MULTI SOLAR (PVT) CO-GENERATION POWER STATION

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ABSTRACT

A new innovation technology includes construction of a Multi Solar Power Station using the Multi Solar (PV/T) Collectors System and a thermal (steam turbine) generator, using the excessive solar thermal energy produced by the Multi Solar System (MSS) which doubles the amount of electricity produced by the PVT Power Station while reducing the costs of the solar electricity produced to as low as under $3 USD per watt in certain countries.

The scientific basic principal of the MSS Co-Generation System is A built-in MSS that has the highest efficiency existing today - 85% (15% electricity, 35% hot water, 35% hot air or total 70% thermal energy). Each square meter of the MSS produces 150W DC electricity from PV panels (with 30% higher efficiency than the usual PV due to the cooling system of the PV) and a total of 700W thermal energy. This mass of thermal energy could be transferred into electrical energy with 25% efficiency by using a thermal turbine based on a low pressure steam generator.

Keywords: Cogeneration, Solar, Photovoltaic, Steam.

1 INTRODUCTION

The Multi Solar (MSS) PV/T/A technology is the basic element of the Solar Photovoltaic/Thermal Power Station. The MSS is an innovative, patented (PATENT NO 5522944) Solar PV/Thermal/Air System that makes it possible to convert solar energy into thermal energy and electric energy at the same time using a single integrated collector.

The Thermal Steam Generator (Turbine) is the complementary unit to the MSS collector. This generator makes use of the thermal energy produced by the MSS collector in order to provide an additional and equal amount of energy as is produced by the photovoltaic

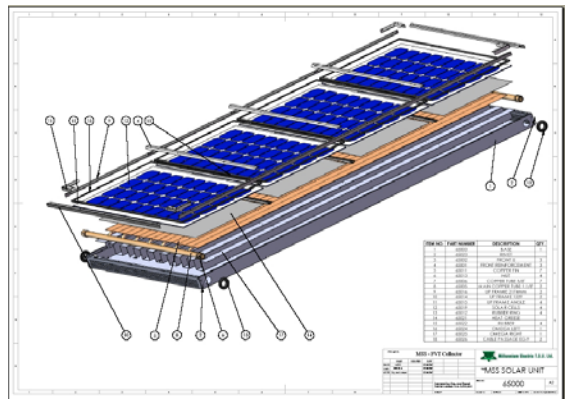

Figure 1: MSS (PVT) Collector Schematic Drawing

2 MULTI SOLAR (PVT) CO-GENERATION POWER STATION OPERATION CONCEPT

Millennium Electric proposes to establish a solar power station in an alternative structure, operated by 150ºC steam generation and thermal turbine. The existing commercial steam turbines can reach 25% optimal efficiency by using solar thermal energy made by the MSS collectors. This decrease of the feeding temperature for the steam turbine leads to dramatic improvement of the economic feasibility, as a result of the smaller solar array required to provide the same output. This innovative technology should improve the ability of various countries to live up to their commitment to increase solar energy production.

The progress of solar technologies, the comeback of renewable energies and the development of the Multi Solar System (MSS collector) which produces electricity from PV cells with 30% higher efficiency (due to the cooling of the PV cells by internal water pipes on the back side of the MSS collector and the creation of mass thermal energy at the same time using a single integrated collector), promote technological and economic opportunities using the solar thermal energy created by the Multi Solar System.

The MSS is the appropriate technology for this innovative idea since it's the only mature Solar PV/T technology which has been in operation for many years. The Multi Solar (MSS) PV/T/A technology which has been

developed in Israel has been integrated in a variety of projects for over 10 years. The MSS has proven technology for commercial applications. Governmental incentives today make it profitable to establish solar Photovoltaic/thermal power stations yielding high profits for the long term.

The Solar thermal/photovoltaic power station will be based on the Multi Solar System in coordination with solar thermal collector array in rows, in order to achieve maximum optimization of the combined system.

Improvements for the basic technology:

Since the proposed solar thermal technology is limited to an operation heat of 150ºC, we are limiting the solar steam temperature to a maximum of 130ºC, which is the feeding temperature of the thermal turbine. Other commercial steam generators working at higher temperatures, may be more efficient, but are also more expensive for operation. Our innovative idea is to increase the heat of the steam produced by the solar station, while reaching the optimal temperature for the thermal turbine.

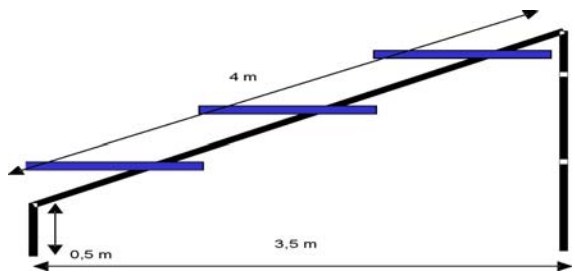

Figure 2: solar thermal energy heating in three levels of M collectors.

The system consumes the solar thermal energy produced by the MSS collectors at 55°C at first level. This temperature is being increased by the special solar thermal collectors, connected in 2 rows and transferred to the thermal turbine in temperatures of up to 150°C (steam). The thermal turbine produces electricity based on the thermal energy of 20-25% efficiency. In order to increase efficiency percents, the option to use tracking devices for the MSS collectors may be considered.

In cases when the heat produced by the Multi Solar System will be insufficient to produce the steam for the operation of the thermal turbine (especially at winter days), a substitute boiler operated by fuel or gas will provide sufficient energy for the operation of the thermal turbine.

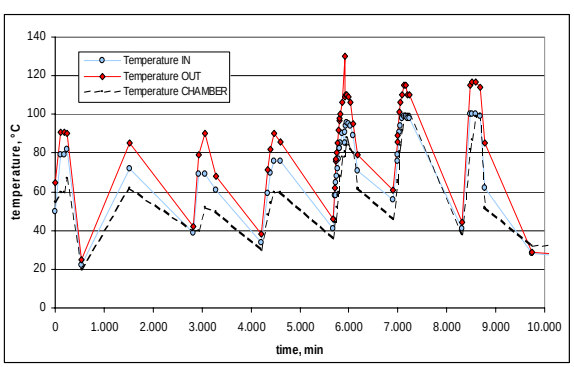

Figure 3: Results taken from the "Solardist" project completed by Millennium and tested by TTZ in Heraklion, Greece 2004-2006 and reported to the EC –SOLARDIST report EVK1-CT-2003-30028.
In this project only two levels of thermal solar collectors were used and achieved a temperature of maximum 138°C degrees. By adding the MSS collectors at the first input level at 55°C, the Multi Solar Thermal co-generation power station could easily achieve 150°C.

3 OUTCOME AND RECOMMANDITIONS

1.1 It is clear that using the Multi Solar power station with thermal turbine at 150°C will significantly improve the economic viability of the station, using small amounts of fuel (if any) for the operation of the Multi Solar station.

1.2 Cooling the water for the Photovoltaic cells will increase the electrical efficiency at an annual average of 30%. Using the hot water produced by the MSS collector at 55°C will save the preheating energy needed to reach this stage.

1.3 The use of the low temperature (150°C) low pressure thermal steam turbine will save the water and the expensive desalination processes as well as get rid of salty materials existing in other thermal turbines.

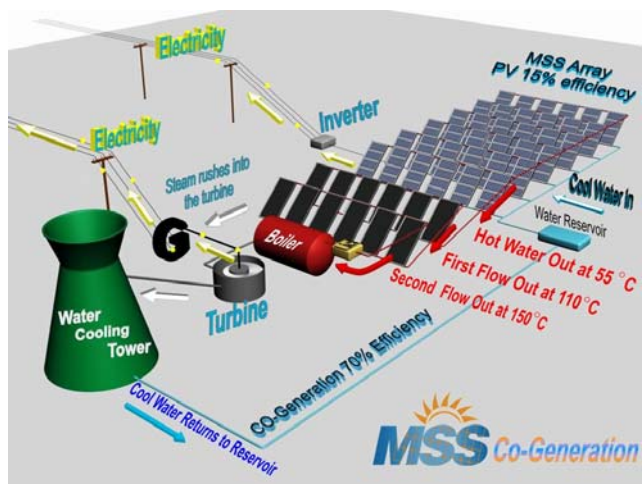

Figure 3: MSS PVT Solar Thermal Generator Systems planned by Millennium Electric

4 COST & BENEFITS OF THE MULTI SOLAR POWER STATION (INCLUDING THERMAL TURBINE)

The total cost of the Multi Solar Thermal co-generation power station is around $2.5 USD per watt installed since the power station will produce twice the amount of

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electricity at half the total cost (Total cost: $4.0 for the Multi Solar System and additional $1.0 USD per watt for the thermal turbine). The electricity output will be provided equally: half by the Multi Solar System (50%) and half (50%) by the thermal steam turbine.

Maintenance costs are very low; around 1.5% of the total power station costs (per year). These costs include the maintenance of cooling the water system for the thermal turbine, but not the costs of backup fuel for the operation method.

Such Multi Solar Thermal Co-generation power stations using thermal generators should reach ROI in 3-5 years in those countries that provide feed in tariffs for solar energy production.

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