

FUNCTIONAL AND PORTABLE SSP/WPT CONCEPT DEMONSTRATORS

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1. Introduction

Space Solar Power, with Wireless Power Transportation to the Earth by means of a microwave beam is one of the key solutions for clean and inexhaustible energy. The concept has been proven valid by many studies, yet it still remains beyond the horizon of effective political and economic concerns, mostly because it requires extended visions which are not yet common place. Functional visual aids may be of considerable help to promote the concept, demonstrate the technologies, which are involved, and alleviate unjustified fears.

2. A question of engineering, not technology

All the basic technologies necessary for the construction of WPT and SSP systems are available and the question of development is no longer of scientific nature, but rather a matter of macro-engineering and political choices. It was also said that SSP is not really space business or radio-wave business, but basic energy and environment business using space opportunities and electromagnetic technologies. As a consequence, the future of WPT and SPS is not so much in the hands of the space community or radio-communication community but rather depending on decision-makers who may not always be aware of the great potential of SSP for the energy future of Mankind. The cost of implementing SSP may be high, but it remains comparable to other macro-engineering projects already completed on the surface of our planet. The development of SSP may be viewed as a defence project where Government and Industry will team to protect our world against the menace of the foreseeable shortage of fossil energy

3. Functional energy beam demonstrators

Using small functional demonstrators to present physically the principles and the technologies at work may improve greatly the necessary communication with decision makers and help make steps towards more sophisticated engineering development in what appears to be a new but major field of activity for the economy. "Hands-on" presentations help understanding through the barrier of the "science-fiction" feeling that may be carried by word or text only. They may quickly evidence the fact that the technologies are at hand with industry and finance executives and political leaders. The portable demonstrators are also very helpful to dispel the fears and unfounded safety concerns, which are often opposed to the concepts of WPT and SSP because of lack of proper knowledge.

Fig. 1. SPS-2000 Demonstrator features
A four-element Projecting slot antenna,
delivering a microwave power of 29 dBm
at the ISM frequency of 2.45 GHz,
and a four-element H-type wire rectenna
array for collecting beamed energy.
(picture was taken at Prof. Nagatomo's
Space Power Laboratory, at ISAS
from left to right : Dr. G. Pignolet with
Grad. Students K. Kimata and T. Nagakawa)



3. SPS-2000 Attaché Case

One model, the SPS-2000 “Attaché Case” demonstrator (fig.1) has been designed in co-operation between CNES and ISAS. Several sets have been constructed, and they have already been presented successfully in many occasions. The model includes a Sun simulator, satellite model and Earth energy collection display. A bank of electrical bulbs – the Sun – illuminates a solar panel on the satellite, which produces a few watts of electricity. This power is used to power an energy beam generator that projects 2.45 GHz microwaves towards the “Earth” module. At the end of the process, a rectenna array collects the energy of the beam and produced DC current, which is used for powering a display with LED’s and meter.

4. Grand-Bassin demonstrator

A fixed demonstrator has been in operation since the end of 1998 to present point-to-point WPT, based on the project for the village of Grand-Bassin. It features a beam-forming array on one side and a rectenna array on the other side, demonstrating how WPT technology can be an environment-friendly technology to be used to extend grid power to remote or environment-sensitive sites (fig.2).



Fig.2 – Grand-Bassin fixed demonstration model. With respect to relative size, small trees are the model for the beam projecting array and flowers are model for the rectenna design.

In the fixed model, microwave energy is obtained from a probe located in a kitchen microwave oven, that is part of the educational concept, and it is distributed to three phased elements. On the user end, several LED and a small electrical motor are used to evidence collected energy. A portable version of the demonstrator is under development, with 2.45 GHz voltage controlled oscillator and multiple phased solid state microwave generators to replace the microwave oven and its magnetron.

5. New design requirements for antennas

WPT, which is an essential technology for SSP, calls for different circuit and antenna design requirements than is currently used for communication. Because of the very large areas that will be necessary, especially for the collecting arrays in the case of SSP, but also for projecting arrays in the case of point-to-point WPT such as in Grand-Bassin, good environmental integration is of prime importance, even more than technical efficiency. The order of priorities in the case of Grand-Bassin, or similar cases, is first good aesthetics and environment integration, then low cost and third only conversion efficiency. Portable demonstrators will be useful to evidence the new requirements and foster adequate technological research.

6. Dedicated Web contact for further developments

The Grand-Bassin project has been recognised by space agencies as a primary next step in the terracing process on the long way to SSP. Thanks to a Bootstrap Award granted by the FINDS foundation (<http://www.finds-space.com/Pignolet.html>) and the Space Studies Institute (<http://www.ssi.org>) it has been possible to open a dedicated web site (<http://www.grandbassin.net>) to publish, in French and in English, the extended documents on the development of the Grand-Bassin project and on the availability of the portable SPS-2000 and Grand-Bassin demonstrators, for general education purposes or for special presentations.

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