

# Racking Manufacturer

**M**ounting systems for low-slope, commercial roof applications are wide ranging and represent one of the most rapidly evolving equipment groups. Solutions range from preengineered products to customized racking systems. Since 2009, nine new players have entered the market, nearly doubling the number of manufacturers. Many have several distinct product lines.

To generate this article, we sent surveys to 24 manufacturers that have developed solutions for low-slope commercial roof applications. Some of these manufacturers were not even on our radar when we started our background research. Four did not respond to our requests for company and product-specific information.

Survey questions addressed topics ranging from product line overviews and suitable array capacities for a given racking system to integrated equipment-grounding provisions and wire management options. Because structural engineering requirements vary from project to project, often significantly, we also queried manufacturers regarding the specific array design, engineering and permitting support services offered.

The manufacturer overview table on page 57 provides basic information on the companies behind the racking systems. Because racking can represent significant shipping and freight costs, US and Canadian manufacturing and warehousing locations are included in the table when the manufacturer provided this information.

This article is intended to serve as a starting point to help determine the right rack for the right project. As always, the devil is in the details.

## LOW-SLOPE RACKING SYSTEM MANUFACTURERS

While it is not possible to cover the intricacies of the dozens of racking systems available for low-slope roof-mounted arrays in a single article, we have assembled company and product line overview information for 20 primary players in the market.

## Solutions for Low-Slope Commercial Roof Applications

By David Brearley, Ryan Mayfield and Joe Schwartz

### Applied Energy Technologies (AET).

The Rayport Roof Ballasted System manufactured by AET is the only stainless steel racking system available for low-slope roof applications, making it a sound option for corrosive coastal environments.

Modules are installed in landscape format on support rails that can be ordered with tilt angles ranging from 0° to 30°. Support rails are connected to ballast tray assemblies, which are in turn secured to assemblies at the front and the rear, creating a monolithic array structure. AET does

not offer product-specific wire management options.

The Rayport system is designed to be compatible with all framed modules. AET offers the Rayport Frameless Module System for thin-film module technologies as well. A spacer bar is utilized during installation to set the support rails at the correct spacing for a given module model. One common bolt size is used for all racking joints. Holes for rack grounding lugs are provided on the back of each support rail. EPDM rubber pads protect the roofing material from abrasion damage.

The Rayport Roof Ballasted System and Rayport Frameless Module System are suitable for project capacities of 20 kW and larger. Both systems carry a limited 15-year warranty. Full array layout and loading analysis and layout drawings are provided with each Rayport system.

**Cooper B-Line.** The ARISTA Monolithic Solar Mounting System is a low-slope rooftop solution from Cooper B-Line. Recycled rubber DURA-BLOCK supports serve as the system base, elevating north-south strut rails off of the roof membrane and helping to reduce roof wear. The base strut can be ballasted in place or mechanically attached. Preassembled 90° strut fittings are used to attach vertical uprights to the base strut. Preassembled angled strut fittings (10°, 20° or 30°) at the top of these uprights are used to anchor the tilted east-west rails that support the PV modules. The use of preassembled components eliminates loose parts on the jobsite and decreases labor time in the field. Expansion splice plate assemblies for interconnecting base struts are designed to

# Survey

accommodate material expansion and contraction while maintaining system strength.

Because the ARISTA Monolithic Solar Mounting System is strut based, it is compatible with standard strut fittings and accessories. This enables a wide range of mounting options for conduit, combiners and other accessories. Cooper B-Line offers many BOS components, including cable management solutions and electrical enclosures. The racking system accommodates both portrait and landscape module orientations. In addition to the standard ARISTA system, Cooper B-Line can also provide an array of custom engineered mounting solutions upon request.

The ARISTA Monolithic Solar Mounting System is covered by a 10-year warranty on material and workmanship, and a 5-year warranty on the finish. Cooper B-Line offers design, engineering and permitting support for its mounting system, which received structural validation through a certified third-party wind-tunnel test.

**DPW Solar.** The POWER-FAB product line from DPW Solar offers a wide variety of mounting solutions for low-slope roof applications.

The company's recently released Power Grid mounting system is designed to achieve maximum power density on commercial rooftops while maintaining roof drainage. The top-clamping, modular mounting system allows for the flat installation of frameless thin-film or framed crystalline PV modules in either portrait or landscape mode. The mounting grid can be fully ballasted, mechanically attached or a hybrid of both.

For applications where a 5° to 25° tilt is desirable, DPW Solar offers the POWER-FAB CRS nonpenetrating flat-roof mounting system. Module layout is limited to landscape orientation. Both the Power Grid and POWER-FAB CRS mounting systems incorporate EPDM rubber base material for protection of underlying roof membrane. The company reports that both designs are supported and qualified by full-scale wind-tunnel testing.

Where mechanical attachment or higher roof clearances are desirable, mounting solutions can be configured for projects of any size using DPW Solar's Power Rail components. The company has two rail profiles to choose from, the P6 or the P8, depending on the required span between supports. Tilt-up kits are available with fixed-length or telescoping

**SunLink** Roof Mount System (RMS)



Shawn Schreiner

Courtesy JAC-Rack



**JAC-Rack** Solar Ballast Mounting System

legs. The company's ground-mount solutions, like the Large Ground Mount or the Multi-Pole Mounts, may be suitable for use in some commercial rooftop applications.

DPW Solar also offers a ballasted residential mounting system, the POWER-FAB BRM. This system is configurable for tilt angles of 20° to 45° and is fully ballasted in place using standard pavers. The BRM system is suitable for modules in portrait orientation.

Integrated equipment-grounding options for DPW Solar products are available using Wiley Electronics' WEEB hardware. However, the company does not offer proprietary wire management hardware.

DPW Solar's racking systems are recommended for projects of 20 kW up to MW-scale capacity. The product lines are covered by a standard 10-year warranty. DPW Solar offers design and permitting assistance, such as wind loading analysis, ballast calculations, roof loading analysis, array layout and CAD drawings.

**HatiCon Solar.** The Flat Roof mounting system from HatiCon Solar is optimized for design flexibility, field adaptability and quick assembly.

The HatiCon Solar racking system is designed around an adjustable aluminum base triangle that is available in three tilt ranges: 10°–15°, 20°–30°, and 35°–45°. Where appropriate, these base triangles can be directly mounted to a surface. Alternately, they can be attached to a variety of rails that span appropriate roof members. They can also be directly attached to ballast. The base triangles can be manually adjusted in 5° increments. This variable height enables a level installation even on uneven roof surfaces.

To speed the installation process, base triangles are delivered to the site preassembled. Likewise, end- and mid-clamps

for framed or unframed PV modules arrive preassembled. The structural design calls for X-bracing between base triangles (at least one for every row and once every 40 feet) and these diagonal straps also ship preassembled. While the HatiCon Solar Flat Roof mounting system accommodates portrait module orientation and a range of tilt angles, landscape orientation at a 10° tilt is the most commonly used design. The company does not offer integrated equipment grounding or proprietary wire management hardware.

The HatiCon Solar Flat Roof mounting system is recommended for projects starting at 100 kW in capacity and up to the MW scale. The products are covered by a standard 10-year warranty. The company provides project layout and system optimization services, as well as engineering wet stamps.

**IronRidge.** The standard roof-mount solution from IronRidge features a unique curved aluminum extrusion with internal splice bars that do not conflict with foot placement. The stronger XRS rail profile is recommended for commercial low-slope roofs. This is a mechanically attached solution with a variety of options for attaching the rails to the roof, including flashable aluminum standoffs, L-feet and tilt legs. For elevated, structurally attached mounting systems, hardware from the company's Scalable Ground Mount product line is available to interface between a Schedule 40 pipe substructure and XRS mounting rails. The XRS mounting system supports both portrait and landscape module orientations.

IronRidge also offers a ballasted roof-mounting system that can be installed with just one tool, for systems 50 kW and larger. The IronRidge BRM is a rail-free mounting system for landscape-oriented PV modules with tilt angle options of 0°, 5° and 10°. (As of press time, no documentation for this product line was available on the company's website.)

Integrated WEEB equipment-grounding hardware is available for all IronRidge mounting systems. While no proprietary wire management solutions are currently offered, third-party solutions like Acme Cable Clips from Wiley Electronics can be used.

The IronRidge XRS and BRM mounting systems are suitable for small commercial through MW-scale projects, and are covered by a standard 10-year product warranty and a 3-year finish warranty. IronRidge offers standard span tables for its XRS rail in both flush and tilt-up configurations. Standard certification letters are available for many US states. IronRidge provides web-based software to help with basic system configuration; engineering services are available for more complex projects.

**JAC-Rack.** In addition to the JAC-Rack ballasted mounting system, the company offers roof- and

CONTINUED ON PAGE 52

ground-mount solutions that system designers can consider for low-slope roof applications.

The JAC-Rack ballasted solution is rail-based. Aluminum base extrusions with an extruded rubber nonslip base are installed in a north-south orientation with ballast trays between them. Perpendicular rails installed on angled mounting brackets tilt the array at 5°, 10°, 15° or 20°. Three rail profiles—Series 150, Series 250 and Series 300—are available to choose from depending on the span, wind or snow loading requirements.

Channels in the base extrusion are large enough to be used for wire management, and the company offers snap-in clips to keep the PV source-circuit conductors in place once they are routed within these channels. This facilitates stringing modules together between rows, as well as routing source-circuit conductors from multiple rows to a common combiner box. Integrated equipment grounding is available using JAC-Rack's Ground Control hardware, which includes WEEB grounding clips.

Where structurally attached solutions are desired, the JAC-Rack solar roof mounting system can be configured for flush or tilt-up applications. While the company's product catalogue does not include flashable round stanchions or standing seam clamps, these can be sourced elsewhere.

For increased roof clearance, the JAC-Rack solar ground-mounting system facilitates tilt-up designs elevated using round tubing, which can be sourced locally and flashed for waterproofing. Both portrait and landscape orientation are supported.

All JAC-Rack products are covered by a 10-year standard warranty. Project suitability ranges from small commercial to MW scale. The company offers both design and engineering services, including structural engineering certifications. Standard span tables are provided for all rail series. The

### Schletter IsoTop System



Courtesy Schletter

company can interpret and send DWG files for AutoCAD, as well as other universal formats like IGES.

**Mitsubishi Electric USA.** The Diamond Mount from Mitsubishi is a scalable racking solution. The rack is sold with modules, presourced combiner boxes and wiring solutions in 100 kW, 250 kW and 500 kW blocks. The mounting system was designed and engineered by P2, a California integrator with extensive experience in racking solutions.

The standard tilt angles are 14°, 18° and 25°. According to Mitsubishi, other angles can be specified. The Diamond Mount racking system allows installers to choose either portrait or landscape module orientation. The system was designed to be fully ballasted, but optional roof-attachment components are available.

The modular rack design employs a triangulated structure, reducing installation time and keeping the system square during array construction and assembly. The spans between the footings are bridged with aluminum beams. This detail minimizes roof contact and helps evenly distribute weight to structural components of the building.

The Diamond Mount racking system is designed for commercial PV systems from 100 kW and up. It comes with a standard 10-year warranty, which is extendable to 25 years. The system has undergone wind-tunnel testing, and test results are available to local jurisdictions upon request.

**PanelClaw.** PanelClaw's Grizzly Bear and Polar Bear low-slope racking systems can be fully ballasted or incorporate flashed roof penetrations as necessary. The rail-free racking systems accept all module types, to be mounted in landscape mode only. Depending on the width of the module, the resulting tilt angle varies between 10° and 13°. The Polar Bear is suitable for areas with a basic wind speed of 120 mph, and the Grizzly Bear is rated for 100 mph.

Each rack consists of three major parts—a module support with integrated ballast, a claw for module attachment and a wind deflector. The components are secured with only two nut and bolt sizes to simplify installation. The inter-row rack spacing is variable, allowing for optimal array design and shade mitigation. The module support includes multiple mounting-hole options to compensate for variances in roof heights along rows of modules.

The ballasted module support includes a preinstalled rubber pad to protect the roof surface. The ballast also incorporates two wire chases for wire management during installation. The integrated Wiley WEEB lug simplifies bonding the modules to the rack in the field.

The universal claw secures the module to the ballasted support at each corner of the module. PanelClaw has

CONTINUED ON PAGE 54

worked with several PV manufacturers to have its mounting method included as part of the UL-listing process. For modules that cannot be mounted on the short edge of the frame, there are optional claw attachments for proper support. The optimal design starts at a six-by-six grid of modules, but single module placement is possible, allowing installers to avoid roof obstructions easily and have flexibility in the final array layout.

The Polar Bear and Grizzly Bear racking systems can be used for systems of any size. The products are covered by a standard 10-year warranty and have undergone third-party testing, including wind-tunnel testing. PanelClaw offers support with system design and AutoCAD blocks for use in permitting and construction drawings.

**Schletter.** The Schletter mounting systems include fully ballasted and penetrating racks suitable for nearly any size of commercial rooftop array.

The AluLight rack is a fully ballasted rack that holds the modules at a 12° tilt in landscape orientation. The frame is assembled on-site using a rivet gun to connect the components. The backside of the frame incorporates a wind shield to minimize the uplift forces imposed and reduce the required ballast weight. The modules are held in place with standard top-down clamps.

Another ballasted option, the Windsafe System, offers a range of tilt options, from 10° to 45°, that allows system designers to maximize power density on the roof. The Windsafe System offers variable row configurations and is delivered on-site with the majority of the rack preassembled. Mechanical attachment options are available to supplement the primarily ballasted design.

The IsoTop racking system is a penetrating system designed for use on commercial buildings with membrane roofs. The system is engineered to minimize roof

penetrations by maximizing the spans between attachment points. The result is a rack system that can properly support modules with up to 32 feet between supports. The supports are connected directly to the primary structural members of the building, reducing the loads on the roof substructure.

The CompactVario and CompactGrid racking systems can be either fully ballasted or penetrating. These racks can be used with any roof type, including low-slope metal roofs. The CompactVario allows the supporting rails attached to the roof to span longer distances than the CompactGrid system does, allowing for greater flexibility in the array design. The CompactGrid is an optimal solution for roofs with an east-west slope.

All Schletter racking systems come with a standard 10-year warranty. A Schletter engineer can stamp its rack designs for most US states, or the company can arrange for a third-party engineer for states it does not cover in-house.

**Silverback Solar.** In contrast with many manufacturers of racking systems for low-slope roof applications, Silverback Solar does not offer a ballasted solution. All of the company's products are designed to be mechanically secured via a patented, watertight roof attachment.

The support structure for Silverback Solar's elevated racking systems is based on 2.5-inch and 1.5-inch tubular steel sourced from Allied Tube & Conduit. This design approach maximizes the span of structural members and minimizes the number of required roof penetrations. All tubing components are protected by Allied's Gatorshield finish. Sliding tubing connectors allow for unlimited adjustment during installation. Fittings are slid over the tubes, the rack is leveled and plumbed, then secured in place with self-drilling tek screws.

Modules can be installed in portrait orientation only, but any tilt angle can be achieved. A patent-pending panel clip adjusts for any module thickness from 1.21 to 2.02 inches. Each clip consists of a saddle and retainer. The saddles are fastened with two self-drilling screws, and the retainer is secured with a machine bolt. Integrated equipment grounding and wire management solutions are in development.

Silverback Solar's racking systems are suitable for arrays ranging from 100 kW to MW scale. The products carry a standard 10-year warranty. Silverback Solar provides project-specific structural calculations, wet stamped by a licensed structural engineer for any US state. The company also provides blueprint-sized shop drawings and detail sheets to assist with installation. CONTINUED ON PAGE 56



**Silverback Solar** Solar Racking System

**SnapNrack.** Two new SnapNrack models are being released in 2011. The original Roof Mount Series 100 rail system was developed for residential installations. Two new systems, the mechanically attached Commercial Roof Series 400 and the ballasted/mechanically attached hybrid Commercial Roof Series 450, have been scaled up for larger projects. (As of press time, no documentation for these products was available on the company's website.) Both the 400 and 450 series racking systems are designed for landscape module orientations with tilt angle options of 5°, 12° and 20°.

Anodized aluminum rails feature an integrated wire management channel and require no additional wire clips or ties to support and protect module cabling. Labor-saving features include snap-in channel nuts and rail splices that eliminate the need to slide mounting components in from the ends of the rails. To further simplify installation, one wrench fits every assembly bolt in the system. A wide variety of stanchions and flashing kits is available for mechanically attached or hybrid attachment designs. Rails can be leveled by raising or lowering the points where they attach to the standoff assembly. The racking system is fully compatible with Wiley Electronics WEEB equipment-grounding products.

SnapNrack's Commercial Roof Series 400 and hybrid Commercial Roof Series 450 carry a 10-year limited warranty. The manufacturer recommends a minimum project size of 100 kW for the Series 400 and 20 kW for the 450 Series product lines. In-house design assistance is standard and third-party engineering services are available.

**SolarDock.** The fully ballasted and enclosed low-slope SolarDock roof racking solution is a lightweight mounting system with a high-tilt angle of up to 35°, suitable for arrays of 5 kW and larger. While custom tilt angles from 5° to 30° (in 5° increments) are available, the manufacturer stresses that higher

array tilt angles reduce the build-up of dirt and debris, shed snow more readily in cold climates and reduce array operating temperatures, thereby increasing system production.

Modules are mounted in landscape format on ventilated, aluminum structural enclosures that are designed to fit most commercially available modules. Individual units are attached side-to-side and front-to-back, creating a monolithic array structure. The mounting system itself rests on 1-inch insulation, eliminating abrasion issues. Insulation panels are spaced to allow for unimpeded water drainage. Ballast material is positioned toward the back of each mounting unit.

SolarDock's UL- and TUV-listed, fully enclosed design provides wire management and protection from debris build-up or rodent damage. Cabling is contained within the racking system, and installers can core out the front and back of the racking system where necessary to run conduit between units. Two sizes of SolarDock equipment-grounding clips are available. The SolarDock units are certified as a ground path, and only one grounding lug is needed for every 45 connections or five rows.

The SolarDock roof racking system is designed for array capacities of 5 kW and larger and carries a 25-year standard warranty. The company supplies preliminary module layout services. Full mechanical and ballast plans are provided for purchased systems. Currently, signed and sealed drawings for 29 states are available for a fee, and additional states are being added.

**Solar FlexRack.** The Solar Rooftop FlexRack roof-mount solution from Solar FlexRack is designed for speedy installation. This is accomplished using preassembled modular racks that eliminate and simplify mechanical work in the field. The collapsible mechanical assemblies ship from the factory in a compact form. These units are small and light enough that, once on-site, only two people are needed to carry each one into position on the roof. Once a Solar FlexRack is in place, simply cut the zip ties holding everything together, unfold it and tilt the top plane up. After the preconfigured uprights are lifted into position, everything is bolted together.

North-south and east-west connections between individual mounting units are accomplished using connection arms. Standard Solar FlexRack configurations for framed crystalline modules or unframed thin-film laminates are 3-by-3, 3-by-2 or 3-by-1, but custom configurations are also available. Framed modules slide into position; unframed laminates are attached using padded clips. Both portrait and landscape module orientations are supported. Tilt angle options are

CONTINUED ON PAGE 58



Courtesy SnapNrack

**SnapNrack** Commercial Roof Series 450

### Footnote Key

<sup>1</sup> Approximate. May include parent company.

<sup>2</sup> Highland, IL; Pinkneyville, IL; Troy, IL; Reno, NV; Sherman, TX; Mississauga, ON

<sup>3</sup> Harvey, IL; Phoenix, AZ; Wayne, MI; Kokomo, IN; Philadelphia, PA; Ajax, ON

DNR—did not report

# Racking Manufacturer Resource Guide for Low-Slope Roof Applications

Manufacturer	Parent Company	Year Entered Racking Market	Number of Employees <sup>1</sup>	Headquarters Location	US & Canadian Manufacturing Locations	US & Canadian Warehousing Locations	US & Canadian Sales Office Locations	US & Canadian Sales Contact	Company URL
Applied Energy Technologies	The Applied Group	2009	20	Clinton Township, MI	Macomb, MI Scarborough, ON	Toledo, OH Scarborough, ON	Clinton, MI	586.466.5073	aetenergy.com
Cooper B-Line	Cooper Industries	2010	28,000	Houston, TX	six locations <sup>2</sup>	six locations <sup>2</sup>	most states and provinces	877.586.8607	cooperbinesolar.com
DPW Solar	Preformed Line Products	1993	2,500	Albuquerque, NM	Albuquerque, NM Albemarle, NC Cambridge, ON	Albuquerque, NM Albemarle, NC Cambridge, ON	Albuquerque, NM Cambridge, ON	US: 800.260.3792 CAN: 519.740.6666	dpwsolar.com preformed.on.ca
HatiCon Solar	N/A	2009	10	Ontario, CAN	California Oregon Ontario, CAN	California Oregon Ontario, CAN	Ontario, CAN	909.235.7150	haticonsolar.com
IronRidge	N/A	1998	30	Willits, CA	N. California	N. California Mid-Atlantic	N. California Mid-Atlantic	707.459.9523	ironridge.com
JAC-Rack	JAC Products	2009	1,000	Pontiac, MI	Franklin, GA	Franklin, GA	Pontiac, MI	800.526.3491	jac-rack.com
Mitsubishi Electric USA	Mitsubishi Electric	2010	125,000	Cypress, CA	multiple US states	multiple US states	multiple US states	714.236.6137	mitsubishielectricsolar.com
PanelClaw	N/A	2007	30	N. Andover, MA	multiple US states Ontario, CAN	multiple US states Ontario, CAN	N. Andover, MA California	978.688.4900	panelclaw.com
Schletter	Schletter GmbH	1990	1,000	Haag, Germany	Tucson, AZ Windsor, ON	Tucson, AZ Windsor, ON	Arizona Virginia New Jersey	US: 520.289.8700 CAN: 519.946.3800	schletter.us schletter.ca
Silverback Solar	RoofScreen Manufacturing	2007	13	Santa Cruz, CA	Santa Cruz, CA	Santa Cruz, CA	Santa Cruz, CA	877.765.2759	silverbacksolar.com
SnapRack	Mainstream Energy	2008	600	San Luis Obispo, CA	Sacramento, CA	Sacramento, CA	Albuquerque, NM	805.540.6999	snaprack.com
SolarDock	N/A	2003	8	Wilmington, DE	New Castle, DE Detroit, MI Ontario, CAN	New Castle, DE Detroit, MI Ontario, CAN	Delaware, Ohio, Florida, Nevada, Washington	US: 302.504.0124 CAN: 705.743.1817	solardock.com
Solar FlexRack	Northern States Metals	2008	125	West Hartford, CT	Youngstown, OH Markham, ON	Youngstown, OH Markham, ON	all 50 US states Ontario, CAN	720.840.6615	solarflexrack.com
Sollega	N/A	2009	11	New York, NY	Tigard, OR	multiple US states	San Francisco, CA New York, NY	(W) 415.648.1299 (E) 212.417.0321	sollega.com
SunLink	N/A	2004	55	San Rafael, CA	Southwestern US Ontario, CAN	San Leandro, CA Markham, ON	San Rafael, CA	415.306.9837	sunlink.com
TOUGH TRAC	N/A	2009	325	Medford, NY	St. Louis, MI	St. Louis, MI	Medford, NY	631.504.6700	toughtrac.com
Unirac	Hilti Group	1998	DNR	Albuquerque, NM	DNR	DNR	DNR	505.242.6411	unirac.com
Unistrut Energy Solutions	Atkore International	2009	3,100	Harvey, IL	six locations <sup>3</sup>	six locations <sup>3</sup>	Harvey, IL Ajax, ON	877.336.4332	unistrutenergy.com
Zep Solar	N/A	2009	35	San Rafael, CA	California Wisconsin Michigan	San Rafael, CA	San Rafael, CA	415.329.0768	zepsolar.com
Zilla Rac	Next Generation Energy	2006	52	Lafayette, CO	multiple US states Ontario, CAN	multiple US states Ontario, CAN	multiple US states Ontario, CAN	877.643.4786	zillarac.com



Courtesy Sollega

**Sollega** InstaRack System

0° to 30°. Both mechanically attached and ballasted configurations are possible using the Solar FlexRack. Grounding straps are available, as are wire management clips that install in the rail.

The Solar Rooftop FlexRack system is designed for projects of 25 kW capacity and up. The system carries a 5-year standard warranty. In addition to engineering certification for snow and wind loads, the company offers roof layout design assistance.

**Sollega.** InstaRack is a ballasted racking system from Sollega designed specifically for low-slope roof applications in the 50 kW to 1 MW range. It is a one-piece molded unit that requires one tool (a 5/16-inch wrench) for installation and utilizes readily available Unistrut rails and standard intermodule and end-clamp hardware. Individual InstaRack units are designed to interlock with the module rows to the front and rear to add additional array structural stability. The patent-pending, no-assembly support is designed to reduce product shipping costs and installation labor costs. InstaRack is manufactured using high-density polyethylene made from 35% recycled content with a UV inhibitor.

InstaRack is available with set tilt angles of either 10° or 15°. The modular design ensures compatibility with most solar panels of 36 to 44 inches in width. Modules are installed in portrait orientation. A proprietary hinge plate enables easy access under the modules. For arrays that require a hybrid ballast/mechanical attachment, 6-inch stanchions are available, as are windscreens to reduce wind loading on the array. Integrated module equipment grounding is possible using Wiley Electronics WEEB grounding clips.

InstaRack carries a 25-year standard warranty and was developed for arrays of 50 kW and larger. Sollega offers array layout and design engineering services, as well as wind and ballast calculations. Preengineered product specifications are available for permitting purposes.

**SunLink.** SunLink offers two mounting solutions, one for framed crystalline modules and a second for frameless

thin-film modules. Both racking systems can be fully ballasted, mechanically attached or use a hybrid method for securing the array to commercial rooftops.

SunLink's Roof Mount System (RMS) is designed for mounting framed modules in landscape orientation and offers field-adjustable tilt angle settings of 5°, 10°, 15° and 20°. The system components are designed to link together to provide rigidity and support to the entire array. RMS mounts are compatible with most low-slope roofing material types, including BUR, OVC, TPO and SMS. ETL-listed spars are available for most modules to satisfy equipment-grounding requirements. A fully integrated wire management system, including wire clips and covered wire ways, is available.

Two unique features decrease RMS installation time and associated costs. First, SunLink is reportedly the only racking manufacturer that offers prepanelization—the off-site assembly of modules in configurations of three or four. According to the manufacturer, prepanelization can take over 50% of the mechanical assembly time off the roof, minimizing on-site installation time, liability and the chances of poor weather conditions slowing project implementation time. Second, the RMS's Tilt-Access feature allows sections of module rows to be tilted up vertically to reduce wiring time during installation and to allow for roof inspection or repair.

The SunLink Frameless Roof Mount System is a lightweight and fast-installing roof-mounting solution designed for frameless and laminate thin-film modules. In most conditions, the system requires no additional ballast weight or roof penetrations. A simple three-step process (slide in blocks, rotate down links and click in panels) eliminates the need for installation tools and results in rapid on-site assembly. Modules mount in portrait orientation at tilt angles of 2° to 10°.

SunLink's Roof Mount System and Frameless Roof Mount System are suitable for array capacities from

CONTINUED ON PAGE 60



**Unirac** ISYS Roof Mount

Courtesy Rosendin Electric

30 kW to multiple MW scale. Each system is covered by a 15-year standard warranty. Custom-engineered solutions are available for unique or difficult projects. An online sales quote tool is available. SunLink offers full engineering services, including array design and layouts for projects over 30 kW, shading analysis and site-specific design and engineering support, including wind load analysis and permitting assistance for ballasted systems.

**TOUGH TRAC.** Each of TOUGH TRAC's five low-slope racking systems are designed to be compatible with most common modules. In 2011, adjustable universal end- and mid-clamps were introduced that accommodate module frame thickness from 1.33 to 1.97 inches. A click-in-place rail-mount system is in development. All five racking systems are compatible with WEEB products, and wire management solutions are available on request.

The Low Angle Ballast system supports a single row of modules in either portrait or landscape orientation with a low-profile 10° tilt angle. The penetration-free, fully ballasted rack utilizes TOUGH TRAC's standard rail, which can span up to 96 inches. Rear joining braces create a fully interlocked array structure.

The Mid Angle Portrait system mounts one row of modules in portrait orientation, while the Mid Angle Landscape system mounts in two rows in landscape orientation. Each has a standard 30° tilt angle. A rear cross brace provides support for lateral movement. Using the standard rail allows spacing up to 96 inches. The system is available in both mechanically attached and ballasted formats.

TOUGH TRAC's Continuous Array Large model supports four rows in landscape or three rows in portrait with a standard 20° to 30° tilt angle. The Continuous Array Small model supports two rows in landscape or two rows in portrait. Either standard or heavy-duty rails can be specified, for up to 8-foot and 12-foot spans, respectively. Side and rear cross braces provide lateral support, and vertical supports feature welded base plates to minimize installation time.

The Low Angle Light ballasted system secures one module with a dedicated ballast tray. The system does not require mounting rails and is made up of three primary structural components.

TOUGH TRAC's racking systems are suitable for small commercial through MW-scale projects. The products come with a limited 20-year warranty. TOUGH TRAC offers standard engineering certifications and fee-based engineering services.

**Unirac.** Low-slope roof-mounting solutions from Unirac include a variety of mechanically attached and ballasted options for PV systems of all sizes and configurations.

The newest of these product lines is the ISYS Roof Mount, which is designed for flat-roof mounting applications. At its base, this system utilizes a 5.25-inch galvanized steel I-beam that is elevated off the roof membrane using recycled rubber



Courtesy Unistrut Energy Solutions

**Unistrut Energy Solutions** Custom Solar Racking

blocks. The front and back leg supports accommodate 0° to 30° array tilt angles. The system is designed to be self-ballasting. It can be utilized with a variety of flashed stand-offs. The east-west rails that support the PV module are galvanized steel with a 3-inch profile; modules are attached using bottom-mounting hardware.

The Unirac RapidRac G10 ballasted mounting system consists of just seven parts and can accommodate any project size. Aluminum mounting frames are used as ballast trays. Module brackets attach between these trays and tilt the PV array at 10°. WEEB hardware facilitates equipment grounding. Optional mechanical attachments are available to minimize or eliminate the use of concrete ballast materials.

Where mechanical attachment with higher tilt angles is desired, designers can consider tilt-up configurations using the Unirac SolarMount rail system. Two rail profiles are available, as well as a variety of standoffs, tilt legs and module top-mounting clamps or bottom-mounting clips. Integrated equipment-grounding hardware is available from the manufacturer for the SolarMount rails. If higher roof clearances are needed, designers can employ the Unirac Large Array (U-LA) mounting system, which includes a pipe-based substructure. The U-LA system features heavy-duty SolarMount HD rails that can withstand extreme wind or snow loads. The U-LA mounting system is compatible with locally sourced Schedule 40 or 80 steel pipe. Both of these mechanically attached solutions are versatile and can accommodate custom designs.

The ISYS Roof Mount is covered by a 20-year limited product warranty and is designed for systems of at least 200 kW in capacity. Unirac's other racking systems are covered by a 10-year limited product warranty and a 5-year finish warranty. Extensive engineering documentation is available on the Unirac website for all of the company's product lines. Unirac also offers configuration and estimation tools and support. The company's Custom Solutions Division supports the needs of larger projects. CONTINUED ON PAGE 62

**Unistrut Energy Solutions (UES).** Unistrut Energy Solutions employs a custom design and engineering approach for each project, engineered around a core product line, to achieve a cost-effective solution.

UES sources galvanized steel tubing, angle, channel and strut stock from Allied Tube and Conduit and Unistrut. These often locally sourced structural components serve as the basis of UES's array structures.

Multiple racking solutions, including mechanically fastened, ballasted or hybrid systems, are available, based on the customer's preferences and the project's structural requirements. Typical tilt angles range from 10° to 40°. Designs can accommodate either portrait or landscape module orientations. While integrated equipment grounding solutions are not available directly from UES, wire management options are extensive and include metallic and nonmetallic ladder tray, channel tray and wire basket tray.

UES's customized racking systems have a standard 10-year warranty. The systems are suitable for projects with capacities of 50 kW up to MW scale. The company offers a variety of services that includes reverse engineering, conceptual design, metallurgical analysis and structural design. It also offers engineering calculations, CAD drawings and seals to meet local and geographic project requirements. UES will work with a client's engineering firm if preferred.

**Zep Solar.** For installations using Zep-compatible modules, the Zep System III is a solution with an ultra-low parts count for commercial-scale, ballasted low-slope roof applications. The rail-free solution utilizes only four components: row connectors, ballast pans, leg sets and Zep fasteners. Modules are set at an 11° tilt angle and mounted in an interlocking fashion in landscape format. The row connectors and ballast pans include an integrated EPDM friction pad to reduce wear on the roof surface. For locations with high wind requirements, options such as wind guards and mechanical roof attachments can be incorporated into the mounting system.

The Zep fasteners incorporate both equipment grounding and structural support from module frame to module frame. As the modules are interconnected, the Zep attachments create a UL-listed equipment-grounding connection, eliminating the need to bond individual modules. In turn, the Zep ground lug is installed at the end of each row of modules and used to terminate the equipment-grounding conductor that is routed to the combiner box.

Zep System III is recommended for projects with capacities of 50 kW and larger. The system is covered by a 20-year standard warranty. Zep Solar provides array design, site and load assessment, ballast feasibility studies and assistance in determining ballast requirements. A list of Zep-compatible modules is available on the company's website. While Zep-compatible modules are currently limited, this innovative system still warrants attention.



**Zep Solar** Zep System III

**Zilla Rac.** Next Generation Energy's (NGE) Zilla Rac RED3 tilted ballast system is designed for low-slope roof applications in all wind zones. The racking system consists of a grid of north-south rails that sit on the roof surface and mate to the ballast pans. The post standoffs that determine the modules' tilt are directly attached to the north-south rails. The front end of each module is held in place with a rail channel that mates with a module clip attached directly to the module. The clip installation method allows for quick access to the back of the modules during maintenance. Each of the rail sections includes an integrated chase that allows the installer to support and manage the source-circuit conductors. When required, options from the Zilla Rac product line can be used to make mechanical attachments to the roof structure.

The racking system can be adapted to multiple configurations, allowing the installer to avoid rooftop obstructions and install the modules in either landscape or portrait. The installer can determine the tilt angle for the array and adjust the post standoff as necessary.

The Zilla Rac RED3 system was designed for arrays starting at 25 kW in capacity. The system is covered by a 10-year standard warranty and a 45-year material finish warranty. Integrated module equipment grounding is provided. To help verify proper installation, NGE offers design and engineering services for the US, Canada and the Caribbean. ☎

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