

## Reflectivity of Solar Electric (PV) Modules for the Fresno Airport Solar Power Project

The question of solar module reflectivity and the potential visual impacts arises from time to time when solar electric power projects are near airports or population areas.

Solar modules are designed to absorb solar energy and to convert it to electricity. Most are designed with anti-reflective glass front surfaces (“flat plate PV modules”) to capture and retain as much of the solar spectrum as possible. Solar module glass has reflectivity less than water or window glass. The Fresno Airport Solar Project will utilize both flat plate PV modules and PV modules that capture and concentrate sunlight onto a solar cell. In the case of concentrators, all the light that hits the solar modules is focused onto a smaller area within the solar module, and the only reflected light is from heat.

The following pictures show both types of solar modules planned for the project.



Many projects throughout the US and the world have been installed near airports with no impact on flight operations. Information on some projects is provided.

## Solar System Covers Roof

The major portion of the six-month project period was taken up with design and permitting processes. The actual installation took four to six weeks. Garcia says his instructions from FedEx Express were, “Don’t bother the operations,” and the installation crew did not.



The Hub's 81,000-square-foot roof offered an ideal site for the system.

During the permitting process, the Federal Aviation Administration got involved because it was concerned about the height of the crane that would lift PV panels to the roof, about 30 feet above the building. The FAA asked that a red flag be placed on top of the crane to alert airplane pilots. The FAA also had concerns about potential glare from the panels that might affect aircraft landings. Garcia says the PV panels have anti-reflective coatings to absorb as much light as possible. “This is true for all crystalline panels and is standard for PV panels,” he says, adding that the reflectivity of the panels is less than that for water.

Garcia describes the method used for installing the PV panels on the roof of the Express Hub. A solar panel, made up of 60 silicon wafer cells, is mounted on an insulated PowerGuard unit known as a tile. The 5,769 tiles were then arranged on the roof to surround the many air-conditioning units located there. The solar panels encompass virtually the entire 81,000 square feet of roof space across the facility's two buildings.



Federal Aviation Administration  
Western Pacific Regional Office  
PO Box 92007-AWP-520  
Los Angeles, CA 90009-2007

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BEN COLCOL - PROJECT MANAGER  
FEDERAL EXPRESS CORPORATION  
2601 MAIN STREET  
IRVINE, CA 92614

**\*\* THIS IS NOT A DETERMINATION \*\***

Additional information is required before we can complete an aeronautical study concerning:

Structure Type: ROOF-MOUNTED SOLAR PANEL ENERGY SYSTEM  
Location: OAKLAND, CA  
Latitude: 37-43-3.18 NAD 83  
Longitude: 122-12-22.88  
Heights: 54 feet above ground level (AGL)  
44 feet above mean sea level (AMSL)

Please verify and determine the correct coordinates for the site. When plotted, the submitted coordinates do not match the site depicted on the submitted map.

If your site depiction is correct, the coordinates would be  
Latitude: 37-43-13.3, Longitude: 122-13-00.4 NAD 27.

If the submitted coordinates are correct, the site depiction will need to be amended and a corrected map submitted.

If data is changed as a result of FAA verification, it will be necessary for you to ensure the corrected information is also on file with the FCC (if applicable).

NOTE: IF NO RESPONSE IS RECEIVED WITHIN 30 DAYS OF THE DATE OF THIS LETTER, ACTION WILL BE TAKEN TO TERMINATE THIS AERONAUTICAL STUDY.

If you have any questions, please contact our office at (310)725-6558. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2005-AWP-363-OE.

Signature Control No: 408559-338971

(ADD)

Ladonna James  
Technician

# TECHNOLOGY DEVELOPMENT PROJECT FACT SHEET

## SP002: PRESCOTT AIRPORT SOLAR POWER PLANT

The Prescott Airport Solar Power Plant is a multi-megawatt solar site featuring two types of photovoltaic (PV) technologies – single axis tracking flat plate PV, and two-axis tracking High Concentrating PV (HCPV). Started in 2002, over 5 MW is planned to cover 55 acres. Over 3.5 MW of one-axis PV is under construction, using conventional PV panels. These systems deliver more energy from the solar panels by rotating them on a horizontal axis throughout the day.



Over 1.5 MW of HCPV system is under construction. These systems use plastic lenses to concentrate the sunlight 250 times onto much smaller, high efficiency solar cells. This reduces the area of PV material by 250 times, which should result in a potentially low cost solar electric generation technology.

Location: Near the Love Field Airport, Prescott, Arizona

Plant Output (as of July 2006)	3,387,850 Watts DC 2,879,700 Watts AC
Solar Module Manufacturers:	BP Solar, Sharp Electronics, Amonix
Inverter Manufacturer:	Xantrex & AES
Inverter Power Ratings, AC:	30, 37 kW & 125 kW
Type of Tracking:	Single Axis and Two Axis High Concentration
Projected Annual Energy Generation:	6,335,340 kWh AC

**Estimated emissions avoided as a result of operating this solar power plant based on APS' 2003 fuel mix:**

CO <sub>2</sub>	8,045,882 Lb/yr
SO <sub>x</sub>	8,869 Lb/yr
NO <sub>x</sub>	16,472 Lb/yr
Particulates	1,140 Lb/yr



For more information contact Janet Crow at 602-250-4990 or  
janet.crow@aps.com



Concentrators of reflective type reflect solar into a narrow target.

## **Solar power for Munich Airport's Terminal 2**

On the roof of Munich Airport's Terminal 2, energy is gained from the sun. The photovoltaic array on top of the terminal is so far the largest facility of its kind to be built at an airport. It went into operation on July 10, 2003. Since then the state-of-the-art equipment has fed 445,000 kWh annually into the public electricity grid: enough power to meet the needs of 155 households all year round.

With the solar project, the participating partners – Lufthansa AG, Deutsche BP AG, BP Solar, Air BP, GLS Gemeinschaftsbank eG, B.A.U.M. e.V. and Munich Airport – again underscored their commitment to sustainable progress. Over its projected 30-year lifetime, the facility will save the environment from CO<sub>2</sub> emissions totalling approximately 12,000 metric tons.

The total investment for the photovoltaic array was EUR 2.65 million, which means that it paid for itself in energy terms after just two years of operation.

The solar power source is a grid-linked photovoltaic facility, which means that all energy produced is fed directly into the public power grid. It is made up of BP Solar 3160 series polycrystalline modules. They generate DC current, which is decentrally converted into AC current by alternators placed on the roof before being fed into the electricity grid (string technology).

Anyone interested in learning more can refer to the information pillar in Terminal 2, which provides further details and current data on the facility.





### **Airline Terminal**

The Maryland Aviation Administration decided to install a building-integrated PV system at the new international terminal at Baltimore/Washington airport. SDA supported airport architects in the design and integration of a 20 kW solar electric light canopy over the esplanade at the airport's passenger rail terminal.

The light canopy is over 300 feet long and features a skylight spine with 84 large-area Solarex 250-Watt PV modules on the south-facing slope and clear skylight glass on the north-facing slope. The PV modules are roof integrated as the finished skin of the structure, taking the place of conventional architectural glass.

The support structure for the light canopy was custom fabricated by the Kawneer Company. Each large-area PV module also has its own integrated DC-to-AC micro inverter developed by SDA to deliver 60

## Local

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### SFO heats up power-saving efforts



(Juan Carlos Pometta Betancourt/Special to The Examiner)  
SFO is expanding its solar panels program, such as those on the roof of the Jason Yuen A&E Building, to generate more energy on site.

spokesman Mike McCarron said. An exact date hasn't been nailed down yet, he said.

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Tara Ramroop, The Examiner

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**S.F. AIRPORT** - One of the area's biggest energy users is reducing its power bill, one solar panel at a time. Construction on a new photovoltaic panel installation, a \$5.6 million project funded completely by the San Francisco Public Utilities Commission, is slated to begin soon, airport

According to a San Francisco Airport Commission-approved agreement, the SFPUC will install solar power generation systems in Terminal 3, one of the domestic terminals. The terminal sucks up between two and 2.5 megawatts of energy — which represents approximately 5 percent of total airport power usage. The solar panels are expected to save half a megawatt — enough energy to power approximately 500 homes — and \$200,000 annually, McCarron said.