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CLEANPOWER Showcased Power Conversion Products For Utility-Scale Renewable Energy Systems

by David G. Morrison, Editor, How2Power.com

This year's [CLEANPOWER Conference and Exhibition](#) drew over 480 exhibitors and more than 8300 attendees to New Orleans in May to learn about the latest developments in utility-scale renewable energy. It featured talks, interviews and panel discussions with industry leaders as well as notable politicians on subjects relating to energy policy, and trends, goals and challenges in the renewable energy field. This event, which was formerly called Windpower, still addresses wind energy, but also devotes significant time and space to energy storage, as well as solar energy, power transmission and the emerging subject of hydrogen power.

While the conference program mostly focused on the business and policy aspects of renewable or clean energy, the exhibition provided a veritable tour of the clean energy industry that encompassed the materials, devices and equipment needed to build wind power, solar power and energy storage installations, and to some extent power distribution, as well as all manner of services required to develop, build or operate such installations.

From a power electronics perspective, the Cleanpower expo was interesting in that it included a number of vendors of inverters, drives and UPSs used in these systems, as well as companies who have developed some of these power converters for use in the larger systems they build. In this article, I'll highlight some of the many power electronics product examples I encountered in the Cleanpower exhibition.

Drives For Wind Turbines

[Avid Controls](#) is a Waller, Texas-based manufacturer of high-powered electronics such as inverters and rectifiers. The company has a licensing agreement with GE Power Conversion to build the MV3000 product line, which includes the air- and liquid-cooled DELTA inverter modules and associated rectifier modules. The inverters are rated for 500 A (air cooled) and either 800 A or 1000 A (liquid cooled). The air-cooled units are for 380- to 525-Vac systems, or 600-/690-Vac systems, while the liquid-cooled systems are designed for 575- to 690-Vac operation. In both cases up to six DELTA inverter modules may be connected in parallel.

Among their various uses, these inverters find applications in the power train of wind turbines. The Delta products are utilized in most SGRE G2 and G4 wind turbines. In these turbines, the inverters find uses as both generator and grid-side converters, serving as AFE drives. These are essentially ac drives, which convert ac to dc to ac.

Avid Controls supports the installed base in all industries that utilize the MV3000 products along with integrators that utilize the MV3000 products for new projects.

At the Cleanpower expo, the company showed its replacement for the Delta inverter, the Avid Extreme Inverter (AEI), a liquid-cooled inverter module (Fig. 1). According to John Norwood, who is sales manager at Avid Controls, this new product overcomes a limitation of the original DELTA inverter, which fails due to moisture and thermal cycling. The AEI overcomes these problems by using a patented sealing process of the Semikron SKiiP 4 IGBTs, which employ the latest sintering technology for bonding the IGBT chips.

According to Semikron Danfoss sintering "increases resilience to active and passive thermal cycling compared to a conventional solder approach." These units also employ conformal coating on all pc cards and other specialized enhancements to make the AEIs impervious to moisture.



Fig. 1. The Avid Extreme Inverter modules are high-reliability liquid- and air-cooled inverter modules with nominal ratings from 550 A to 1400 A and up to 690 Vac for use with MV3000 AC drives, controlled by the Common Drive Controller (CDC).

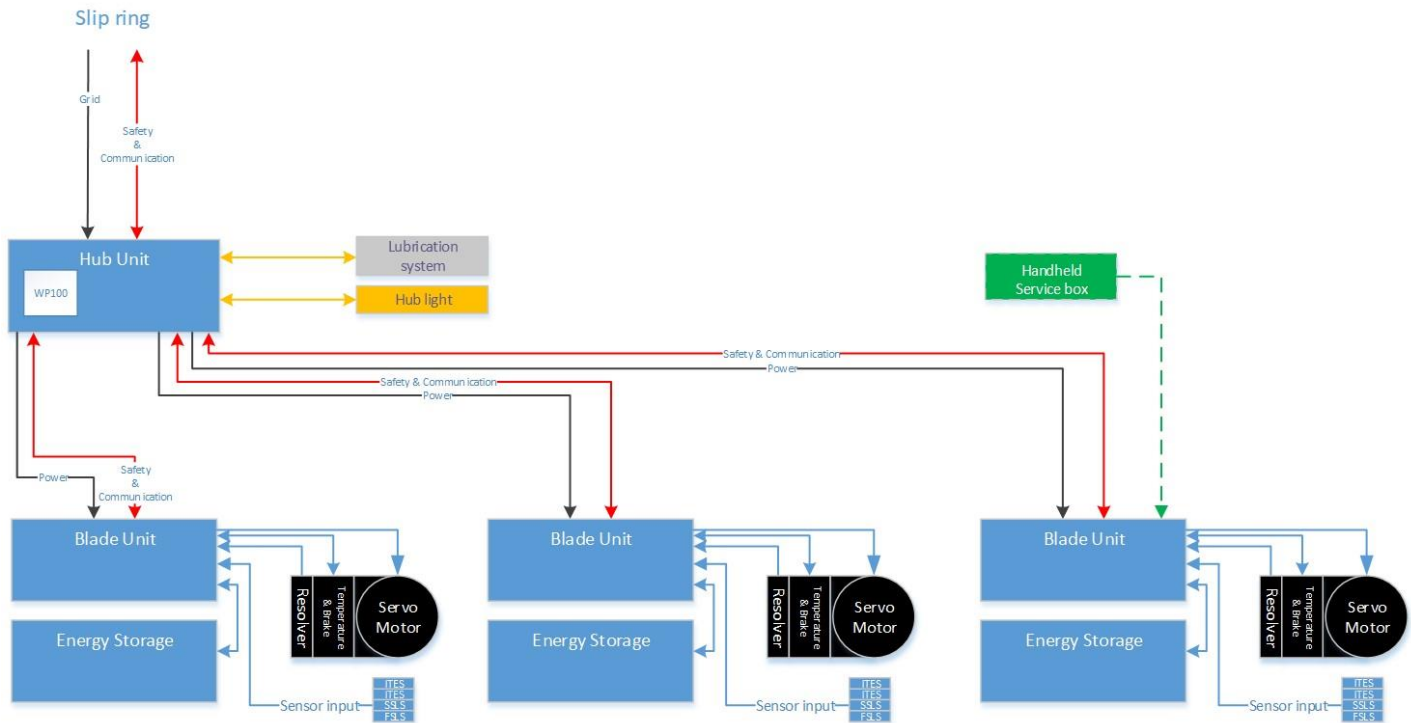
For more information, contact [John Norwood](#).

At its booth in the Clean Power 2023 exhibition, [Emerson](#) displayed a key component of its Ovation Green electrical pitch solution, the wind turbine blade drive unit (Fig. 2a). In a wind turbine, there is one of these units for each blade, as shown in the example diagram for a three-blade turbine (Fig. 2b). The recently introduced Ovation pitch blade unit (BU 158) is the latest generation of this product, which has been continuously improved for size over the years.

As the company notes, the key to managing a wind turbine generator is its ability to vary the pitch of the blades as it rotates. The blades govern the speed and torque applied to the gearbox and generator inside. Modern wind turbines use electrically driven actuators to drive each blade, usually consisting of a motor, drive unit, and a back-up energy storage unit. These components are located within the rotating hub of the turbine.



(a)



(b)

Fig. 2. The Ovation pitch BU 158, pictured in (a), is a key part of the Ovation Green electrical pitch solution (b), a turnkey system for providing pitch control of turbine blades in any wind turbine model up to 10 MW.

Weighing only 50 kg, the Ovation pitch BU 158 operates from a nominal supply voltage of 400 Vac and generates 0 to 380 Vac at 0 to 300 Hz with a nominal power of 40 kW. It operates at a 4-kHz switching frequency.

This pitch drive must withstand the worst environmental conditions including temperature extremes, water, sea salt and other contaminants in the air, says Jesper Nielsen, business development director of renewable energy technologies for Emerson. He adds that routine maintenance of this unit consists solely of replacement of its fan unit every five years.

While supplied directly to some new units, Emerson is promoting this pitch drive unit for retrofitting in applications where existing drive units may have some performance or reliability issues.

“The existing electrical pitch systems in the turbines today are normally represented in the top three of the most common errors to stop the turbine. This affects the availability and performance of the turbine. The most common issues are due to [failure of the] switch gear components used in the standard pitch systems. These switch gear components have been converted into electronic components which gives a high reliability, operating temperature area and performance,” says Thomas Andersen, vice president of renewable energy technologies for Emerson.

He adds “Besides, an analysis of an existing pitch system in case of failure normally takes engineers 2 to 5 days, plus missing spare parts, etc. and the need for experts and lost turbine production. In the case of an issue on the Ovation pitch unit, non-experts on site can just replace the box in two hours and get the turbine to produce again. The system is also designed for a lifetime of 30 years and does not require any maintenance. From an operational standpoint, existing systems need to stop the turbine for test of the backup capacity (batteries or ultracapacitors), impacting the availability and performance of the turbine. With the new electrical pitch system, we do not have to stop the turbine as we can test and verify the capacity on the fly (while the turbine is in operation).”

For more information, visit www.Emerson.com/Ovation-Wind.

The Cleanpower expo also featured companies offering string inverters for solar applications. For example, [CHiNT Power Systems](#) (CPS) offered information on 250-kW/275-kW, 1500-Vdc units that they introduced a year and a half ago, the CPS SCH275kti-do/us-800. Designed for ground-mount applications, these string inverters are designed specifically for the North American market (Fig. 3). According to Jordan Harrison, application engineer at CHiNT Power Systems, these inverters have all the latest certifications for the U.S. market including UL 1741-SA, UL1741-SB, CA Rule 21, SA14-18, and IEEE 1547-2018.

This inverter also has some capabilities that set it apart from similar products on the market. "A unique feature of this inverter is that it has full power capacity up to 42°C. It is also the highest power output, 275 kVA, in its class. The benefit with the 275-kVA capacity is 250 kW of real power can be produced even at a 0.9 power factor," says Harrison.

The company released a 350-kW string inverter at the RE+ show in September. According to Harrison this inverter has features similar to the CPS SCH275kti-do/us-800, but with higher output power. For more information, see the [datasheet](#) or contact [Jordan Harrison](#).



Fig. 3. The 250-/275-kW high-power CPS three-phase string inverters are designed for ground-mount applications. The units are high performance, advanced and reliable inverters designed specifically for the North American environment and grid. High efficiencies, wide operating voltages, broad temperature ranges and a NEMA Type 4X enclosure enable this inverter platform to operate at high performance across many applications.

[Sungrow](#), whose motto was "Clean Power For All" showed its string inverters for utilities and commercial applications. An example unit on display was the SG350HX-US, a 350-kW multi-MPPT (maximum power point tracker) string inverter for 1500 V-dc systems (Fig. 4). This inverter was introduced at the beginning of this year.

The SG350HX-US is a versatile string inverter as it can be applied to commercial and industrial (C&I) and utility-scale projects. Furthermore, this inverter is available with an MVS (medium voltage switchgear) skid to improve efficiency and reduce operations and maintenance (O&M) costs," says Jennifer Sulyman, product marketing manager at Sungrow USA.

She adds that "the SG350HX-US is engineered with safety as a priority. This inverter has 24-hour real-time ac and dc insulation monitoring and two strings per MPPT, reducing the possibility of string reverse connection, making it extremely safe. The SG350HX-US is UL1741 SB and IEEE1547-2018 certified."

Within the company's portfolio, this string inverter is also distinguished by its power output. "The SG350HX-US is Sungrow's most powerful string inverter with up to 16 MPPTs and a 99% maximum efficiency, says Sulyman, who further describes the product as "Sungrow's strongest string inverter for commercial and industrial (C&I) projects."

Additionally, the inverter has benefits with regard to O&M efficiency. These include features such as the Q at night function and scalability of the SG350HX-US, which are said to make this inverter easy to operate and maintain for many different-sized projects.

Other features of the SG350HX-US include enhanced grid support with <30 ms of reactive power response time and 500-Wp+ module compatibility. For more information, see the product [page](#) or contact [Jennifer Sulyman](#).



Fig. 4. The SG350HX-US 350-kW string inverter boasts high yield with up to 16 maximum power point trackers (MPPTs) and a max. efficiency of 99%. It also offers features for low cost, grid support, and safety.

Another exhibitor showing inverters for solar applications was [Power Electronics](#). According to Alexander Cubas Paryag, senior sales engineer, the focus of their very large exhibit was inverters for solar and dc-dc converters for energy storage applications. In particular, they displayed their Inverter Gen 3 Freemaq PCSM which is rated up to 4.2 MVA (Fig. 5).

This product, which was introduced in June 2022, is a central inverter, but divided into four power modules, making it a hybrid of both the central and string inverter styles. According to the vendor, it is the only inverter on the market that allows four isolated dc inputs, making it ideal for long duration energy storage projects. Also, it's able to deliver full power up to 1500 Vdc, while similar inverters start limiting at 1300 Vdc, says the company.



Fig. 5. Power Electronics showed its Inverter Gen 3 Freemaq PCSM, an inverter for solar applications, which is rated up to 4.2 MVA. The booth visitor on the right gives some clue as to the scale of this unit.

The company also showed a yet-to-be-released product, the FD-1200, a dc-dc converter for solar sites with energy storage (Fig. 6). By combining up to four per inverter, this product provides 1200 to 4800 kW of dc-dc conversion for charging batteries from PV panels. This makes the FD-1200 a good match for the Gen 3 Freemaq PCSM solar inverter described above. According to the vendor, the FD-1200 is distinguished by its ability to deliver 1.2 mW at a time when similar products on the market are limited to around 600 kW.

The FD-1200 is due to be released in Q1 of next year. In addition to these products, Power Electronics also showed its EV charging stations (similar to ones it has previously shown at CES.) These included the NB 240-kW EV charger. For more information, email [Alexander Cubas Paryag](mailto:Alexander.Cubas.Paryag).



Fig. 6. By combining up to four FD-1200 dc-dc converters, users can achieve 1200 to 4800 kW of dc-dc conversion for charging batteries from PV panels.

Another exhibitor, [LS Energy Solutions](#), has developed string inverters under the AiON-SIS name for energy storage applications and they use their string inverters mainly as components within the energy storage solutions they develop. For example, the company has developed the AiON-ESS, an all-in-one containerized unit that combines the inverters with battery storage (Fig. 7).

As noted on the company's website, this "all-in-one integrated system is a flexible, modular energy storage solution for 1-hour (AiON-ESS Power Series) and 2- to 6-hour (AiON-ESS Energy Series) applications. Both models incorporate our third-generation string inverters, together with Tier-1 energy focused batteries in a single, scalable enclosure, enabling configurations of any size for almost any application. The fully integrated, containerized system reduces upfront capital outlay and saves on site installation work."

"The all-in-one system is built from paralleled string inverters installed inside an air-cooled section of the container, together with an isolated HVAC- or liquid-cooled dc battery compartment. D battery strings are aggregated in small groups to keep the bus voltage at lower, safer levels for the end customer. The system can operate from 200 V up to 1350 V, making it compatible with most current and future energy storage technologies."



Fig. 7. LS Energy Solutions' AiON-ESS energy storage solution is an all-in-one containerized unit that combines inverters with battery storage.

The Power Series version of AiON-ESS uses Tier 1 NMC (nickel manganese cobalt) Li-ion cells to provide power for 1-hour applications. Meanwhile the Energy Series version of AiON-ESS uses an LFP (Li-ion phosphate) Li-ion chemistry to provide 2 to 6 hours of energy storage.

According to Curt Feldman, director of business development at LS Energy Solutions, the main use of this ESS product for utilities is load shifting because most power demand is from 4 to 8 pm. Commercial customers on the other hand may use this ESS for peak shaving. In developing the AiON-ESS, the company was able to achieve 3 MWhr of energy storage, which was as much battery as they could pack into the single-container module.

There are other companies developing similar types of energy storage solutions, which are commonly referred to as Battery Energy Storage Systems or BESSs. Most integrators of such systems combine products from different vendors such as installing a battery module from one source and power electronics and other electronics hardware from other sources. However, with the AiON-ESS, LS Energy Solutions ships an all-in-one complete system for which they make most of its components except for the battery cells themselves.

"This provides quality control and addresses supply chain issues," says Feldman, who adds, "Everything is built in the U.S. to get the IRA tax credit. [Even] the power electronics are made in the U.S."

Beyond the battery and electronic aspects of systems like the AiON-ESS, they also contain a host of safety features. Feldman states they have "smoke detection, heat detection, gas detection, and the ability to exhaust air out of the container. Dry agent statics or Novec 1200 remove oxygen." He adds that "deflagration weakens the structure to control how it explodes. And a last resort is dry pipe, which floods the system with water."

LS Energy Solutions' string inverters, like those used in the AiON-ESS, were originally legacy products from Parker Hannifin's (Charlotte, NC) Energy Grid Tie Division, which became LS Energy Solutions. The company

has string inverters with ratings as low as 140 kVA, but units with 200 to 250 kVA, which are probably in the “sweet spot” for short circuit and safety protection, can be used in both commercial/industrial applications as well as for utilities, says Feldman. By paralleling these string inverters up to 3 MW+, the company can meet the customer’s power requirements for energy storage.

Among the string inverters that LS Energy Solutions inherited, the PBE-160 was a legacy item. However, the company has enhanced it and now offers the AiON-SIS in 400-, 480-, and 600-Vac variants. The company is also considering bumping the voltage to 690 V and adding compliance with 1741SB. For more information, contact the [company](#).

Another manufacturer of BESSs in the expo was [Tecloman Energy Storage](#), a company that makes BESS solutions for residential, commercial and industrial, and utility applications. In addition to being an integrator of BESS solutions, the company develops the component products used in these solutions including inverters and the electronics used within the BESSs. For the residential BESSs, it even makes the cells for the batteries, though it purchases them for the commercial, industrial and utility applications, according to Wesley Leung, senior sales manager at Tecloman. For more information, contact [Wesley Leung](#).