

Spectrolab's Connie Siv pays close attention to the business of building solar cells that generate electricity.

DANA REIMER PHOTO



# Energy cell

Spectrolab delivers power to Earth—as well as to other planets

By JOEL R. NELSON

What do telecommunications-service customers, planetary scientists, homeowners and law-enforcement officers around the world have

in common? They all benefit from products made by the 375 people at Boeing subsidiary Spectrolab Inc.

You'll also find Spectrolab involved in other important applications. Those majestic solar panels extending from Earth-orbiting communications satellites, including those that support U.S. national security and intelligence? Built by Spectrolab. Rovers trekking across Mars? The International Space Station? Powered by Spectrolab. Solar cells generating energy for residences, and high-intensity searchlights that help po-

lice helicopters home in on crime suspects? Spectrolab again.

As the world's largest manufacturer of space solar cells, this Sylmar, Calif.-based company plays a central role in Boeing Space & Intelligence Systems' mission success. Virtually every spacecraft built by S&IS carries Spectrolab solar cells that convert sunlight into power, as do satellites built by other manufacturers. About 60 percent of commercial satellites currently operating carry Spectrolab products. The company also plays a significant role

in generating renewable energy and builds powerful airborne searchlights.

This year marked two significant milestones: Spectrolab's 50th year in business and the production of the company's two millionth multijunction solar cell, a level far beyond what anyone else has achieved (see box on Page 33).

**THERE AT SPACE AGE'S DAWN**

Spectrolab was founded in 1956, as the space age dawned. Within three years it had supplied solar cells to such U.S. spacecraft as Pioneer 1, the first satellite launched by NASA, and Explorer 6, a 1959 mission that produced the first photo of Earth from space. In 1969 Spectrolab solar panels accompanied the first humans to visit the surface of the moon.

More recently, Spectrolab cells have helped keep the Mars Opportunity and Spirit rovers—designed for 90-day missions—operating for nearly three years. The ISS derives its power from Spectrolab cells, which eventually will enable more than 200 kilowatts of power for mission requirements and day-to-day operations. The Mars Reconnaissance Orbiter carries the largest solar array ever sent to another planet. It is built by Spectrolab. And Spectrolab powers the spacecraft built by S&IS' Satellite Development Center in El Segundo, Calif., including the Boeing 702, the world's most powerful commercial communications satellite.

"While we are diversifying, our core business is space. We're in that industry for the long term and we'll continue to focus on maintaining Spectrolab's leadership through technological improvements and further cost reductions," said David Lillington, Spectrolab president.

**MEANWHILE, BACK ON EARTH ...**

Leveraging its space expertise, Spectrolab cultivated a bustling business in terrestrial solar cells over the past decade.

Spectrolab has developed terrestrial solar cells that convert almost 40 percent of sunlight into electricity and might eventually deliver power through solar concentrator systems to isolated areas of the U.S. Southwest, as well as to Australia, Africa and Europe.

Under a contract signed in August, Spectrolab will deliver 600,000 solar cell concentrators to SolFocus, Inc., a California-based company that develops renewable energy alternatives. Also that month, Spectrolab contracted with Australia's Solar Systems Pty. to deliver 500,000 solar cells for solar concentrator power stations. These cells, capable of collectively generating more than 20 megawatts of

electricity—enough to power about 8,000 U.S. homes—will convert the sun's rays into affordable electricity for homes and businesses. Working with several international and U.S. solar concentrator system manufacturers, Spectrolab is seeking to rapidly expand its share of this market.

While providing power in space and electricity on Earth, Spectrolab also generates light with its Nightsun searchlight.

BOEING GRAPHIC



An artist's concept shows Spaceway F2, a commercial communications satellite built by Boeing Space & Intelligence Systems, drawing solar power from panels built by Spectrolab.

## ■ INTEGRATED DEFENSE SYSTEMS

These are used by more than 90 percent of all law-enforcement airplanes and helicopters worldwide. A Nightsun, the world's brightest searchlight, is equal to 215,000 100-watt light bulbs.

### BUILDING A CULTURE

"We put a lot of effort into using the annual Boeing Employee Survey feedback to improve the quality of life here, and to make Spectrolab a place where associates want to work," Lillington said. "We all work closely together as one team."

This unity has spawned some unique cultural traits. For example, Spectrolab workers call themselves "associates of Team Spectrolab" rather than "employees," and the company runs its own monetary Team Incentive Plan. Spectrolab sponsors an annual Pride in Spectrolab celebration along with a steady stream of reward-and-recognition events.

"It's great to tell our families we help build systems they use every day, such as XM Satellite Radio," said Spectrolab technician Ali Glaser, Spectrolab's Associate of the Year in 2005. "That makes us all feel good."

Along with rewarding associates for achieving certain financial and delivery-schedule metrics, the Team Incentive Plan promotes maintaining a safe workplace by incorporating safety goals. The company recently celebrated more than 300 days without an accident.

### WITH THE BOEING PROGRAM

Spectrolab might be small, but it's fully aligned with Boeing's vision, values and initiatives.

"Customer satisfaction is absolutely key for us, and we work very hard on that," said Lillington, adding that every customer is surveyed quarterly. "We also work hard to provide the best value. Our industry expects continuous cost reductions and technological advances, and our success in becoming a recognized Lean leader within Boeing will help us deliver them."

Glaser credited Spectrolab's embrace of Lean manufacturing, including factory performance boards that illustrate production flow, metrics, scheduling and safety, for improving efficiency. "Lean empowers us to decide what needs to be done, and to do it," she said.

The best-value emphasis has produced tangible results. For example, the company earned the prestigious California Awards for Performance Excellence in both 2005 and 2006. Spectrolab won the George M. Low Award, NASA's premier recognition for



PHOTO COURTESY OF SOLFOCUS

Solar cells populating a solar concentrator owned by California-based SolFocus Inc. show one of Spectrolab's Earth-bound applications.

supplier quality and technical excellence, in 2004. Also that year, the company's triple-junction solar cells and four associates were inducted into the U.S. Space Foundation's Space Technology Hall of Fame.

Entering its second half-century, Spectrolab looks to a promising future.

"We are following a long-term technology road map to maintain our leadership position in each of our product areas," said

Lillington. "We're making the investments necessary to improve our products' performance and lower production costs, and we have great opportunities for growth. I think pride is very important also in achieving our growth potential. It's clear from the Employee Survey data that all Spectrolab associates are proud of the work they do." ■

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## Multijunction Solar Cells 101

Spectrolab this year produced its two millionth multijunction solar cell—a milestone that sets the company apart from its competitors.

Which raises a question: What's a multijunction solar cell?

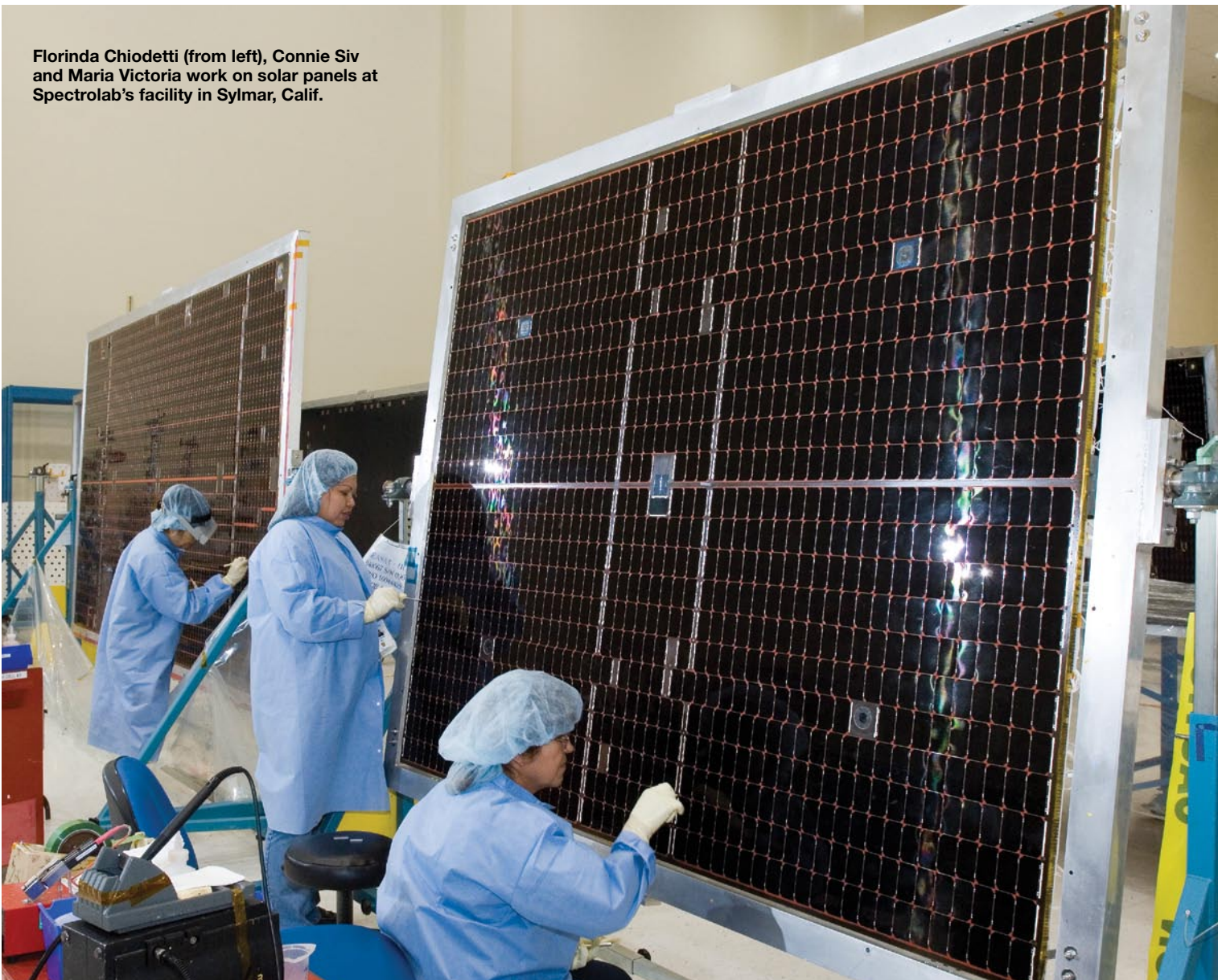
Made of semiconducting materials resembling those found in computer chips, solar cells capture sunlight and convert it into electricity. Solar energy dislodges electrons from these materials' atoms, letting the electrons flow through the material and produce electricity. This process of converting light (photons) to electricity (voltage) is called the photovoltaic effect.

"Multijunction" refers to a layered structure that captures solar energy and converts it into electricity. Each junction converts a different part of the solar spectrum. Portions that are unused at one layer pass to the next one. Terrestrial multijunction cells' conversion efficiency has gained steadily over the years; Spectrolab attained the current world record, 39 percent, in 2005. (The company's space cells operate at 28.3 percent efficiency.) Spectrolab is continually pushing for new levels of conversion efficiency in both its space and terrestrial products.

Each Spectrolab space-based solar cell can produce approximately 1 watt of power. These cells are attached to panels that extend from the spacecraft's body. Approximately 100 such cells would be needed to generate power for a 100-watt incandescent light bulb.

Spectrolab solar cells have powered more than 550 satellites and interplanetary missions over the last 50 years. Its multijunction solar cells generate more than 575 kilowatts of power on orbit.

Florinda Chiodetti (from left), Connie Siv and Maria Victoria work on solar panels at Spectrolab's facility in Sylmar, Calif.



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