish has been operating for about three weeks now in an automated mode. Power output is 3-4 kW. There will be a detailed performance report after 3-4 months. Heat pipe receiver testing at the PSA is under negotiation.

SAIC USJVP, Tom Mancini, SunLab for SAIC. Phase 2 started about one year ago, with redesign of the dish, next generation of STM engine, and hybrid receiver. Phase 2 requirements include 750 hours of automatic operation, and 150 hybrid hours. Phase 2 objectives include a performance and reliability database, and testing of hybrid operation, generator, and power conditioning systems. 5 systems will be installed. The project is currently about 6 weeks behind schedule. The first dish is up, but the engine is not yet installed. The new dish has face-down stow; is 15% lighter and 20% larger; and utilizes a standard structure. The new PCS is smaller; has 1/3 fewer parts; is hybridized with recuperation; and

uses a new heater tube design. About 100 hours of gas testing have been completed. Issues include new dish, receiver, and engine designs, new control system; need for a better design of drive to keep cost lower; ring fabrication; welds; hydrogen leakage; and Phase 2 schedule.

Allied Signal Dish/Brayton DECC Project, Tom Mancini, SunLab. The objective of this dish/engine project is to test a Brayton PCU on a Sandia TBC. It will use a gas-fired turbo gen set. Testing is scheduled to begin in summer 98. There is considerable interest in a volumetric receiver from either DLR or WIS.

Australian Activities, Wolfgang Meike, PAWA. Utility restructuring has limited interest in solar thermal, requiring near-term profit. No work in dish area will continue in this current environment. Renewables not looked at favorably because of potential impact on coal industry. New legislation may require generators to produce 2% by renewables in the near future. There is some controversy over how much CO₂ is emitted by coal industry. The consortium supporting dishes has evaporated, although there are still some positive messages. They are searching for additional partners to cover SolarPACES funding, and are hopeful.

Distal II Systems, Peter Heller, DLR/PSA. 3 new systems are installed and operating. New systems are 10 kW; new Solo 161 engine; tracking system is fully automatic; 8.5m diameter; one host PC for 16 systems; fully automatic operation; alpha type engine with direct illumination receiver with new receiver geometry (reduced thermal stresses); better heat transfer with more uniform illumination. 9 Solo units have over 30000 hours of solar and cogen operation. Open loop control with one time correction for foundation; could produce 3 additional units for 21k DM/kW (\$11k/kW) ; 100 units for 12kDM/kW (\$6.5k/kW) (as part of Eurodish effort). New activities include hybrid heat pipe test (HYHPIRE) as well as Thermacore heat pipe. SBP will sell a dish for 250k DM (\$135k) with one-year warranty. They are continuing work in the cogen sector - targeting one year maintenance interval. (EU program is targeted to 6k ECU/kW (\$6.5k/kW), competitive with PV.)

Sector 3: Start Missions (Michael Geyer, Sector Leader)

The START mission report from Jordan is complete and a copy provided. Abu Dhabi is willing to lend up to \$134 Million (50%) to the project. Jordan is willing to prepare a request to the GEF. Sumitomo Bank is willing to host a meeting to discuss financing. Bechtel and Pilsolar are planning an industry mission to Egypt and Jordan.

As follow-up to the START mission to Egypt, Egypt has submitted an official proposal to the GEF. The first phase study would be completed in Jan 99 for \$350k, with a potential project to start in 2001.

The START Mission from Brazil will be available in a couple of weeks. Eduardo Serra, CEPEL, had previously requested help in reviewing their proposal to the GEF. Based on that review (headed by Patricia Cordeiro of Sandia) they have received a \$300K grant for a preparatory study to analyze all possible solar thermal technologies (observers of the study include Argentina, China, India, Morocco) and hold international workshops to discuss options with the international community.

Regarding future START Missions, interest has been expressed from Chile, Argentina, South Africa, Namibia, Zimbabwe, and Uzbekistan. Geyer proposed the next START mission be to southern Africa (including South Africa and Namibia), with planning beginning in April 1 and the mission in Summer 98. Chile and Argentina might then be considered for future activities. DLR and TFC have received a 125 kECU grant from the EU to support START missions.

Carlos Ramos, IIE/Mexico discussed the status of Mexico projects being impacted by the internal oil prices; the people making internal decisions do not know about the technologies; officials in Mexico are very much focused on oil as the primary energy supply. No one in Mexico knows what has happened at

Solar Two. Now is not a good time for a START mission to Mexico because the officials do not know about Solar Thermal technologies. Regarding how we could provide information to the Mexicans on the materials that they want, Carlos liked the suggestion of a pre-START (warm up) mission to help the Mexicans provide information to their officials.

Sector 4: Market Barriers and Opportunities (Tom Williams, Sector Leader)

Sector Overview Discussions, Tom Williams, NREL. Tom provided an overview of possible directions for Sector 4, with emphasis on providing information to decision-makers.

Parabolic Trough Roadmapping, Hank Price, NREL. Hank presented details of the international technology roadmapping meeting held in Golden in February. Avi Brenmiller, Solel, who participated in the roadmapping meeting, added some additional comments. His message is that troughs are the only real solar thermal technology, and we are confusing decision-makers by proposing three different technologies some of which might become commercially available later. The Jordan report has a general recommendation about three general technologies. If I were a Jordanian, what would I do? Avi contends that the solar community must make a strong decision about what must be done or we will not exist. There was strong disagreement with this perspective from a number of participants, though there was also some agreement with the concern that the competing perspectives provided in the START missions could be confusing.

Life Cycle Assessment of an 80 MW SEGS and a 30 MW PHOEBUS Power Tower, Tom Williams for Weinrebe and Bohnke, U. Stuttgart. Tom presented results that showed a cradle to grave approach to analyzing the technologies. The systems are analyzed in terms of the global warming, acidification, and nutrification or over fertilization. CO₂ equivalents for Coal/Rankine are 950 g/kWh, PV 300, ST 20, ST hybrid is 300, wind 40, hydro 10, combined cycle 450.

STEPS Expert System for the Market Assessment of ST Power Stations, Tom Williams for Franz Trieb, DLR. STEPS is a tool that takes very broad information and takes a “first cut” at what the siting of a plant should be, including resources, infrastructure, economic assessment, etc. Output is an “optimal” siting issue.

SolWin, Frank Schillig, DLR/PSA. SolWin is a Windows software package directed to the financial community to help them understand and analyze our technologies. The model standardize the calculation procedures, and has both performance and economics tools. It appears to aspire to being all things for all people. He invited module development to be done by people attending the session. They intend to have a version available by mid 1998 for preliminary test and evaluation.

Adrian Gaye, SolarGen. Although he did not have a prepared presentation, Craig Tyner asked Adrian to discuss SolarGen’s activities. The 1994 joint project in Armenia didn’t work out, but in 1998 in Crete they will demonstrate a fixed collector, tracking receiver concept. It will be a mass-produced, industrial, modular product of about 100 kW size. It will be employed on a desalination project with Alpha Loyal in the Canary Islands. They are targeting a salable product post haste in terms of strategic alliances. They are also trying to use their system for roof-mounted air conditioning systems.

Next Meetings:

Next Task I and III Meetings: Oct 27-28, Mexico (Carlos Ramos will confirm and IIE will host.)

Next spring’s meeting will probably be in Israel, last week of Jun 99 (in conjunction with ISES). It is expected that the ExCo will also meet there.

Task I Meeting Action Items (all designated 9803-#):

1. Tyner: Get presentations by e-mail from all Task I presenters.
2. Meike: Provide Sector 1 input for annual report ASAP.
3. Tyner: Plan National Coordinators meeting at Odeillo conference on Tuesday
4. Tyner: Plan Sector 4 first at next meeting.

Appendix A: Meeting Agenda

IEA/SolarPACES Task I: Electric Power Systems Task Meeting

Almeria (Aguadulce), Spain
Tuesday, March 3, 1998



Updated Agenda

09:00	Introduction and Opening Remarks (Craig Tyner, Operating Agent)	
	1997 Annual Report Input	C. Tyner
	Updates for Program of Work	C. Tyner
09:30	SECTOR 1: Central Generation Systems (Wolfgang Meike)	
	Israeli/MDAC Tower Project	M. Epstein, WIS
	TSA Status	P. Heller, DLR, Spain
	DISS Project Status	J. Ajona, PSA, Spain
	BREAK	
	Colon-Solar Project	M. Blanco, PSA, Spain
	THESEUS Project Status	M. Geyer, DLR, Spain
	Solar Two Status	C. Tyner for M. Prairie, Sun+Lab
	Boeing Panel Test at NSTTF	C. Tyner for J. Pacheco, Sun+Lab
	Other?	
11:15	SECTOR 2: Distributed Generation Systems (Tom Mancini)	
	Australian Activities	W. Meike, PAWA, Australia
	U.S./German Dish Stirling Project	
	SAIC Utility-Scale Joint Venture Project	T. Mancini, Sun+Lab
	Allied Signal Dish/Brayton Project	T. Mancini, Sun+Lab
	Distal II Dish Stirling Systems	P. Heller, PSA
	Other?	
12:30	LUNCH	
13:30	SECTOR 3: START Missions (Michael Geyer)	
	START Mission to Brazil – final comments	M Geyer, DLR/PSA
	START Mission to Jordan – final comments	M Geyer, DLR/PSA
	1998 START Mission Discussions	M Geyer, DLR/PSA
	START Procedures/Reporting	C. Tyner, Sun+Lab, USA
14:30	SECTOR 4: Market Barriers/Opportunities (Tom Williams)	
	Sector Direction	T. Williams, Sun+Lab, USA
	BREAK	
	Technology Roadmapping	H. Price / A. Brenmiller
	Life-Cycle Assessment of STE Power Stations	G. Weinrebe, U. Stuttgart
	STEP Project	F. Trieb, DLR
	SolWin Software Development	P. Heller, DLR, Spain
16:30	Other Participant Input: Egypt, UK, India, Brazil, EU ?	
17:00	Additional Business, Action Items (Tyner)	
17:30	ADJOURN	

Appendix B: Meeting Participants

Appendix C: Presentation Summaries