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Ms. Blanca S. Bayó, Director
Division of the Commission Clerk and
Administrative Services
Florida Public Service Commission
Betty Easley Conference Center
2540 Shumard Oak Boulevard, Room 110
Tallahassee, FL 32399-0850

(040000)

Re: Florida Power & Light Company's (FPL's) Photovoltaic Research, Development and Education (PVRD&E) Project Report

Dear Ms. Bayó:

Enclosed for filing on behalf of FPL are the original and seven (7) copies of FPL's PVRD&E Project Report. This project was approved by the Florida Public Service Commission in two dockets, Docket No. 991788-EG (Order No. PSC-00-0915-PAA-EG, Order approving FPL's Demand Side Management Plan, issued May 8, 2000) and Docket No. 010715-EG (Order No. PSC-01-1406-PAA-EG, Order granting approval of modification to FPL's PVRD&E Project, issued June 29, 2001).

Please contact me if you or your Staff have questions regarding this filing.

Sincerely,

Natalie F. Smith

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Enclosures

Summary

FPL Photovoltaic Research, Development and Education Project

FPSC Docket Nos: 991788-EG / 010715-EG

This report summarizes the results of the FPL Photovoltaic Research, Development and Education (PVRD&E) project, which evaluated five photovoltaic (PV) installations. The primary objectives of the project were to analyze the performance and feasibility of grid-connected, rooftop-mounted PV systems and to educate local building department officials on the issues involving rooftop-mounted PV systems. This project was approved by the FPSC in two dockets, Docket No. 991788-EG (Order No. PSC-00-0915-PAA-EG, Order approving FPL's Demand Side Management Plan, issued May 8, 2000) and Docket No. 010715-EG (Order No. PSC-01-1406-PAA-EG, Order granting approval of modification to FPL's PVRD&E Project, issued June 29, 2001).

In Docket No. 991788-EG, FPL's proposed DSM Plan contained its newly proposed PVRD&E program. Under the program, FPL was to analyze the impact on FPL's system, relevant demand and energy data, the homeowners' financial benefit, and the durability of the technology. FPL received approval to install and monitor up to ten sites. FPL also planned to hold workshops reporting the results to contractors. FPL expected that the development and analysis phase of the project would take at least three years, with total project costs estimated at $471,000.

In Docket 010715-EG, the Commission granted approval for FPL to extend the PVRD&E project to include commercial, industrial and government buildings. This docket included a stipulation that if the PVRD&E project demonstrated that the PV rooftop systems could be offered cost-effectively, then FPL would consider adding such PV systems to its Demand Side Management (DSM) Plan.

A total of five (5) PV sites were installed and monitored. The sites were located in Homestead, Rockledge, Merritt Island, Palm Coast and Miami, Florida. All of these sites were grid-interconnected per the "Interconnection Agreement for Small Photovoltaics, 10 kW or Less," Rule 25-6.065, Florida Administrative Code. These sites utilized "flat plate" crystalline technology on the roofs of the respective houses and the sizes ranged from 1.2 kW to 4.8 kW (direct current rating). Initially, the project called for research of two additional sites utilizing "thin film" building integrated PV systems (BIPV) that a builder had installed on two model homes in the Palm Coast, Florida area. Each used amorphous-silicon type "thin film" PV technology, one was a 2 kW system and the other 1 kW. These two PV sites were not able to be included in the study due to technical and installation difficulties experienced by the builder.

The five PV sites were monitored and winter and summer PV performance data was collected from the summer 2002 through the fall 2003 by the Florida Solar Energy Center (FSEC). The length of the monitoring period per site was primarily affected by the individual customer's construction schedule. Two sites experienced significant technical problems with the PV equipment which resulted in insufficient performance data being collected during the monitoring period. This resulted in the performance analysis being based on the three PVRD&E sites with full data.

Several PV electrical output characteristics were monitored and evaluated during this R&D project including the total quantity produced, timing of the output, PV system losses, the PV output consumption per home, and energy exported to FPL. The average annual alternating current energy produced by the PV systems was 3,169 kWh per home. Of the produced energy, 2,483 kWh or 78%, was consumed by the residence and 686 kWh, or 22%, was exported to FPL. The maximum summer PV output per home was 1.21 kW with an FPL system coincident summer peak hour impact 1.01 kW. The maximum winter PV

output per home was 1.28 kW with an FPL system winter coincident peak hour impact of 0.03 kW. Figure 1 and 2 show coincident PV outputs as compared to FPL's hourly load profiles. The energy produced by a PV systems is direct current (dc) and requires an inverter to convert it to alternating current (ac). The average annual dc output was 4,282 kWh, which resulted in 3,169 kWh ac output. The average reduction per home due to inverter losses and other system related losses was calculated as 26%. Table 1 summarizes the average PV performance data.

The average economic payback per customer was calculated based on the initial PV system cost, projected repairs, avoided energy purchases from FPL and revenues from energy exported in accordance with FPL's "Interconnection Agreement for Small Photovoltaics, 10 kW or Less." The average cost per PV system was $21,030 and the value of the energy savings and exported energy was $223 per year, resulting in a simple payback of 94 years. For this project, participants received a rebate of $4 per watt provided by the Florida Solar Energy Center in 2002, which reduced the average payback period to 44 years. The 44- and 94-year paybacks are longer than the expected life of a system of this type and do not include the cost of replacing the inverters.

The project energy and economic data was analyzed for cost-effectiveness utilizing the FPSC-approved DSM cost effectiveness methodologies. The results are that the PV systems were not cost effective from an FPL rate impact perspective. The Rate Impact Cost Effectiveness Test failed with a ratio value of 0.96. From the customer perspective, the cost-effectiveness ratio resulting from the Participant Test was 0.08. This poor participant test ratio is due to a very high capital investment requirement relative to the associated annual electric bill savings.

Data on the physical equipment and effects on FPL's system was also collected. The primary components that failed on the flat plate (crystalline) PV systems were the inverters. There was an average of one inverter failure and replacement or repair per year at each of the monitored PV sites. The average replacement cost of the inverters was approximately $1,000 / kW.

FPL hosted three one-day training seminars in Miami, West Palm Beach and Port Charlotte in the fall of 2002. Over 100 individuals attended the seminar, including code officials from various regions, and electrical contractors. The seminars were conducted by representatives from FSEC and FPL and provided invitees PV systems related information ranging from inspection procedures for PV systems through FPL's PV interconnection rules.

The PVR&DE project was approved for a total budget of $471,000. **By leveraging the synergies** available by teaming with FSEC's concurrent program, the actual total project expenses were $164,977.

In summary, after performing the PV cost-effectiveness calculations based on the performance data acquired, it was determined that these PV systems in their current installed configuration and application are not cost-effective for a FPL DSM program. Based on the 2002 installed PV system price, the PV systems were not found to be a cost effective option for FPL's customers.

(Tables and figures attached)

Table 1: PV Project sites, 1 year Ave. Performance taken from summer 2002 to fall 2003

1. Rated d.c. output (kW d.c):	2.8
2. Max. actual a.c. output (kW a.c.):	2.06
3. PV summer daily ave. at coincident peak (kW):	1.01
4. PV summer daily ave. at PV peak hour (kW):	1.21
5. PV winter daily ave. at coincident peak (kW):	0.03
6. PV winter daily ave. at PV peak hour (kW):	1.28
7. Annual PV Energy Produced (kWh):	3,169
8. PV power exported to the grid (kWh):	686
9. Summer coincident impact of max. actual PV a.c. output (%):	49%
10. Winter coincident impact of max. actual PV a.c. output (%):	1.5 %
11. Total PV system installed cost ($):	$21,030
12. Annual dollar saved by customer ($)	$223
13. Simple payback period, with no rebate considerations (years.):	94
14. Maximum a.c. power output to rated PV d.c. power output (%):	74%

Figure 1: Summer PV output vs. FPL load **Figure 2:** Winter PV output vs. FPL load