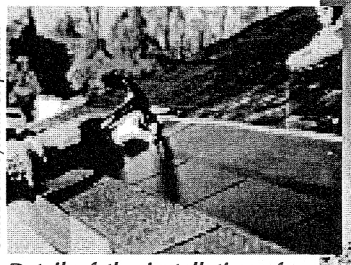
Dome on the Range — From the Sun to the Stars

BY MARK C. FITZGERALD

With a confluence of interest, opportunity and technology, building-integrated photovoltaic (BIPV) systems are regularly providing new and interesting expressions of PV design possibilities. On October 10, 1997, a BIPV system came on line that is interesting not just for the technology, but for the application.

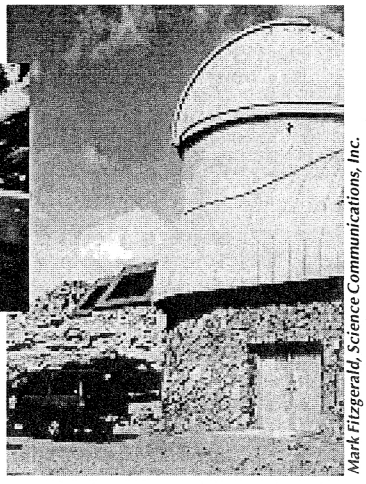
At 14,125 feet (4305 m) above sea level, the array providing power to the University of Denver's (DU's) Meyer-Womble Observatory and Laboratory, is the highest BIPV system in the world, if not the highest fixed terrestrial PV array of any type. It is also one of the first field applications of the new United Solar Systems Corp. (USSC) triple-junction amorphous silicon PV shingles.

The Meyer-Womble research facility of DU on Mt. Evans, Colorado, 45 miles (70 km) west of Denver, has a long, distinguished history. A bequest from alumnus William Herschel Womble allowed DU to revitalize its astronomy program and, in the summer of 1996, the university completed construction of its new 2100-square-foot (195-m²) Meyer-Womble Observatory. This facility houses the new 28.5-inch (0.72-m) aperture binocular telescope, funded by the Meyer Foundation of Illinois.



United Solar Systems Corporation

Detail of the installation of a United Solar Systems Corp. amorphous silicon PV roofing shingle.



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Innovative PV roofing shingles installed on a historic A-frame building (shown here in background) provide electricity to power University of Denver's Meyer-Womble research facility at 14,125 feet above sea level on Mount Evans.

Why BIPV?

Because the nearest utility line was 15 miles (24 km) away, the observatory site always had been powered by conventional generators. Prof. Robert Stencel, Womble Professor of Astrophysics at DU and observatory director, wanted to reduce reliance on the facility's current diesel generator, for both aesthetic and fuel logistics reasons. Renewable energy sources are the obvious choice.

But a traditional retrofit mounting of a PV system on the site was not an option. The observatory, in the Mt. Evans Wilderness, is operated under a Special Use Permit granted by the USDA Forest Service, which wanted to minimize the visual and structural impact of any site modifications—in this case, on the historic A-frame building, designed in 1935 by Bernham Hoyt, designer of the Red Rocks Amphitheater near Denver.

Then, at a 1996 holiday party, a former DU student suggested the new USSC roofing shingles as a solution that might satisfy the Forest Service. He put Stencel in touch with Joe Burdick, Burdick Technologies Unlimited, who represents USSC, and together they designed a system to satisfy the aesthetic and safety concerns (50 m/s winds, severe hail storms, and extreme snow loads) of the Forest Service. Then, with funding from Public Service Company's Renewable Energy Trust, from the University of Denver and the balance from the Colorado Office of Energy Conservation and the National Renewable Energy Laboratory, the project was approved and initiated in the summer of 1997.

The System

Like the feathers on Daedelas' wings, 96 USSC shingles were applied row-upon-row, in two 48-shingle subarrays. Unlike Daedelas' wings, this array would only benefit from reaching nearer to the sun. Unfortunately, the altitude brought with it extremes of wind and weather, stretching a 1-week installation into 4 weeks, and requiring special adhesives to hold the shingles in place. However, managed by Burdick Technologies Unlimited (BTU), of Lakewood, Colorado, and installed by D & D Roofing and Thames Electric, both of Denver, and SunFire, of Boulder, Colorado, the system beat the weather and the calendar (the road to the site was closed for the season soon after the system achieved first power).

The array, with its amorphous-silicon shingles, each 7 feet (2.13 m) long, produces approximately 1600 Wp. The power is stored in 16 Trojan deep-cycle, 12-V batteries and conditioned through a Trace 4024 inverter (the voltage was kept low for liability reasons). The system provides power for the computers, instruments, related equipment and the New Mexico State University/Southwest Technology Development Institute's data acquisition system.

The installation of a continuous power source moves the new facility a major step closer to the goal of remote operability. "The provision of a modest but steady source of power will enable us to begin overwinter monitoring of the observatory systems, and to develop the communication pathways needed to ultimately bring telescope images to classrooms, facilities like Gates Planetarium and the Internet," says Stencel.

In addition, this example of building-integrated PV in such an extreme setting moves this technology a major step closer to providing a significant power resource in the conventional built environment. ✪

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System Specifications

Array Design:	Roof-Integrated
Modules:	96 USSC Amorphous Silicon PV Shingles
Module Power Specs:	17 Wp; 8.5 V, 2 A
Module Physical Specs:	2.13-m (7-ft) long
Array Power:	1632 Wp
Array Configuration:	2 subarrays (48 modules each)
Power Conditioner:	Trace 4024, 24 V
Battery System:	16 Trojan L-16 Deep Cycle
Data Acquisition System:	New Mexico State University/Southwest Technology Development Institute: irradiance, temperature, voltage, amperage, battery state-of-charge

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