***Development of a Low Cost Concentrating Solar Energy System Using Solar Sausages***
Project Report November 2012

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**Industry Partner:** Hunter and Harp Holdings (HHH), Sunnyland Solar
**Project Time Period:** April 2011 – August 2012

**Executive Summary**

This continuing project is, as the title states, development of a low cost concentrating solar energy system using Solar Sausages™. Concentrating solar energy systems normally consist of rigid parabolic mirrors to focus sunlight onto receivers. In this project the mirror is replaced with a "Solar Sausage™", a clear Mylar cylindrical balloon that has a reflective Mylar film separating the top and bottom halves of the cylinder. By maintaining the pressure in the top half slightly higher than in the bottom half, the reflective Mylar film attains curvature and is made to focus incident sunlight onto a photovoltaic device mounted on top of the balloon. The Solar Sausage™ was developed at Florida State University (patent pending), by Dr. Sean Barton and Mr. Ian Winger.

Accomplishments during the period of the grant include scaling up the size of the Solar Sausages™, determining how to seal the ends cheaply and durably, determining how to make many reproducibly by hand, specifying a machine to manufacture them, designing layouts of Sausages and their air supply and control systems, testing photovoltaic devices outside their normal operating conditions, and deploying hundreds of Solar Sausages at three distinct sites. Though initially envisioned as a development project to create three sites producing 0.5 to 2.0 MW of electricity to feed back into the power grid, the novel nature of the concentrating system resulted in many challenges, effectively converting the project to more of a research effort. Much has been learned, but the answer to whether this system can be effectively deployed to produce power for the long term is not yet known.

The size of Solar Sausages™ was scaled up from 2 m long by 0.4 m diameter to 20 m long by 2 m diameter. Several challenges were overcome in the scale-up. Figuring out firstly how to seal the ends of the cylinders at all, and then how to do so simply, cheaply and reproducibly required testing many glues and configurations of the Mylar films. Developing techniques to handle the 20 m long Mylar sheets without damaging them required ingenuity. After deploying the first several sausages and inflating them, problems were discovered in attempting to maintain several sausages at the correct differential pressures to allow the middle curved, reflective Mylar films to focus the concentrated sunlight on the 10 cm wide photovoltaic detectors. Much of the instrumentation purchased using matching funds was for the automated control system to detect and control changes in focus quality due to differential pressure changes. Significant difficulties were encountered in keeping the Solar Sausages™ inflated in the presence of thunderstorms. In summer afternoon thunderstorms rapid atmospheric temperature and pressure changes regularly occur. These wreaked havoc on inflated sausages, often resulting in deflation and subsequent violent fluttering of the 20 m long Mylar cylinders, due to high winds, leading to balloon rupture. Much recent effort has been to engineer an air supply system capable of keeping the sausages inflated even in the presence of these rapid atmospheric changes. When they remain inflated they are much more resistant to damage due to high winds.

Benefits to the State include demonstrating that scaled up Solar Sausages™ can be built and deployed in large numbers in fields for concentrating solar energy systems. The expertise of Dr. Barton has been crucial to successfully designing and deploying the systems. Ancillary benefits include the employment of many workers during the manufacture and deployment of the Solar Sausages™ (paid separately by Sunnyland Solar LLC).

State of Florida funds were used mainly to support the salaries of the post-doctoral researcher Dr. Sean Barton, and to provide Prof. Van Winkle partial summer salary. Incidental expenses were also charged for a variety of supplies. Total expenditures were $45,981.97. Cost-share monies from Hunter and Harp Holdings were handled in two accounts, one for items on which overhead was charged (primarily used for salaries and travel), and one for instrumentation (on which overhead was not charged). Matching costs charged to the first account were $45,833.21 and to the instrumentation account were $55,009.55. The project continues under the auspices of Sunnyland Solar LLC, who are continuing to support research at FSU while converting the research project back into a development project.

As can be seen in the accompanying photographs, the project is well along in terms of deployment of the technology on the Yulee St. site.

First full-sized inflatable mirror

View of the Yulee St. site from the NE corner

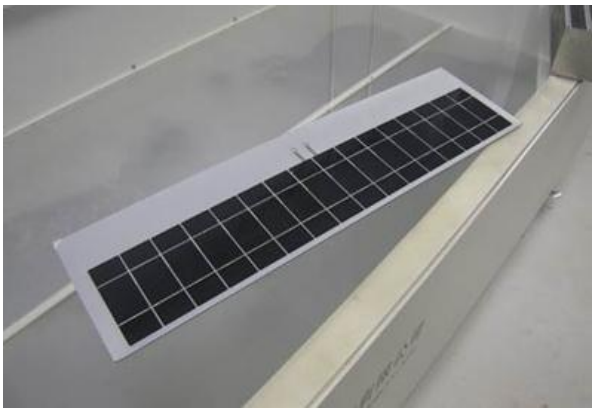
Production of the Balloons

Applying Glue to Reflective Membrane

Load-Adhesion Testing Of A 50-Foot Balloon

A 50-foot balloon

Street View of the Yulee St. Site From The East



Encapsulated Photovoltaic Cells