VOLUME 5 | ISSUE 3

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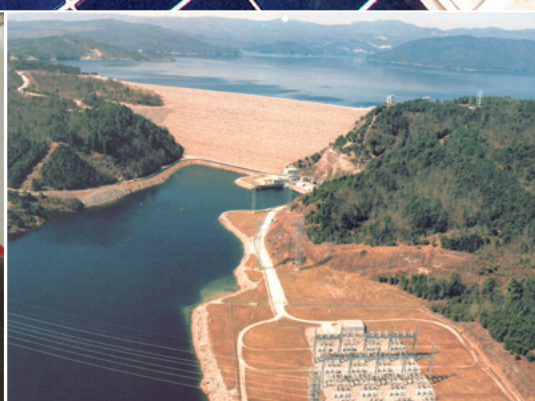

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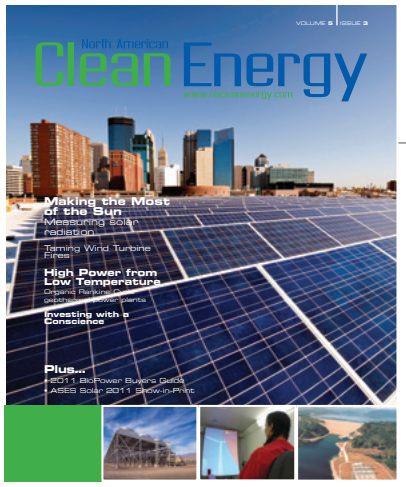

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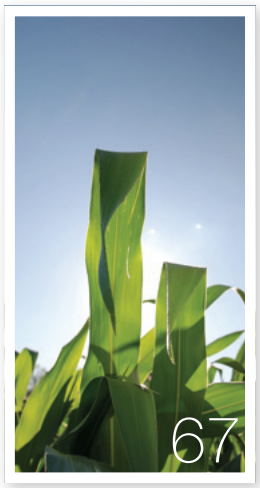
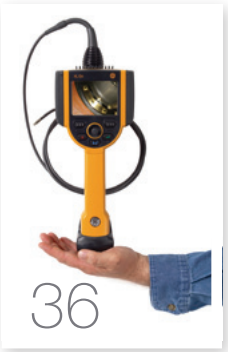
Westwood Professional Services selected Unirac, Inc. to supply an ISYS Roof Mount (IRM) custom-racking solution for the recently completed 600kw solar array atop the Minneapolis Convention Center. The array consists of 2,613 PV modules that produce approximately 750 MWh of electricity per year. This system is one of the largest PV solar installations in the upper Midwest, as well as one of the largest commercial rooftop systems to feature a 30° tilt.

contents





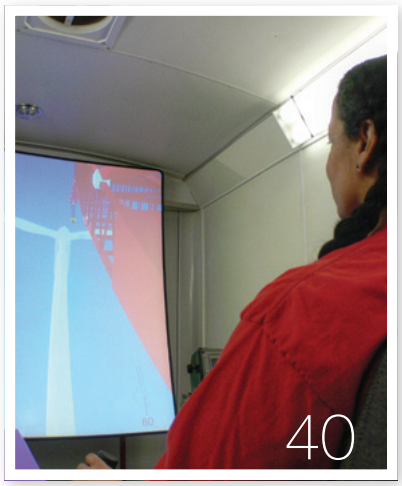


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Photo by Michelle Moore

TO BEGIN THIS ISSUE, we at *North American Clean Energy* offer our thoughts and prayers to all of those affected by the March 11th 9.0-magnitude earthquake and following tsumani in Japan. Despite watching the press coverage and hearing the statistics, the impact is unimaginable.

Considered Japan's worst natural disaster and the world's most expensive natural disaster on record (with estimates at over $300 billion worth of damage), there aren't words to accurately describe the devastation or account for the lost lives. As of press time, the death toll was at 14,435 people, according to The National Police Agency, with another 11,601 people unaccounted for. Approximately 130,000 survivors are staying in 2,300 shelters across the country.

From lost family members, children, and friends to missing neighborhoods, homes, businesses, and even electricity (the disaster knocked out at least 15,000 megawatts of electricity generating capacity, which is greater than the total summer peak demand for all of New York City*)—not to mention the fear of radiation from the Fukushima nuclear plant—many there are still struggling with shortages of basic necessities. Some estimate it will take five years or more to fully rebuild Japan. As days turn to weeks, and weeks to months, the country will continue to need help. From the American Red Cross (www.redcross.org; or make a $10 donation to support relief efforts to Japan Earthquake and Pacific Tsunami by texting REDCROSS to 90999), to Global Giving (www.globalgiving.org), to Save the Children (www.savethechildren.org), there are various organizations set-up to accept donations.

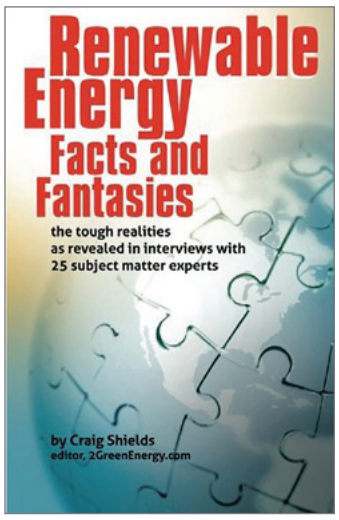
Aside from uniting communities and countries through acts of compassion and support, perhaps the only good that comes from disaster is the necessity and ability to build anew. Japan is not new to natural disaster and, with strict building codes, had previously invested enormous resources into protecting their buildings and structures from earthquakes and tsunamis. Experts believe this preparation actually saved many lives despite the recent devastation.

With the need to rebuild once again comes the opportunity to build even better. Rebuilding efforts call for new investments, purchases, and labor, which may boost the Japanese economy. This could result in a boost for clean energy, as well (and already has for some stocks). According to the Nautilus Institute for Security and Sustainability, deploying a mix of renewables and energy efficiency could also result in Japan's need for electricity being met three years earlier than through nuclear and conventional fossil fuel power (*source: www.grist.org | www.nautilus.org).

Recent reports seem to echo this perspective, maintaining Prime Minister Yukio Hatoyama and US Energy Secretary Steven Chu agreed to reinforce cooperation in developing technologies to generate solar power and other clean energy sources in Japan. It will be interesting to see what the future holds, and we certainly hope for the best.

This issue, we look at socially responsible investing, wind energy project finance, geoexchange systems, and the potential of pumped storage hydropower. We also present our 2011 BioPower Buyers Guide, and much more. Thanks for reading!

Michelle Froese



Renewable Energy: Facts and Fantasies

The number one best-selling energy book on Amazon in 2010, "Renewable Energy Facts and Fantasies," is now available—free. Author Craig Shields is offering his book online as an e-book, and at no charge. Why? "Simply to create a broadspread understanding of the issues," according to Shields. Based on interviews with 25 of the world's top researchers, authors, and analysts, delve into the myths and "tough realities" that currently affect the world energy industry.

"All of us—well, almost all of us—want clean energy. Whether our concerns are healthcare issues caused by emissions, enriching terrorists, military conflicts, social chaos and injustice, global climate change, or other forms of long-term environmental damage, there is no doubt that we need to put an end to our reliance on fossil fuels. But it's just not that easy," explains Shields. "We would do well to understand the realities if we are to have informed, relevant discussions as to what we must do as a nation—and as a civilization."

Get your copy at http://2greenenergy.com/renewable-energy-facts-fantasies.

Funding for biomass R&D

To support President Obama's goal of reducing America's oil imports by one-third by 2025, the US Departments of Agriculture (USDA) and Energy (DOE) jointly announced up to $30 million over three to four years that will support research and development in advanced biofuels, bioenergy, and high-value biobased products. The projects, funded through the Biomass Research and Development Initiative, will help create a diverse group of economically and environmentally sustainable sources of renewable biomass and increase the availability of alternative renewable fuels and bio-based products. Advanced biofuels produced from these projects are expected to reduce greenhouse gas emissions by a minimum of 50% compared to fossil fuels and will play an important role in diversifying America's energy portfolio.

US DOE | www1.eere.energy.gov/biomass

How solar PV impacts home sales

New research finds strong evidence that homes with PV systems sell for a premium over homes without solar systems. Findings from the Lawrence Berkeley National Laboratory's study indicate that homes in California, which include PV installations, sold for a premium of approximately $3.9 to $6.4 per watt. The finding corresponds to an average home sales price premium of approximately $17,000 for a relatively new, typical-sized PV system.

"Installing solar reduces ownership costs and increases resale value. Now that's a value proposition," said Adam Browning, executive director of the Vote Solar Initiative.

"Families across the country are turning to solar energy to cut their electricity bills and add value to their homes," added Tom Kimbis, The Solar Energy Industries Association's (SEIA) director of Policy and Research. "The Lawrence Berkeley study shows that solar can be a solid investment for homeowners and a revenue generator for homebuilders. This report adds to previous findings that homes with solar sell faster than those without it."

This was the first research to collect and analyze data on the existence and extent of residential PV sales prices impact across a large number of homes and over a wide geographic area.

The report, "An Analysis of the Effects of Residential Photovoltaic Energy Systems on Home Sales Prices in California," can be downloaded from http://eetd.lbl.gov/ea/ems/re-pubs.html.

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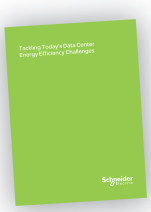

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Allan Marks

Using Sale Leasebacks in Wind Energy Project Finance

By Allan Marks; Milbank, Tweed, Hadley & McCloy LLP

Using a sale leaseback structure for wind project financings offers a variety of benefits including predictable revenue for investors, flexibility in timing to qualify for federal renewable energy incentives, and the possibility of a larger cash grant for developers applying for a grant, among others. The following provides a brief overview of the traditional project financing structure, the benefits of a sale leaseback structure, and highlights the recent leveraged lease re-financing of the Hatchet Ridge wind project.

Traditional project financing structure

In a traditional project financing structured to monetize tax incentives (such as the investment tax credit and bonus depreciation for renewable energy projects), the developer shares ownership in the project venture with tax equity investors, seeking to offset profits from other unrelated business. Herein, a developer and tax equity investor purchase interests in a joint venture created to own the project assets, and take on long-term, non-recourse debt from lenders. The project assets serve as collateral for the debt. In a wind deal, the project assets typically include: wind turbines and related electrical equipment; long-term agreements for the sale of power; possibly its monetizeable renewable energy attributes (renewable energy credits); and, all project cash flows and rights to the real property on which the turbines are installed.

In the finite period during which a wind project provides a tax shield, the tax equity investor is allocated a large majority—often over 90%—of the project's income, loss, and tax attributes. After the investor earns a specified rate of return from cash distributions and tax allocations, the ownership of the joint venture "flips," so the developer holds 90% or 95% of the ownership interests with the tax equity investor's stake reduced accordingly. After the flip, the developer often retains an option to purchase the tax equity investor's remaining interest at fair market value, which can be exercised at pre-determined times.

Sale leaseback structure

In a sale leaseback transaction, a tax-advantaged equity investor buys a qualifying wind facility from a developer, and immediately leases the facility back to the developer or to a special purpose vehicle owned by the developer. The lessee must pay fixed rent (or a fixed termination value) to the investor/lessor for the term of the lease. The lease payments are typically due come "hell or high water," despite any glitches in the project's performance or force majeure events. The developer lessee bears all of the operating costs, which are typically paid ahead of rent. At the end of the lease, the investor/lessor still owns the facility, but the developer/lessee usually retains an option to buy it from the lessor at fair market value.

In a deal that uses either the cash grant or a tax incentive, like the federal investment tax credit, fixed rent payments offer the prospect of predictable long-term revenue for the equity investors. This can expand the pool of institutions attracted to the transaction, including those that wouldn't normally purchase membership interests directly in a project venture. For a project developer, the risk of defaulting on loans may increase due to the rigidity of the lease payments to the lessor. The upside is the project developer immediately captures any profits that rise above those lease payments. To manage fluctuating revenue flows that mirror the natural intermittency of wind, leveraged leases in wind financings can be structured with quarterly or semi-annual rent payment periods, and built-in cash reserves to be funded during high-production times.

Due to the regulations governing use of federal renewable energy incentives, a lease structure can lend some extra flexibility in timing. A sale leaseback transaction can close up to 90 days after the facility is placed in service and still receive the cash grant or investment tax credit; whereas, a traditional "partnership flip" tax equity investment must achieve financial close before the facility is in service. The sale leaseback structure also allows a project to be up to 100% financed by a combination of tax equity in the lessor and debt; but, in a partnership, the developer often must fund a portion of the equity interests.

For developers applying for a cash grant, another benefit of this structure is the value of the property that forms the basis for the grant amount, which is the independently appraised fair market value of the facility when transferred to the lessor, rather than its original cost basis. Once a project has been packaged by the developer and sold to the lessor, the eligible cost of the facility becomes the price of the whole package. If the fair market value is higher than the original cost basis of the facility's equipment, this can potentially result in a larger cash grant award.

Despite these benefits, a sale leaseback structure will not always be preferable. The legal framework of the particular policy incentives used to aid financing and the characteristics

of the project itself—such as its construction timeline, size, and goals of its developer—will determine how to best expand the pie. Navigating the applicable tax rules requires care. For instance, wind power developers may not use a sale leaseback structure and receive the production tax credit because production tax credits require a project to be owned and operated by the taxpayer.

Case in point: Hatchet Ridge

Hatchet Ridge, a 101.2 MW wind project became operational in October 2010, and less than 90 days later closed a re-financing using an innovative sale leaseback structure. The project was the only large-scale wind farm to come online in California in 2010. It was also the first leveraged lease transaction closed since the 1980s to re-finance a wind farm already producing and selling power.

The project company, Hatchet Ridge LLC, entered into a power purchase agreement with Pacific Gas & Electric Company to buy the facility's electricity—the power equivalent of serving 44,000 homes—for 15 years. The innovative structure of the deal attracted equity and debt from various institutional investors, each of whom provided funds to the owner/lessor. The owner/lessor used that money to purchase the project from the developer, with an agreement to lease it back. The investment bank used provided a letter of credit facility, and acted as sole placement agent for debt securities in the project in the form of Pass-Through Certificates—which were designed with a term longer than the project's power purchase agreement, and an attractive coupon. A consortium of insurance companies bought $143 million worth of Pass-Through Certificates, demonstrating the depth of the institutional private placement debt market for renewable energy deals, while another institutional investor acquired the equity in the lessor.

From the beginning, the developer had planned for Hatchet Ridge to elect the cash grant *in lieu* of the investment tax credit. This meant the deal required only enough tax equity to take advantage of depreciation benefits. The lessor received a cash grant, reducing the effective amount needed to fund the sale leaseback. But, by structuring the deal as a sale leaseback transaction, the developer was able to maximize the value of the project's cash flow to its equity investors, as well as to its lenders. The leveraged lease was the perfect device to attract institutional capital, reducing the developer's need to tie up its own cash, which can now be re-deployed to build other projects.

Where next?

With the extension of the full suite of federal incentive programs for wind energy projects—this year with increased depreciation benefits—and tax equity still elusive, well-structured sale leaseback transactions may continue to help wind projects get financed. For the right projects, sale leaseback structures can efficiently employ many of the incentives designed to spur renewables, while drawing in capital-rich institutions that haven't traditionally participated in clean energy project finance. In today's policy and market landscape, the leveraged lease has become a valuable tool for renewable energy developers and financiers.

Allan Marks is a partner at Milbank, Tweed, Hadley & McCloy LLP.

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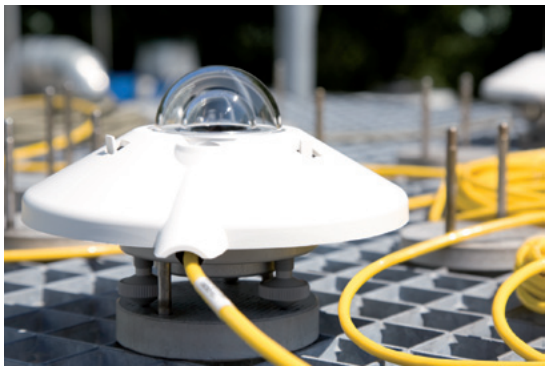

Making the Most of the Sun

Measuring solar radiation

By Clive Lee

Understanding solar radiation

The sun is the earth's major energy source and radiates its energy from a distance of 150 million kilometers, or 8.3 light minutes. This solar radiation reaches the outside of our atmosphere with an irradiance of about 1360 Watts per square meter (W/m2). It covers the spectrum from ultraviolet, through visible, to near infrared wavelengths.

When solar radiation reaches the top of the earth's atmosphere, it's much like a parallel beam coming in a straight line from the sun. By the time this beam reaches the earth's surface, it has traveled through the atmosphere and changed its composition through scattering, diffusion, and absorption. This is caused by gasses, water vapor, particles, and by clouds. Some of the absorbed energy is re-radiated in the far infrared. Light is scattered differently by the atmosphere, depending upon its wavelength, and this results in blue sky during the day and a red color at sunrise and sunset.

As a result of these effects, three components can be distinguished at the surface: direct, diffuse, and global solar radiation. The first are the solar rays traveling in a straight line from the sun, which were not scattered or absorbed by the atmosphere. The second is solar radiation, which has been diffused by the atmosphere and clouds and, as a result, is coming from all directions of the hemisphere. Finally, global solar radiation is the sum of the direct and diffuse solar radiation irradiating a flat horizontal surface. In this case, the contribution of the direct beam component is proportional to the cosine of the angle between the position of the sun in the sky, and the normal (vertical) to the horizontal surface.

Measuring solar radiation

Good quality, reliable solar radiation data is becoming increasingly important in the field of renewable energy with regard to photovoltaic (PV) and thermal systems. It helps with well-founded decision-making on activities such as research and development, production quality control, determination of optimum locations, monitoring the efficiency of installed systems, and predicting the system output under various sky conditions. Particularly with larger solar power plants, for example, errors of a few percent can significantly impact upon the return on investment.

Global radiation is measured with pyranometers, which are radiometers designed for measuring the total (global) irradiance on a plane surface. Direct radiation is measured with a pyrheliometer, which has a slightly larger view than the sun and its aureole, and does not see the rest of the sky. To make measurements, the pyrheliometer must point precisely at the sun, and this is achieved by using an automatic two-axis sun tracker. A shading assembly on the sun tracker is used to block the direct radiation from a pyranometer so that it measures only the diffuse sky radiation.

Instruments needed for an installed system

PV panels have a wide field of view and are positioned to receive the maximum amount of solar radiation. Therefore, in addition to the horizontally mounted pyranometer, it's recommended to have another pyranometer fixed to the panel or array to measure the energy available from the hemisphere so that the panel can "see" the tilted global radiation. This allows the system efficiency to be monitored, and maintenance such as cleaning to be scheduled.

Concentrating PV systems use lenses to collect and focus the sun's radiation onto the cells. Thermal solar energy systems use reflectors to focus the radiation onto a target to be heated. Both have a relatively small angle of view, and it's important to know the amount of radiation available directly from the sun. In this case, a pyrheliometer mounted on a sun tracker is used to monitor the energy available.

Depending upon the atmospheric conditions, 10 percent or more of the incoming energy is far infrared radiation from the sky and clouds that could be utilized by thermal solar energy systems. This can be measured using a pyrgeometer.

Pyranometers and pyrheliometers make technology independent, and widely comparable measurements and their calibrations are traceable to the World Radiometric Reference at the World Radiation Centre in Davos, Switzerland. If involved in PV or thermal solar energy technologies and power generation, measuring the sun's radiation with accuracy and reliability can make a big difference.

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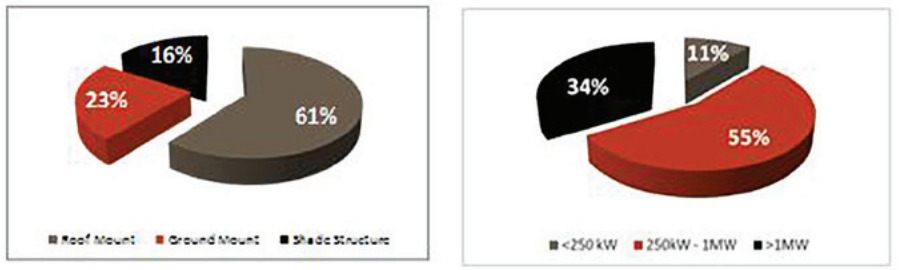

Figure 1: *O&M data collected from a contracted base of PV sites of various sizes and mounting options.*

PV O&M Benchmarking

Planning for site performance management

By Matt Denninger & Casey Miller

OPERATIONS AND MAINTENANCE (O&M) is often an overlooked part of PV system planning. Yet, proper O&M is critical to ensure a solar system performs as expected over its 20-year, or more, operating life. As the PV industry matures toward a Levelized Cost of Electricity (LCOE) metric that is on par with other forms of electricity generation, we must embrace a long-term view of system performance and cost. With proper system design, best-in-class equipment selection, and professional O&M management, PV site performance and costs can be optimized.

So, why is the operation and maintenance function often overlooked in the early stages of PV system design and planning? A key reason is a lack of awareness of potential site issues and benchmarking data. There simply isn't a mechanism to provide comprehensive, industry wide information in a lessons-learned format. With such a format in hand, designers would be able to see specific issues, probable root causes, and potential impacts on power production.

The following presents site issues collected from a contracted install base in 2009 and 2010 of North American PV sites, as shown in Figure 1. There are a number of methods that can be used to collect O&M data, however, here we pareto the top field issues and discuss the primary potential problems.

Key O&M findings

The Pareto chart in Figure 2 shows the frequency of documented occurrences—not power losses—at PV sites during the period of study. The top four areas that can lead to power production losses as demonstrated by actual case data are examined.

1. Unsealed enclosures & conduit

Left alone, unsealed enclosures and conduit can cause rust, corrosion, or ground faults that lead to future power production losses. In Figure 3, heavy rain caused erosion around the cement pedestal and electrical junction box. The conduit in the box was improperly sealed, exposing entire underground strings to dirt and water, which were washed into the electrical box (see Figure 4 on page 14). Dirt and water in the conduit will likely lead to ground faults and trigger the inverter to shut down.

In Figure 5 (page 14), the seal on the electric enclosures was compromised because improper seal material was selected. This material seems to be degrading from the weather or UV, and is crumbling when touched, leading to gaps between the enclosure and metal lid.

2. Hot & loose connections

Improper connections can create arcs and cause fires, leading to potential safety hazards for field service personnel, individu-

als connected to the site, or any unrelated parties responding to a problem. Some sites have more loose string connections in combiner boxes than others. The top image in Figure 6 (page 14) depicts a combiner box with several connections that fail to meet the IAW torque specification. This is a simple matter to rectify; however, it's unclear whether this was a recent occurrence or one that took place after the site was commissioned one year ago.

Regardless, a complete check of all combiner boxes on an ongoing basis helps mitigate the risk of loose connections. The bottom image in Figure 6 demonstrates how much damage a DC arc in a combiner box can cause. The high frequency of this occurrence points to the significance of string level performance monitoring. With a properly monitored system, faulty strings can be quickly located and repaired.

3. Tracking equipment issues

Many solar tracker issues are related to human error and can be resolved rather quickly. When electrical connections are loose in the tracker encoder boxes, there may be false encoder counts or lost encoder counts, causing the tracker to lose its position. The tracker encoder box in Figure 7 (page 14) had loose wires that caused an intermittent loss of tracker synchronicity with the rest of the system. The individual tracker, which is not aligned with the rest of the trackers, is marked in red. String level monitoring solutions will allow the O&M provider to detect an underperforming string, and assess the associated cost of lost production and the urgency of repair.

4. Under-performing & non-performing strings

String issues pose an immediate and direct impact on power production. The causes include blown fuses, failed power connections, connectors not tightened to torque specs, poorly performing strings, and grounded strings. Non-performing strings can be a result of failing connectors, as well. The connectors in Figure 8 (page 14) became disconnected despite a functional locking mechanism. This is most likely attributed to improperly joined connectors, which were eventually disconnected by excessive movement from wind or vibration. These issues would be easily detected with string level data monitoring solutions.

Conclusion

The examples presented here demonstrate the need for active O&M management

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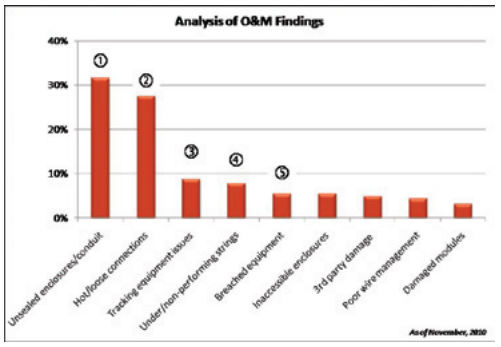

Figure 2: *Pareto chart of the top issues and non-conformances found through the servicing of dozens of PV sites across North America in 2009 and 2010.*

Figure 3: *Heavy rain eroded the area surrounding a junction box.*

Figure 4: *Dirt and water in the electrical box will trigger the inverter to shut down.*

Figure 5: *Weather has degraded improper seal material used for this enclosure, leaving a gap between the enclosure and the lid.*

Figure 6: *Loose string connections in combiner boxes can lead to arcing events.*

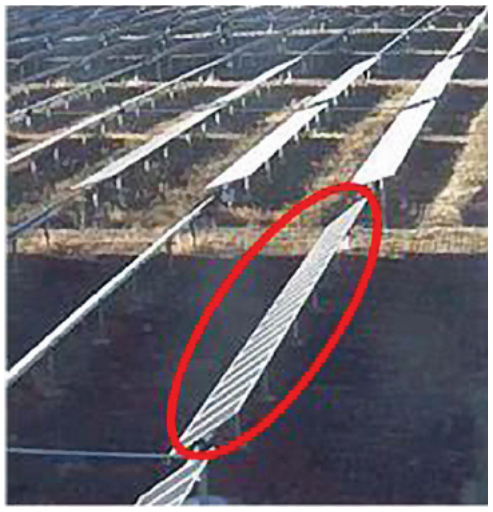

Figure 7: *False or lost encoder counts have caused one of the trackers to misalign.*

Figure 8: *Failed connectors lead to loss of power production.*

...continued from page 13.

and site performance monitoring. Consulting an experienced and knowledgeable O&M provider early in the design and planning process will help identify problematic design practices, proper equipment specification, and appropriate site data monitoring and performance management tools. O&M service providers not only understand specific equipment, but also the functional relationship among all parts of an entire PV system. In addition to maintaining the entire site, a provider should collect data, track and measure system performance, and address any non-conformances or irregularities before they impact power production. They will also offer a global perspective and provide industry benchmarking and recommendations based on a broad portfolio of sites under O&M contract to engineers and designers, ensuring maximum power production.

As the collection of data grows, design teams will be able focus on issues that are important from a strategic or material selection point of view while, at the same time, benchmarking against the rest of the industry. The vision is to provide the market with unbiased, independent, and useful information to enable complete sharing of O&M issues that help all parties improve designs, drive down costs, increase power production, and support the growth of the PV market.

Casey Miller is the director of String Inverter and Site Solutions at Advanced Energy Industries, Inc.

Matt Denninger has devoted nearly 20 years to the high-tech and renewable energy industries, holding leadership positions in sales, marketing, service, and senior management at Advanced Energy Industries, and other companies in the industry.

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PV testing services

Wondering whether solar modules will last outdoors is the most crucial question to the development of a new product. Atlas 25PLUS provides the answer. Atlas 25PLUS is a proprietary, multi-dimensional durability test program designed to subject PV modules to the environmental degradation stresses that can be expected over long-term service. It also provides a crucial missing component to the IEC type design qualification tests. Atlas 25PLUS provides the data needed to demonstrate long-term durability and support warranty and performance claims, while reducing the costs associated with aftermarket failure. Knowing how a product will hold up in the long haul is crucial to its success. Atlas 25PLUS offers a clearer picture of how long modules will last.

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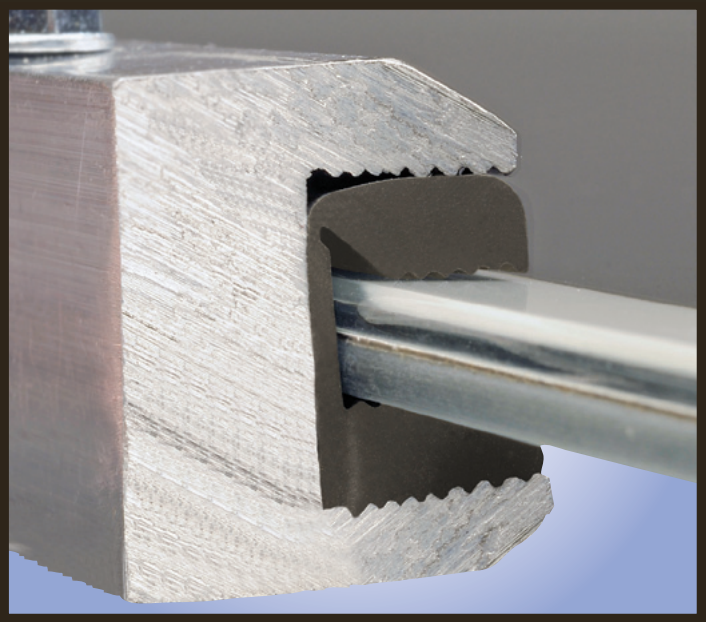

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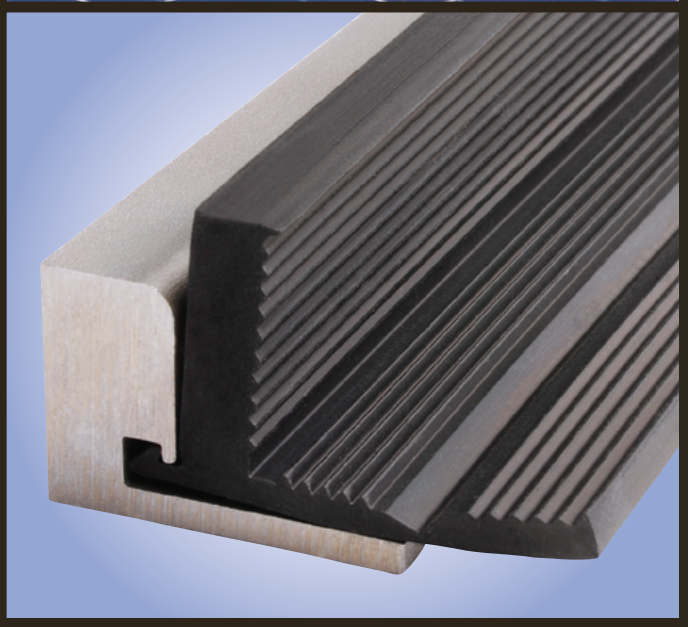

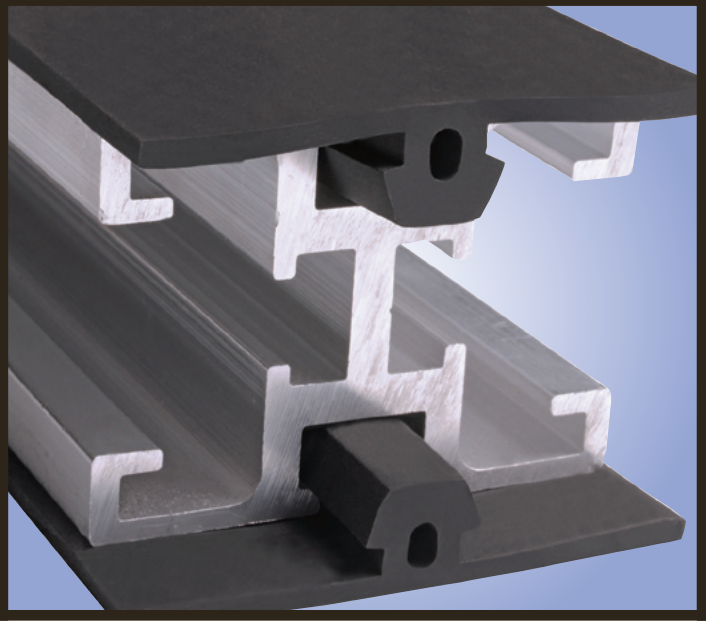

Lauren Manufacturing provides a wide variety of custom isolators for steel fabricators, PV panel manufacturers and PV panel installers. The typical isolator is designed to protect the PV panel glass from the mounting clip used in a racking system.

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When Lightning Strikes

Protecting PV investments

By Doug Eakin

AS TECHNOLOGY HAS BECOME an integral part of everyday life, measures to protect our devices and the systems that serve them have also increased in importance. In some cases, protecting these systems has become critical to a business's ability to operate. For example, protection against damage that can be caused by lightning strikes is now just as important for many businesses as securing their buildings against intruders.

Now, with the growing use of photovoltaic (PV) arrays to harness solar energy, there is an additional area to be considered when it comes to protection strategies. Therefore, it makes sense to take additional measures to protect the investment in the PV system. Some organizations assess the risk of lightning to the cost of protection and assume there is a low probability of damage. The volume of insurance claims, however, tells a different story and it's clear many organizations are doing no such thing. This is probably because they are assessing the chance of suffering lightning damage against the cost of protection and deciding to take the risk.

PV solar arrays, though, are particularly vulnerable to lightning damage because they tend to be mounted high up and tend to occupy large areas to maximize their ability to capture solar energy. To add to the potential problem, climatologists are predicting climate change will lead to more extreme weather conditions, so we may well see the frequency of lightning flashes increasing above the 100 or so that are already happening every second across the world.

Lightning facts and figures

At any one time there are more than 2,000 thunderstorms taking place somewhere in the world. The following are some key facts and figures about lightning:

- Potential: Up to one billion volts
- Current: Up to 200,000 amperes
- Temperature: >30,000° C
- Velocity: 304,800,000 m/s
- Duration: Approx 1ms
- Stroke diameter: 50mm
- Stroke length: From 60m to 32km
- Longest stroke recorded: 195km

When these lightning flashes result in a lightning strike that affects a building, they may fall into one of two key categories—direct strikes and remote strikes. Direct lightning strikes are strikes into the lightning protection system of a building, in close proximity to it, or into the electrically conductive systems implemented in the building (e.g. low-voltage supply, telecommunications, control lines). Remote lightning strikes are lightning strikes that occur far away from the object to be protected, as well as lightning strikes into the medium-voltage overhead system or in close proximity to it, or lightning discharge from cloud to cloud.

Statistics show a large PV system in an open space is likely to be struck by lightning (directly or remotely) within two years of installation—and overvoltage protection systems used inside buildings are not very practical or effective for protecting PV systems. It's also been shown that damage to PV systems can be attributed to overvoltage errors in 45% of all cases. PV systems deserve lightning protection.

Practical experience in a wide range of situations shows the most cost-effective approach is to use a protection system that offers overvoltage protection, fire protection, and personal protection in a single device. Such a system will combine a separator and short-circuiting device with safe electrical separation in the event of a short circuit. These devices prevent fire damage resulting from DC switch arcs while the reliable, error-resistant Y circuit prevents damages to the overvoltage protection caused by faulty insulation in the generator circuit. The integrated DC fuse guarantees safe, arc-free replacement of the protection module.

Clearly, for ease of use, it makes sense to opt for a protection module that can be used in all PV systems—and one that is absolutely safe in every application, thanks to

Continued on page 18...

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...continued from page 16.

an integrated fuse. Suitability for a wide range of applications is also important, so ingress protection to IP 20 is a requirement, as is the ability to operate in the wide range of temperatures permissible for use inside a distribution box outdoors—from -40° to 80°C.

Extending protection

Protection of a PV array could lead to protection of the entire electrical infrastructure. This could lead to protection extended to other areas of the facility.

A sensible compromise is to adopt a zone concept for lightning protection—as described in IEC 62305-4 (DIN EN 62305-4, DIN 0185-305-4). This enables planners, builders, and owners to align the protective measures they adopt with the risk levels to the business of damage occurring. In this way, all relevant devices and systems are afforded a level of protection commensurate with their importance to the business.

An internal lightning protection system is designed to eliminate the risk of dangerous sparks inside the building or structure, following a lightning strike. This could be the result of current flowing in the external lightning protection scheme and sparking over to metallic elements inside the building. Or, it could happen if current flows through any conductive elements on the outside of the building.

The risk of sparking is minimized by ensuring there's a sufficient distance between metallic parts, or by implementing appropriate bonding measures, so that no metallic parts are at different voltage potentials and there is no risk of sparking between them. Either bonding between conductive elements or the use of surge protection devices will address this. Surge protection devices are especially useful in situations where it would be inappropriate to create a direct connection, such as between power and communication lines.

Underlying the decision-making process is the need to address the commercial realities of balancing the level of risk to the importance of the system. With the increased risk of damage that results from installing a large array of equipment at the highest point of the building, this risk/cost balance is changing for many organizations. Protecting the solar PV arrays falls into the high-risk area of the zone concept for lightning protection described above.

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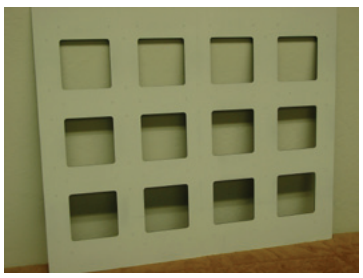

Solar cell tooling

CSI² Ceramic Supply International offers customized, large tooling, specifically for the fabrication of solar cells. Large, flat panels of ceramic can be fabricated to a customer's requirements using their proprietary processes. Panels are 3mm thick, and all designs are confidential and supplied on a custom basis only. Parts can be supplied as non-electrically conductive ceramic, or coated with silicon or silicon-carbide. Other coatings are also available. Basic parts can operate continuously at 1382° F (750° C), and are non-reactive to most environments. There are no standard parts or standard pricing, however, tooling costs are low and prototype costs are reasonable.

CSI² Ceramic Supply International, Inc.

Disconnect switch

Schneider Electric has launched the Square D 1000 VDC disconnect switch, the first enclosed heavy-duty 1000 VDC solar disconnect on the market. The easy-to install switch functions as a local disconnect for a string of PV panels and is designed for an extended life expectancy in harsh environments. Suitable for grounded and ungrounded PV systems, the Square D 1000 VDC disconnect switch offers a pre-configured solar solution and familiar enclosed safety switch design, with no additional components required. The extended life expectancy exceeds IEC 60947-3 mechanical endurance requirements by a factor of 18, and IEC 60947-1 electrical endurance requirements by a factor of 10. The NEMA Type 3 and IP63 enclosure is resistant to windblown dirt and dust and exceeds NEMA type 3R. It operates within a temperature range of -37° C to 50° C, using a white enclosure that can reduce solar gain by up to 35% over standard grey enclosures. The Square D 1000 VDC disconnect switch is available now through regular Schneider Electric distribution channels.

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Solar thermal monitoring & flow solutions

The Apollo2 Energy Monitoring System has been engineered for commercial applications and provides performance-based energy monitoring for solar thermal systems. It automatically interfaces to a web portal via standard Ethernet to present real-time and historical data in an easy to understand format. Features include: six temperature sensors; two data ports including flow meter(s) and CT sensor(s); and, one pressure sensor input. The sensor monitors both solar thermal and PV systems with flow and temperature provided in one package. Also available, the Grundfos Direct Sensors (type VFS) is a series of combined flow and temperature sensors (two-in-one). The VFS sensors are designed for high-volume production and are fully compatible with wet, aggressive media. VFS sensors are available for flow ranges of 1-12, 1.3-20, 2-40, 5-100, 10-200, and 20-400 l/min.

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Above: *Hail impact testing on a solar collector.*
Left: *Outdoor exposure testing of PV modules.*
(Photo courtesy of TÜV Rheinland PTL)

Testing the Reliability & Safety of Photovoltaic Modules

By Richard Bozicevich

NORTH AMERICAN CLEAN ENERGY readers know solar power proliferation will increase exponentially. It is said the world market for PV panels, associated equipment, and installation in 2009 was nearly a third larger than it was the year before. By 2014, that market could be nearly three times greater.

Rapid expansion means opportunity, which can lead to two types of rushes: the rush to get a product to market and the rush just to get into the market. Rushing a product to market can lead to mistakes, short-cuts, and a lack of due diligence while a "Gold Rush" scenario can lead to market participation by those who really don't belong—be it due to a lack of qualifications, capabilities, ethics, or all of the above. Both rushes can lead to market penetration by sub-standard products that fail to deliver or cause damage, injury, or death.

Product failures cause end-users to suffer because they don't get what they expect and/or their property or people are damaged; installers suffer because call-backs are costly; manufacturers suffer from liability issues; and, everyone suffers because industry credibility is diminished and alternative sources gain in popularity. The best way to evaluate reliability and safety is to test products to universally accepted standards and certify their compliance. This article is intended to provide information on that kind of testing.

Qualification testing

Product reliability testing is typically called qualification testing, and usually involves a short duration (60 to 90 days) accelerated testing protocol. Primarily driven by market-

Continued on page 22...

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place requirements, the goal of qualification testing is to identify initial short-term reliability issues in the field.

Qualification testing involves a set of well-defined accelerated stress tests—irradiation, environmental, mechanical, and electrical—with strict pass-fail criteria based on functionality, performance, and visual requirements. Qualification testing does not identify all possible lifetime reliability issues that could be encountered in the field, but it does attempt to capture the most common failure mechanisms. The type, extent, limits, and sequence of the accelerated stress tests are expected to accomplish two goals: to accelerate the same failure mechanisms as observed in-field without introducing other unknown failures, and to induce failure mechanisms in a short period to reduce testing time and cost.

A PV panel being tested to ASTM E 108 fire test at the intended installed slope.
(Photo courtesy of FM Approvals)

Design qualification testing includes a simple performance element, testing the product at Standard Test Conditions (STC). Although there are more accurate simulations, STC is the most universally accepted, and involves irradiance (sunlight intensity), air mass (air clarity through which the sunlight passes), and cell temperature. Flat-plate PV module testing is typically based around IEC 61215 for crystalline silicon modules, IEC 61646 for thin film modules, and IEC 62108 for concentrator PV modules.

The Sandia National Laboratory method provides more significant performance characterizations to predict yield for a given technology. This more-accurate method provides ratings based on module performance at variable temperatures and irradiance levels through day-long outdoor measurements under natural sunlight. Applications for the information gained from this model include system design and sizing, "translation" of field performance measurements to standard reporting conditions, system performance optimization, and real-time comparison of measured versus expected performance.

Testing to IEC61215 Crystalline Silicon and IEC61646 Thin Film standards determines the electrical and thermal characteristics of PV modules and determines if modules can withstand prolonged exposure in certain climates. Testing to IEC62108 is much the same, but relates to concentrating PV modules.

Safety testing

Safety testing is used to satisfy regulatory requirements regarding electrical shock, fire hazards, and personal injury due to electrical, mechanical, and environmental stresses in the field. Electrical safety tests include IEC61730 (for Europe and Asia) or UL1703 (for North America). Some manufactures even drive to higher requirements in combustibility, wind resistance, and hail damage resistance to protect against fire and flying debris damage, and test to the FM standards 4476 and 4478.

IEC61730 and UL1703 relate to module construction to provide safe electrical and mechanical operation during their expected lifetime. These standards address electrical shock, fire hazards, and personal injury due to mechanical and environmental stresses, and are typically performed in conjunction with IEC 61215 or IEC 61646 qualification testing.

Testing costs & timing

Costs and time intervals required for testing will vary by the type of tests and the type of end product under test. Design qualification tests (IEC 61215, IEC 1646, IEC 62108) can range from $45,000 to $125,000, and can take from two to seven months to complete depending on the complexity of the program. Partial qualification testing and product development testing will typically cost between $15,000 and $45,000, and feature testing schedules ranging from a month to three years. Many other protocols are quicker to implement and far less expensive.

Conclusion

Solar module testing has come a long way, but as the industry continues to grow and new technologies evolve, reliability and safety testing will need to further evolve. Besides the obvious benefits of life and property protection, predictable reliability will be crucial to the success of this renewable energy alternative.

Richard Bozicevich is currently the VP of Business Development for TÜV Rheinland Photovoltaic Testing Laboratory, where he directs and overseas North American operations for solar technologies.

TÜV Rheinland has developed internal standards and participates with major standards bodies and scientific organizations (IEC, ASTM, NREL, Sandia) to enact methods to evaluate module performance with the goal of determining how much power particular modules will provide.

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Proper Material Selection in Solar Applications

Essential to protect Balance of Systems controls

By Jeff Seagle

PROPER ENCLOSURE MATERIAL SELECTION is critical for Balance of Systems (BoS) solar applications as the controls are placed in extreme environmental conditions. A material failure for an enclosure housing controls for a BoS caused by environmental corrosion, or impact damage resulting in a breach of proper sealing, can cause a multitude of problems, including: catastrophic and dangerous system collapses, production downtime, increased maintenance costs, and losses in customers, as well as revenue for BoS companies.

Enclosure material choices for BoS

• Steel

Although stainless steels are used in many corrosion-resistant applications like solar, in some environments they are subject to degradation and damage by pitting, crevice, stress cracking, sulphide stress cracking, intergranular, galvanic, and contact types of corrosion. Some companies have chosen to paint steel as a corrosion-prevention method. It's important to note, however, painting of carbon steel increases cost and risk of failure due to failure at or near penetrating and mounting locations.

Continued on page 26...

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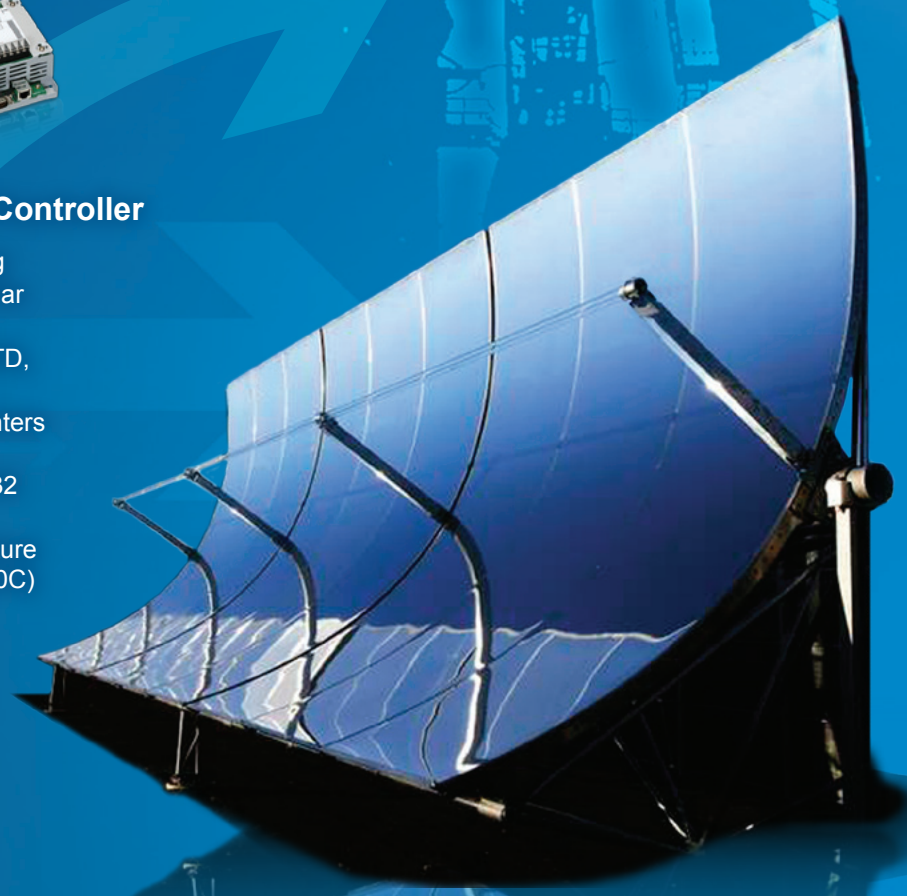

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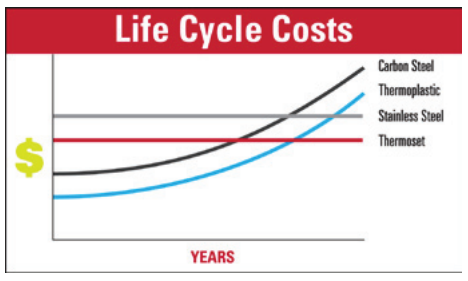

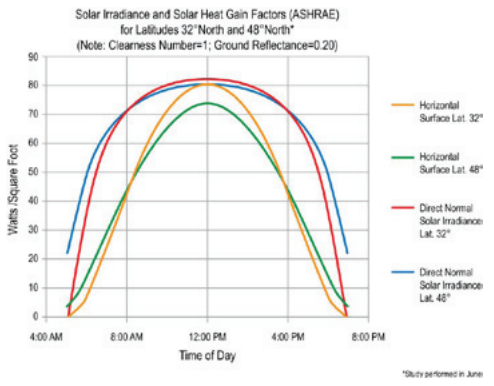

• Aluminum
Some BoS manufacturers in the solar industry have chosen aluminum enclosures. Although aluminum enclosures are corrosion resistance and can be lighter than steel, many specifiers have discovered that after several months in the field, these enclosures often became heavily impacted by sun and rain. Specifically, their finish appears to fail, which is detrimental to long-term protection of controls. And, a marred appearance alone might concern customers, giving them reason to worry about a system failure.

• Fiberglass
Composite (fiberglass reinforced plastics) enclosures were originally developed as an answer to corroding stainless steel enclosures in marine environments. They are now successfully meeting the needs of solar applications. When considering the lifecycle cost of composites (despite a higher prime cost compared to traditional materials like steel and aluminum), many favor the use of composites. Negligible maintenance, minimal recurring costs, and little need for replacement (due to deterioration in service) all translates into a lower overall cost over the lifespan of the product. In addition, composites offer inherent safety as a feature as they are not conductive. Plus, composites are less likely to be affected by temperature due to material stability. Their lighter weight reduces installation headaches, and modification is quite simple. In addition, today's fiberglass materials for enclosures include superior UV formulations to protect the material from damage.

UV formulations for non-metallic enclosures

Some engineers in the solar industry have expressed concerns about fiberglass blooming, which occurs when the fibers in the material bloom to the surface due to ultraviolet exposure. What BoS specifiers need to realize, however, is that a composite formulation is now on the market—one that has proven to provide exceptional UV protection. The formulation is a non-halogenated fiberglass system that beats the effects of outdoor exposure and provides chemical and flame resistance. The material formulation has proven to outperform other available SMC formulations by as much as 60% in its ability to retain gloss and color after exposure to concentrated UV light. This formulation is also able to reduce the effects of UV degradation such as surface roughening and fiber blooming. It fights polymer degradation by making it more difficult for UV light to attack molecular bonds of both primary chains and cross-links. A special UV absorber is added to the formulation, which acts to absorb UV energy, and then release it without damaging the polymer chain.

Extreme environmental conditions

Ultimately, enclosure selection comes down to optimal performance and value for the environment. There are often trade-offs between performance, acquisition cost, and lifecycle cost. It's important to consider the factors that influence enclosure specification for solar BoS applications, and how an enclosure might stack-up. Because BoS/combiner boxes are designed for installation near the PV array, they are exposed to extreme environmental conditions including a wide range of temperature fluctuations, as well as rain, snow, and a potentially damaging impact from the sun. Under such environmental extremes, the need for optimum enclosure protection is paramount. It also explains why fiberglass is the best choice for solar applications. Over the years, fiberglass has proven to properly protect controls in environments very similar to those close to solar arrays.

The solution

After evaluating a wide range of metallic and non-metallic enclosures, many BoS manufactures and their clients have learned that fiberglass properly protects their controls. As a result, they have selected non-metallic enclosures for their systems. The quality of today's manufacturing process and in-house material formulation capabilities often ensure consistency in product quality. Moreover, field-testing has demonstrated fiberglass enclosures provide proven durability within the demanding environments in which many BoS manufacturers place their controls. Finally, fiberglass enclosures now carry UL 94-5V flammability rating, and some are molded from new patented sheet molded compound formulations that provide superior molded-in UV resistance.

Jeff Seagle is the president of Stahlin Non-Metallic Enclosures.

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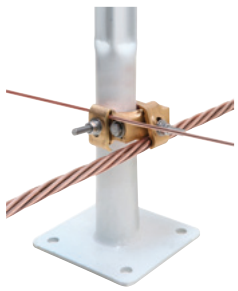

Ground connector

BURNDY introduces the SUPER-CLAMP, its newest Raised Floor Pedestal Ground Connector, for use in solar or wind data centers. The GXP1828RF is a multi-functional, easy to install, range taking ground connector. This grounding clamp accepts an extensive range of pedestal types, as well as conductors. The accepted pedestal range is 3/4" through 2" for use with either round or square styles (7/8" to 2" round; 3/4" to 1-1/2" square). The wire range is #6 solid to 4/0 stranded. The wires can be arranged in parallel or in a cross-grid configuration and can accept one or two wires. The GXP style clamp is easy to install using 1/2" socket type tools, including a nut driver, drill (cordless/corded), traditional socket set, and open-ended or adjustable wrenches. The "open face" design makes this connector very easy to install onto a pedestal without the need to disassemble u-bolts or other hardware first. The clamp is cULus Listed, meeting the requirement of UL and CSA.

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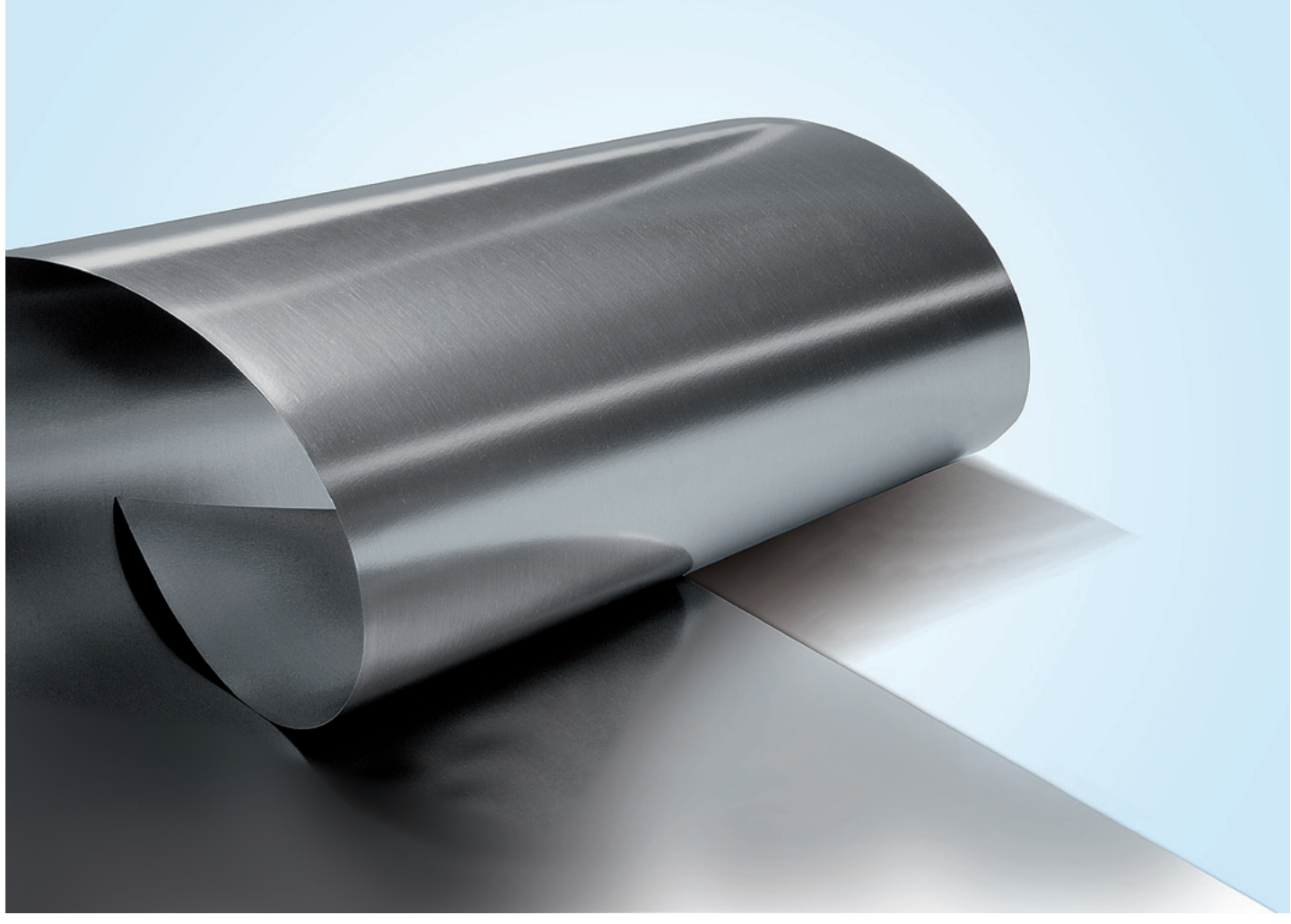


Molybdenum-lanthanum (ML) foil

Higher Efficiency Solar Cells

A look at molybdenum components for coating facilities

By Dr Bernd Kleinpass & Ulrich Lausecker

As a back contact, molybdenum, which is applied by sputtering processes, is an important part of CIGS solar cells. But, beyond that, the material is also used in equipment for the production of thin-film solar cells for heating, shielding, or supporting functions. Whether in its pure form, or saturated with La2O3, molybdenum is the optimal material for demanding vacuum processes, even at high temperatures as noted by its purity, dimensional stability, and chemical resistance.

The CIGS solar cell consists of several thin layers, which are applied by different coating processes. In a typical production process, after the contact layer of molybdenum is sputtered, the absorber materials, copper, indium, and gallium are thermally evaporated, and later selenized in a gas atmosphere. In various process chambers and around the evaporation sources, there are metal shields, heating elements, and other parts.

Coating challenges & demands

A reaction between the materials in the chambers and the aggressive process gas during the selenization results in critical contamination in the highly sensitive coating process. Moreover, the components are regularly heated and cooled. Thermal deformation can be the result. Furthermore, process-related deposits may limit the function of the components over time. Damaged or worn parts must be replaced, repaired, or cleaned.

By using refractory metals such as molybdenum, plant operators can significantly increase the lifetime of coating systems. Molybdenum not only holds up to the highest temperatures (to 1800° C), but it is exceptionally well-suited for use in vacuum, nitrogen, hydrogen, argon, and many corrosive gas atmospheres because of its low reactivity. The material has a low-heat capacity, as well as the capacity for

Equipment parts

thermal expansion. As a result, it can be heated and cooled quickly with low-energy demand and without distortion.

The high melting point of molybdenum leads to vapor pressures, which are some orders of magnitude lower when compared to steel and other metals. Therefore, it guarantees a clean atmosphere and ultra-high vacuum capabilities at elevated temperatures.

Seeking dimensional stability & a longer service time

The service time of molybdenum components can be improved by utilizing molybdenum-lanthanum (ML) material, rather than pure molybdenum. Doping molybdenum with small quantities of La2O3 increases the re-crystallization temperature to 2552° F (1400° C). The resultant elongated grain structure, with jagged grain boundaries, improves the mechanical properties and increases the ductility considerably.

The fine La2O3 particles in ML reinforce the molybdenum matrix, resulting in beneficial properties that are superior to those of pure molybdenum. Forming must take place above the brittle-to-ductile transition temperature. This temperature depends on the deformation history and material thickness. Like pure molybdenum, ML can easily be joined by riveting and folding. Due to its enhanced ductility, ML can also be machined (unlike to pure Mo) even after high-temperature use (e.g. drilling for repair work). Lastly, mechanical cleaning and sand blasting for maintenance purpose can be applied to ML with less risk of parts damage. However, due to oxidation effects, the molybdenum materials cannot be used in air above 662° F (350 °C).

The Austria-based company PLANSEE is not only a supplier of metallic sputtering targets, but has also been operating high-temperature processes since 1921, delivering a broad range of customized furnace components made of molybdenum, tungsten, tantalum, and their alloys.

PLANSEE SE
www.plansee.com
www.plansee-express.com

Solar racking system

PV Racking designs, manufactures, and distributes solar racking components that are used in roof and ground-mounted solar systems. PV Racking uses a revolutionary new solar racking system that eliminates the need for clamps and is, therefore, much easier to install, more secure, and offers a superior appearance. The company, founded and operated by certified solar installers, realized that by using its unique "gravity held, slide-in-place system" that it would eliminate the need for clamps. This change in approach is a dramatic improvement. The PV Racking design team of mechanical engineers realized that in addition to a more secure placement over clamps, the new design would be faster and easier to install, especially on roofs. All of PV Racking materials and components are 'Made in the USA.'

PV Racking | www.pvracking.us

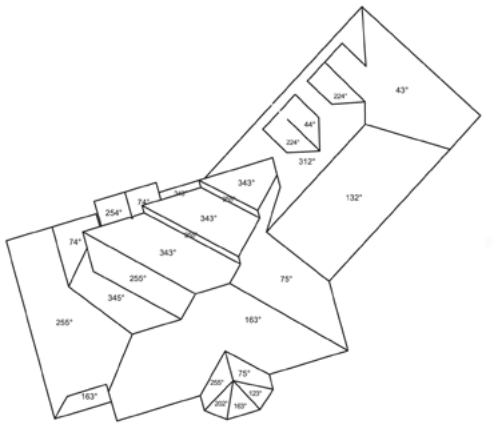
Accurate Measurements Key to Solar Rooftop Projects

Understanding aerial measurements & choosing the right vendor

By Karen L Edwards

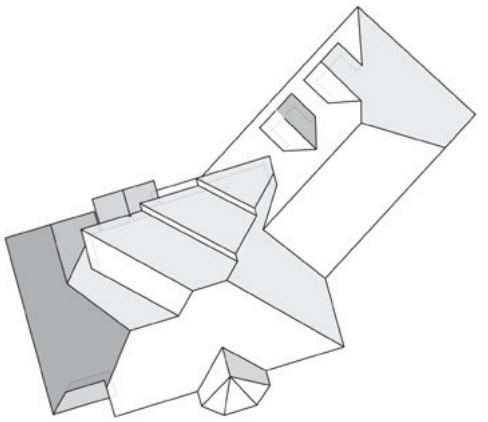
AS STATES INCREASE INCENTIVES for property owners to add or integrate solar-related energy to their homes and buildings, consumers are now looking for single-source solutions for solar installations. Instead of calling a roofing contractor, an electrical contractor, and a solar integrator, consumers are more often seeking companies that can provide the spectrum of services needed to gain a long-term sustainable energy solution and add value to their property. As a result, many roofing companies are taking on the challenge of providing a single-source alternative for property owners, becoming experts in the key areas of solar power.

The most important thing to remember, however, is any work on the roof of a property must begin with an accurate measurement. Being off by merely a centimeter or two can result in a serious blow to the bottom line of a solar project. New technologies have emerged in the last few years that allow measurements to be obtained from the sky. Although this technology provides an easy solution, saves time, and increases volume, it's critical to understand how it works and how to choose a vendor to ensure only the most accurate measurements are received.



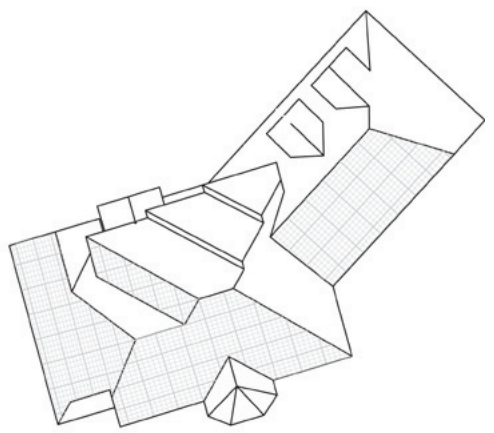
Orientation Diagram

The orientation (azimuth) diagram shows the orientation of the facets. Facet directions are labeled in degrees to assist in determining southern exposure.



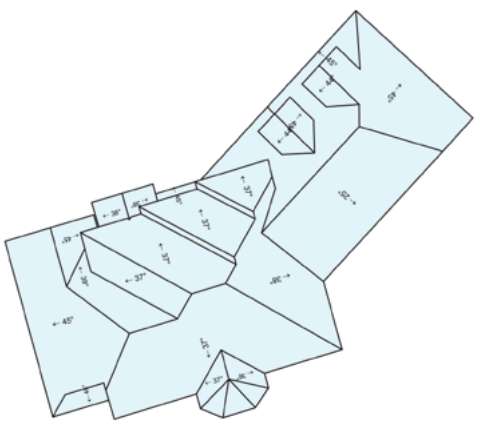
3D Diagram

The 3D diagram is essential to accurate roof measurements.



Grid Diagram

In this grid diagram, roof facets are overlaid with 1x1 foot squares, arranged in groups of 5x5, to aid in marking protrusions.



Degrees Diagram

In the degrees diagram, pitch values are shown in degrees and arrows indicate direction to help with panel placement.

Satellite versus aerial imagery

Looking up addresses on Google Maps or Bing is normal in this day and age, yet the image one sees there should never be used to obtain accurate measurements. This is because the US government restricts the commercial availability of satellite images to 18 inches per pixel, which means that if one were to trace lines over the rooftop of a satellite image, being off by one tiny pixel can result in a measurement error of a foot-and-a-half. Therefore, be sure the measurement service selected uses aerial photography. The resolution on aerial photography is as clear as four inches per pixel.

2D tracing versus 3D modeling

Questioning if a measurement service offers 2D tracing or 3D modeling is also an important step to any solar rooftop project. If a vendor is simply tracing roof lines over an aerial photograph, accuracy will be questionable. This is due to image lean, which is common and caused by a photograph not being taken directly above a property. If image lean is not corrected, it can distort

the model, resulting in lines not being parallel, and hips and gables not being symmetrical. It's important to ensure the aerial measurement vendor builds a 3D model based on photos from the top down and all four sides. Basic geometric principles must be followed to ensure measurements are accurate. Look for a company that has patented its processes and algorithms.

Quality control & assurance

Measurement service companies are emerging every month in the marketplace. As a contractor, it's critical to not be fooled by a pretty website promising easy aerial measurements. Due diligence is required to ensure a company is competent, capable, can handle high volume, can guarantee the accuracy of their work, and will still be in business next month. Make a phone call and ask how long the company has been in business, how many employees it has, etc. Determine what the company's quality assurance process is and ask how many reports the company has delivered. Other key points to cover include the company's financial stability, industry partners, industry acceptance, and investment in research and development. And, perhaps the most important question is if major insurance carriers accept the company's reports as the industry standard in claims' situations.

Solar reports

Aerial measurement services are evolving into more than just measurement providers. Look for a service that offers solar reports. In addition to roof measurements, these reports offer important diagrams for grid layout, solar orientation, and azimuth. Often these diagrams can be provided to contractors in formats that can be imported into CAD, saving hours of time.

Another point to keep in mind when deciding which vendor to choose is what their reports look like. For example, does the company offer the contractor the option to customize a cover page? Is the report going to help make a professional presentation to the customer? Ask for a separate property owner report—one that's designed to be left behind with the owner. This will contain the property images, diagrams, and notes, but will omit the measurements. This ensures the owner has an impressive report, which contains the contractor information, but with measurements that cannot easily be handed over to a competing contractor.

The future of solar & aerial measurement technology

As contractors continue to take a lead with solar-powered installations, it's important they rely on leading technologies. Aerial measurement technology is changing the industry while offering the benefits of accuracy, time savings, and increased safety. Contractors need to embrace new technologies to stay competitive and keep up with the increasing demand for clean-energy generated rooftops.

Karen L Edwards is the marketing director with EagleView Technologies.

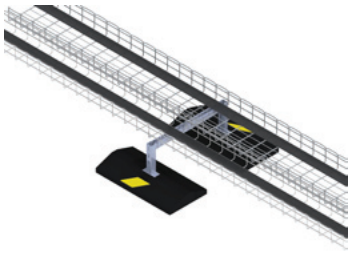
EagleView Technologies | www.eagleview.com

Modular solutions for utility PV systems

SMA America has released its Sunny Tripower 8000TL, 10000TL, 12000TL, 15000TL, and 17000TL inverters for applications requiring PV array voltages up to 1,000 VDC. The three-phase, transformerless Sunny Tripower is ideal for large-scale arrays with modular plant topology, thereby simplifying system design. To create a multi-MW plant, users can connect the AC output of multiple Sunny Tripower devices to a medium-voltage transformer for grid interconnection and feed-in. This modular approach to plant configuration results in decreased installation costs, improved design flexibility, and increased energy production for the life of the PV plant.

Additional features of the Sunny Tripower include 98.1% efficiency, data transmission via Bluetooth wireless technology, an easily accessible connection area, and SMA's patented OptiCool temperature management system. Also integrated is SMA's Optiflex technology, which includes dual MPP inputs and DC input voltage up to 1000 V for custom plant design. The OptiTrac Global Peak operation management system ensures the inverter—even in partially shaded plants—can use nearly all of the energy offered by the PV modules.

The SMA Group | www.sma-america.com



Protective base for solar rooftop installations

Cablo-Port, from Legrand/Cablofil, is a UV- and weather-resistant rubber base that creates a cushion between rooftop-mounted cable pathways, piping, and HVAC equipment that can create leaks in sensitive roofing materials. Cablo-Port is available in standard and widebody base styles—the widebody base minimizes roof pressure, provides a larger area for glue application, and supports up to 1000lbs sq/ft. Cablo-Port features pre-mounted FAS P and channel support options in pre-galvanized, hot-dipped galvanized, and 304L stainless steel. It is also available in a seismic rated series. Cablo-Port is made of 100% recycled rubber to assist with building qualification for LEED credits and features a reflective safety strip for visibility on dark roofs.

Legrand/Cablofil
www.legrand.us/cablofil

Solar flashing mounts

Oatey Aurora Solar Flashings are specifically designed to flash around solar mounting systems, ranging in diameter from 1/2" to 3". Most common residential solar systems are parallel to the roof, so the solar mounts are perpendicular to the roof. The Aurora flashing was designed with the intent to minimize stress around the collar/seal by eliminating the pitch on the flashings. Removing the pitch allows the flashing to be installed on any angle. The products consist of an aluminum, soft aluminum, or galvanized base with a UV-resistant elastomeric collar. The collar has a patented tear-out feature that gives these flashings the flexibility to fit most common solar mounting systems. The collar also accounts for thermal expansion and contraction due to environmental changes, and can withstand temperatures up to 180° F. The low-profile design allows for a cleaner more professional look.

Oatey SCS | www.oateyscs.com

LED technology

Ecoprogetti has created a technologically advanced sun simulator. ECOSUN 10L utilizes LED technology as a light source. This not only supplies a triple-class A radiation in accordance with EN60904-9 standards, but also emits stable light pulses for as long as 10 seconds. The long lifetime of light source (30,000 hours) is enticing from a maintenance cost perspective, and because there is no waiting time from one test to another it's possible to repeat the test immediately. The unit's ease of use and compactness allows a single operator to optimizing the production environment. Other features include a high-testing speed (three to six seconds per module), a high-precision electronic load for the characterization of the module, sensors to monitor the temperature of the modules, and the ability to personalize the impulses (duration and frequency). The Ecosun10L is indispensable for those who want to design a functional PV line with high-production capacity and repeatable measurement. all4-GP North America represents Ecoprogetti.

Ecoprogetti | all4-GP
www.all4-gp.us

Packaged & modular power solutions

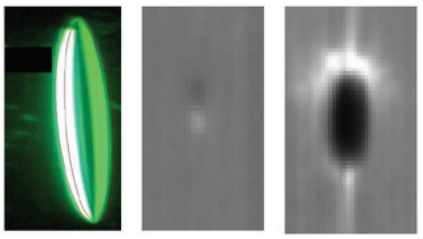
Trachte manufactures high-quality, durable equipment shelters. Their team has the expertise to manage projects with complex electrical and mechanical requirements, and to provide solutions for demanding applications. Sheltered switchgear and motor control center solutions from Trachte help compress a project schedule and avoid project cost overruns. From design and engineering through manufacturing and testing, the team at Trachte provides sheltered solutions through a quality system registered to ISO 9001:2008 standards. Trachte walk-in shelters can be designed for harsh environments, high altitudes, or hazardous locations, meeting the demanding needs of engineered applications worldwide.

Trachte | www.trachteglobal.com

Solar module anchor & lock

The Sollega QuickSnap is a new feature available for the patent-pending InstaRack system. It anchors solar modules by grabbing the module frame and locking itself into the strut without the use of any tools. When used with Sollega's Hinge Plate, the QuickSnap allows modules to be easily carried, pivoted, locked into place, and grounded.

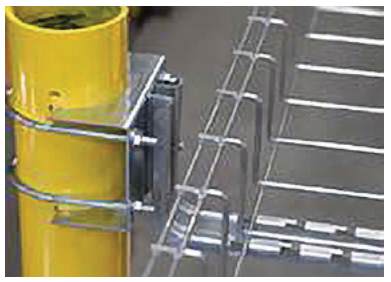
Sollega | www.sollega.com



Solid state glass scanning

Dark Field Technologies has drawn on its decades of laser and camera inspection experience to introduce the world's first Solid State Scanner, NxtGen – SSS, for 100% online, real-time defect detection in raw and coated glass. This is the only technology to marry the benefits of lasers and cameras in a single scanner. Solid State Scanning amplifies defect images by a factor of 20 with detection to 1-5 µm. NxtGen – SSS delivers more accurate defect sizing and classification at a lower cost with no maintenance, no light bulbs, and no cooling required—100% solid state.

Dark Field Technologies | www.darkfield.com



Cable management system

Snake Tray announces their new Solar Snake Tray Pole Mount System for field solar applications. This UL classified cable management system is capable of spanning distances in excess of 30 feet and is designed with integrated supports. Solar Snake Tray for Pole Mounts has a built-in mounting rail for attaching combiner boxes and is available with optional seismic dampeners. Solar Snake Tray nests together for eco-friendly shipping and easy onsite material handling. Available in stainless steel or hot dipped galvanized. Snake Tray manufactures a series of innovative products for all applications of cable management and power distribution, all designed and proven to significantly save on labor, time, and materials.

Snake Tray | www.snaketray.com

Solar thermal collectors & heating system

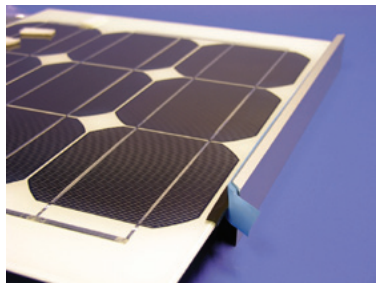
EZINC Solar Thermal collectors come in 4 x 10, 4 x 8, and 4 x 6.5 sizes, and are SRCC OG – 100 certified. They come with NPT US threads, rather than straight copper. There's no need for soldering, and they can be transportable from place to place. They can also be installed side-to-side by using 1" or 3/4" brass fittings, and come with a 10-year warranty. Ezinç is providing four roof brackets per collector as part of the package. Ezinç also manufactures Thermo Siphon Solar Water Heating Systems, which are FSEC and SRCC OG 100 certified. Thermo Siphon Model KG 300 (80 gallons) is Energy Star labeled. The Solar Water Heating Systems Package comes with collector(s), a solar tank, NPT US fittings, mountings, expansion tank, as well as railings and typhoon belts.

Premium Solar
www.presolarnet.com

Solar combiners & re-combiners

Based on the aggressive growth and overall market acceptance for its solar products, Bentek Solar has introduced several new solar products for shipment this quarter. The new extended family of solar products accommodates both 600VDC and the growing 1000VDC marketplace. Bentek Solar's new solar products include: bi-polar combiners and re-combiners for bi-polar inverters; circuit breaker commercial and utility scale re-combiners; and, multiple disconnect safety systems (MDSS and CBSS). Bentek Solar's new solar products and cut sheets can be viewed on the recently extended company website.

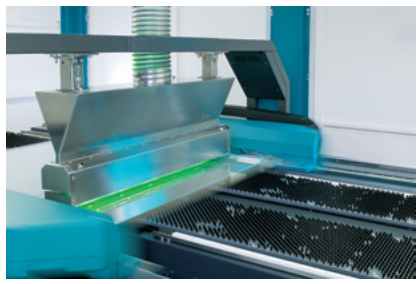
Bentek Solar | www.benteksolar.com



PV frame sealant

Traditional silicone methods used to seal PV modules lead to significant material waste, as well as extensive cleaning time as excess product flows onto a module's surface after the insertion of the PV laminate into the frame. With SolarBond Frame Sealant comes a new-generation pumpable sealant. Saint-Gobain Solar allows solar module manufacturers to significantly improve performance, while reducing overall production costs. The sealant consists of a foamable, single-component reactive thermosetting compound, which allows an optimum cavity fill to be achieved without any overflow, reducing cleaning time and eliminating material waste. Also, because the sealant is warm when applied, it takes significantly less time to set, and achieves high-bonding strength immediately after contact with the glass, backsheet, and frame. Instant adhesion in the framing process ensures a consistent level of quality and leads to increased productivity and shortened production cycles. A long-term, weather-resistant bond also assures durability of the final product.

Saint-Gobain | www.pv.saint-gobain.com



Control system for high-precision scribing

Manz Automation AG presents its inline precision control system (IPCS) for thin-film solar modules. IPCS combines high-precision scribing with fast image analysis. Manz engineers have, thereby, succeeded in minimizing a solar module's "dead area" (i.e. the area that does not transform sunlight into electricity), significantly increasing the solar module's efficiency. The inline precision control system can reduce the dead area to under 160 micrometres. By comparison, the dead area of solar modules fabricated with the laser scribes of competitors is up to 500 micrometres, almost three times as high as with Manz.

The secret to the IPCS is a fast control circuit that follows the position of the lowest line through the use of optical components, and constantly adjusts the position of the laser scribe so this distance between the lines is kept as small as possible—all at a scribing speed of up to 1.6 metres a second. In this way, even "crooked" lines created by thermic deformations during the coating process in the substrate can be scribed with a low dead area. Because the lines lie so close together, there is a greater surface area on the module in order to transform sunlight into electricity. This increases the efficiency of the solar module by some one to two percent. As a result, manufacturers can demand higher prices to reflect the higher output of the solar module, improving their return on investment (ROI).

Manz Automation AG
www.manz.com

The Keys to Wind Farm Asset Management

Predictive maintenance & condition-based monitoring

By Raegan Macvaugh

XL Go Press Photo: XL Go VideoProbe System from GE.

TOWERING HUNDREDS OF FEET in the air, wind turbines are subject to extreme environmental forces that require continuous monitoring and inspection to determine if and when maintenance is necessary. With President Obama announcing his intention to double the amount of electricity produced by renewable sources, like wind and solar, by 2035, monitoring and maintenance needs to remain top-of-mind for asset owners.

A key issue within the industry is and will continue to be how to maximize a wind farm's efficiencies while minimizing downtime. The tips of a turbine blade can reach speeds of up to 300mph and with hail, dirt, and even rain pelting the blades, wear is inevitable. Between the turbine blades themselves, combined with the bearings that support the rotor, and other moving parts in the gearbox, it's clear just how many facets of turbine maintenance are crucial for efficiency. By learning about different monitoring and maintenance techniques, and practicing smart predictive maintenance, unscheduled maintenance and downtime can be significantly reduced, allowing assets to run at full efficiency for longer periods of time.

Scheduled versus unscheduled maintenance

Costs associated with scheduled maintenance are relatively low, however, unscheduled maintenance can have a serious impact on a company's bottom line. Unscheduled maintenance typically means some sort of problem or defect has presented itself and, as a result, there are not only costs associated with the loss of production, but also with the required parts and repairs. Unscheduled maintenance can turn into an expensive, yet often unnecessary endeavor, considering a simply scheduled maintenance (also known as predictive maintenance) twice a year would have likely detected any potential flaws.

Benefits of predictive maintenance

Predictive maintenance has been a common part of planning for other power generation businesses for years, and should be just as common for the wind power industry. As mentioned above, a good predictive maintenance plan can identify issues before they become problems, which could shutdown operation of a turbine. There are other cost-saving factors that result, as well. For instance, predictive maintenance allows wind farm owners to schedule repair and maintenance at the most economical times, grouping turbines that need similar servicing together to save on time and costs.

Condition monitoring

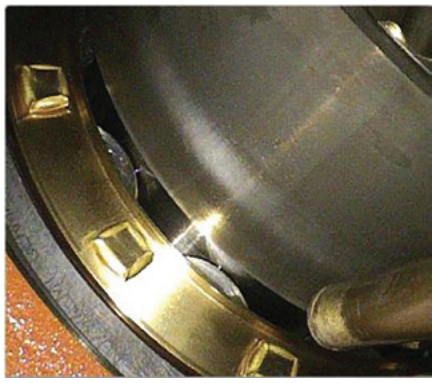
Gearboxes are one of the most expensive components of a wind power system with as much as 25% to 30% of a wind farm's operating and maintenance costs associated with the gearbox alone. Knowledge of the gearbox condition enables continued operations when a defect is not significant, while mitigating the risk of run to failure, an unplanned outage, or a catastrophic event. Detecting a potential problem early can also help in scheduling maintenance as the issue can be addressed as part of an already scheduled maintenance shutdown. Or, it might be addressed in an up-tower maintenance call, saving the costs associated with scaffolding or cranes.

Another key benefit of online condition monitoring is the remote monitoring and software integration capabilities. An entire wind farm can be monitored onsite, or from a central location headquartered in a completely different area. This is especially helpful for monitoring the health of offshore turbines. The addition of software helps to identify trends and provides alarm, diagnostic, analytic, and reporting capabilities that give operators a clear picture of a turbine's condition.

Inspection techniques

It's clear predictive maintenance is a critical part of operating a productive wind farm, but it's important to understand when, where, and how to inspect turbines to best detect potential problems. With the advances in Non-Destructive Testing (NDT) techniques and equipment, inspection offers more efficient and reliable results. The key component to almost all NDT equipment in the wind power industry is portability to make it easier to get to those difficult to reach areas.

Remote visual inspection is a great technique for identifying defects, helping inspectors identify problems quickly through the use of video. Remote visual inspection is typically done with video borescopes, which easily identify pitting, cracking, corrosion, erosion,



XL Go WT GearBox: Inspection image of a wind turbine gearbox taken with XL Go VideoProbe System from GE.

weld, and other defects that could cause unscheduled downtime. When using a video borescope, it's imperative to find models that are lightweight, have excellent light output, and are portable and durable—all necessities when inspecting the tight quarters of a gearbox, without sacrificing image quality.

Challenges

Although predictive maintenance and monitoring is critical to maximizing efficiency and minimizing downtime, some companies still don't regularly monitor and inspect their assets. Climbing to the top of a wind tower is a difficult task that involves erecting scaffolding and hiring cranes, which can costs thousands of dollars. A more cost-effective solution is to find equipment that makes the process easier such as adding permanently installed condition monitoring solutions in the gearbox, as well as using lightweight portable inspection equipment when conducting routine inspection. Software solutions, integrated with inspection and monitoring equipment, also address challenges by making data easily available to personnel located offsite for analysis. Software further allows asset owners to easily access the exact information needed to make informed decisions.

Conclusion

Wind power is going to continue to grow as a critical power resource for the United States, and for the world. It's important to utilize a number of different inspection techniques to ensure maximum efficiency and minimal downtime. Predictive maintenance and continuous monitoring are critical aspects in maximizing the efficiency of wind power as the industry expands. With scheduled maintenance and continuous monitoring, issues can be detected and corrected before becoming catastrophic, saving downtime and lost revenue.

Raegan Macvaugh is with GE Measurement & Control Solutions.

GE Measurement & Control Solutions
www.ge-mcs.com

Tower surface protection

Dr. Shrink offers TowerMinders, designed to protect tower surfaces and their finish from chafing caused by chains and/or ropes. They roll up and down the tower, securing maintenance platforms without marking or scratching it. It's also possible to cover tower ends with Dr. Shrink's premium shrink wrap for weather protection and long-term storage. Dr. Shrink also has pre-sewn wind blade bags that are designed to cover and protect the entire blade. They come with a sewn-in ratchet strap for easy installation.
Dr. Shrink, Inc. | www.dr-shrink.com

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Wind Tower Components & the Difficult to Machine Operations

By Brent Godfrey

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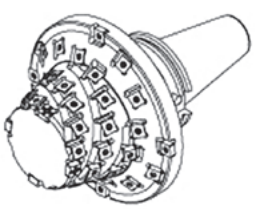


4.

1: The connecting rings, typically measure 10 feet in diameter and are four inches thick, require high-performance turning and drilling operations.

2: Turning operations for the connecting rings require roughing of the outer- and inner-diameters, as well as the faces.

3: The T-MAX P insert geometries are carefully designed for perfect chip breaking and high-metal removal rates at high feed rates, and in dry conditions.

4: A custom-made tool designed with mounted inserts, which provide maximum edge-strength and rigidity, but also require more machine power and torque.

A WIND TURBINE can be dissected into several different structures. Wind turbine towers are typically around 300 feet tall and support 80 metric tons of nacelle and rotor assembly, including blades that can stretch over 100 feet in length. Wind towers are made up of three key components: steel tower segments, connecting rings, and the tower access door. Machining each of these components comes with its own set of challenges and requires the best tooling solutions.

The framework of a wind tower

The bottom of a wind tower is normally set in a concrete foundation with access to the inside via a stairway and a large, heavy-duty steel door. Inside the tower is a ladder that leads up to the nacelle, and a series of cables and cabinets that help to deliver the electricity from the generator to the transmission lines.

The steel tower segments, themselves, come in tubular steel sections of 65 feet to 100 feet (before they are epoxy resin coated for corrosion resistance). They are then bolted together by six-to-eight connecting rings, one at each end. All of the features require some milling, drilling, and turning operations. Components of this size require special machine specifications, including a large working envelope, high torque, high power, and geared spindle motors.

Connecting rings are massive components, measuring upwards of 10 feet in diameter. They are approximately four inches thick (see Figure 1), are normally made of low-carbon steel, and arrive at the machining process with a thick and abrasive skin created during forging.

The first machining operation is normally rough turning of the outer- and inner-diameters and faces (see Figure 2). Depths of cut can range from 0.250 inches to 0.500 inches, and speeds up to 600 surface feet per minute. Large 3/4-inch inserts are typically used and a strong grade/geometry combination is required. This will result in efficient machine time, quality, consistency, and tool economy.

The next operation includes semi-finishing and finishing the same surfaces that were just rough turned. Compared to the initial roughing, geometries essential for lighter feeds and smaller depths of cut are recommended. Higher speeds in the range of 700 surface feet per minute are possible when semi-finishing and finishing with grades that are harder and have more heat protection (see Figure 3). Dry machining is also possible. After the turning operations, an indexable drill is normally used to drill the holes. Connecting rings have more than 100 holes around the perimeter, requiring a rapid short-hole drilling solution. Consider a drill with speeds up

to 1000 surface feet per minute, which enables increases in feed rates to cut the costs per drilled hole.

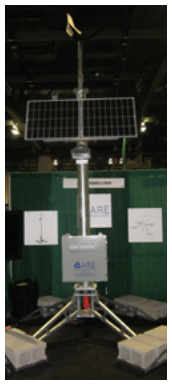
The alloy steel tower door presents some of the most unique machining challenges of any tower component due to its curved nature. One of the main components starts as a large, flame-cut plate that is approximately 10 inches thick and 9.5 feet tall. The edges of the tower door are beveled and chamfered, normally with indexable milling tools that match the angles and geometry of the final surfaces.

At times, wind component and tooling manufacturers will work together to custom-design milling cutters that can adapt to the machine tool, power, and torque. In one example, a custom tool was created that incorporated light cutting and inserts, which could be tilted at various angles. This solution still utilizes almost the entire cutting edges and provides maximum process security and long tool life. It also provides very low cutting forces. Another design incorporates tangentially mounted custom inserts that provide maximum edge strength and rigidity, but also require more machine power and torque (see Figure 4). High-metal removal rates for this design can be attributed to the numerous amounts of inserts surrounding this tool, giving the manufacturer an advantage when machining this difficult component.

Brent Godfrey is an industry and application specialist in the power generation industry for Sandvik Coromant in Fair Lawn, New Jersey.

Sandvik Coromant offers global support and solutions for manufacturing difficult-to-machine components, across multiple industries.

Sandvik Coromant
www.sandvik.coromant.com/us/wind



Interactive training lab

American Resource & Energy is pleased to introduce their new renewable energy education lab, Edison Interactive. This unique comprehensive system offers students hands-on field experience with real-world alternative energy and electronic equipment, while providing a practical LED area light for the school grounds. A 30' tower supports a micro wind turbine, a solar module, and weather measurement devices. The wireless online data display allows students to analyze detailed energy production, consumption, and environmental conditions. The included Assembled Foundation System—an above-ground foundation secured with ballast—allows for transport between schools or to community outreach projects. The Edison Interactive Lab assembles/disassembles in two to four hours and requires no building integration.

American Resource & Energy | www.arewindtowers.com

In a Virtual World

Training crane operators to assemble wind turbines

By Dave Backmann

HOISTING AN OBJECT weighing more than 50 tons to a height approaching 300 feet is inherently a high-risk situation. Asking someone to complete that task while using a large crane—on which they have little or no experience—certainly adds to that risk. Now just imagine putting that same person at the controls in semi-darkness, when the wind is picking up, the snow begins to fly, a heavy fog sets in, or all of the above.

In real life, experience is a must when it comes to constructing, erecting, and maintaining wind turbines. However, there's a first time for everything.

Facing heights, high winds, and unpredictable weather is simply part of the job of erecting wind turbines and on-the-job training is part of that deal. Until now. For training purposes, a new virtual world exists in a first-of-its-kind crane simulator. It was built for a skilled trade union to prepare its members to erect wind turbines under the above conditions, as well as others.

The simulator is owned by the International Union of Operating Engineers Local 139, Joseph J. Goetz Jr. Training Center, in Coloma, Wisconsin. It was built by GlobalSim, a Kongsberg Maritime Company, in Draper, Utah. The machine's software projects real-world scenarios including changing weather conditions, and allows two students to operate a crane independently but simultaneously lift wind turbine components into place. This replicates a procedure used in the field.

Designed with a commitment to realism, the simulator lets students get bumped around if they drive their crane over uneven ground, feel the wind blow against a crane boom, and see the shadow of turbine blades pass over other objects. Equipped with a cab and controls identical to those in a Manitowoc Epic Model 2250 MAXER crane, along with a second set of the controls, two crane students can train together along with a third individual who is learning how to be a signal person. With the second set of controls, an instructor also has the option of working with one student at a time.

Because the simulator is enclosed within a 26-foot-long, eight-foot-wide trailer, it can be transported to locations off the training center grounds.

Putting safety first

Efficiently training people to erect wind turbines is not an easy task. Safety comes first, and often this starts with getting trainees accustomed to running a crane, and running it at the heights needed.

The training center attempted to take on this crane challenge about a decade ago by purchasing a simulator from GlobalSim, mainly to teach Local 139 members how to run it for general use. However, the simulator's intended purpose as a training tool was never fully realized because it was not set up to run a class through. This changed in 2009, when the training center received a $275,000 Green Energy Grant from the State of Wisconsin.

With the Green Energy Grant available, Local 139 training director Daniel Sperberg and instructor Doug Stegeman saw an opportunity to upgrade and repurpose the simulator to train students

how to operate a crane for use in a green industry—wind power. Stegeman discussed creating virtual wind turbine erection scenarios with GlobalSim engineers. With crane operational data and photographs in hand—taken of wind turbine components being hoisted into place on actual jobsites—engineers designed scenarios with the realistic graphics that students now see on the rebuilt simulator's 90-inch diagonal, curved projection screen.

"We're working with big cranes in this industry to lift very heavy turbine components hundreds of feet into the air," Stegeman said. "It is inherently a high-risk situation because of that height. The training center can't buy a real-life big crane like the Manitowoc 2250. But, our students can establish a high degree of confidence with these cranes by using the simulator."

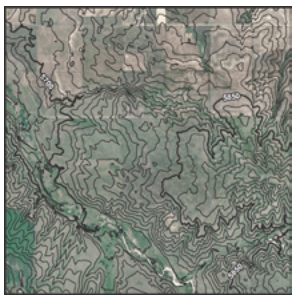
Stegeman said the simulator is programmed with data that approximates actual wind turbines going up in Wisconsin. For example, the range of weight of the nacelle in the simulator is 90,000 to 110,000 pounds, the tower base weight is at about 80,000 pounds, and the rotor assembly at 45,000 to 50,000 pounds.

GlobalSim engineers put the equivalent of three years into developing a high-fidelity working model simulator specific to wind turbine erection, said Daniel Olson, the company's manager of operations. "This effort included creating the software and developing the models to a functional capability and implementing actual crane data," he said.

Jennifer Johnson, a journeyman Operating Engineer from Watertown, Wisconsin, is familiar with running other pieces of heavy construction equipment, but is learning how to operate a crane. She said that training on the simulator boosted her confidence. "It's a stepping stone in learning how to operate a real crane and it's very realistic," she said.

Dave Backmann is the communications director for the International Union of Operating Engineers Local 139, a skilled trade union founded in 1902 with approximately 9,000 members throughout the State of Wisconsin. The members are primarily operators of heavy construction equipment and mechanics who service the machines.

Operating Engineers
www.iuoe139.org



Aerial imagery for wind siting

Digital Data Services, Inc. (DDS), a geospatial solutions company based in Colorado, have announced the launch of full contiguous United States coverage of 15-foot vector contour data and seamless one-meter aerial imagery. These datasets prove invaluable for use in wind power siting and preliminary planning.

Digital Data Services, Inc. | www.digitaldataservices.com

Taming Turbine Fires Before They Start

It's when, not if...

By Scott Starr

ACCORDING TO REPORTS, the cost of a fire that damages or destroys a wind turbine can be as much as $2 million. Property damage to the turbine, and nearby areas, from fires reported in the past decade ranged between $750,000 and $6 million.

Aside from the imminent hazards of a burning turbine, there is also the risk of sparks, embers, or debris falling to the ground and setting off a wildfire due to the remote location of many wind farms. Even if a turbine is not fully burned or damaged, or a potential fire doesn't spread to the surrounding countryside, costs can be considerable. This was shown during a recent fire at a wind farm in California, which resulted in the loss of just one converter cabinet. Cost for replacement: $243,000, including parts and downtime.

Although the financial loss and costs of a fire might be the primary concern of any wind farm operator, pressures are building up from environmental groups and the concerned public in general. Turbine fires—and, particularly those that spread—should be a significant concern, affecting the planning stages of any project. To this avail, permitting might be a more drawn-out, costly, and time-consuming process. Turbine manufacturers and wind farm operators are now, more than ever, becoming acutely aware of the costs, safety, and the environmental arguments in favor of effective fire detection and suppression. But what are the fire risks associated with wind turbines?

Technical equipment and combustible material are concentrated in the nacelle and, once a fire starts in a turbine, it can be fuelled by up to 200 gallons of hydraulic fluid and lubricants. The nacelle itself is constructed from highly flammable resin and glass fiber, and internal insulation can become contaminated by oil deposits, adding to the overall fuel load.

The most common cause of a turbine fire is a lightning strike—a risk that is heightened by the installation of taller and taller wind turbines. Turbines are now being built that are up to 320 feet high. They're frequently sited in exposed and high-altitude locations. Globally, there are around 16 million lightning storms and approximately 1.4 billion lightning flashes every year. However, only 25%

of these are cloud-to-ground (the remainder are either cloud-to-cloud or intra-cloud); yet, this still equates to the US being hit by between 15 million and 20 million ground strikes a year, according to the Colorado-based National Lightning Safety Institute.

The consequences can be judged from the following example. Recently, a wind turbine caught fire as a result of a lightning strike. Burning parts of the rotor blade, which had been struck, fell and caused a secondary fire in the nacelle—all at a cost of $200,000 and 150 days of lost operation.

Mechanical failure or electrical malfunction can also trigger a fire as capacitors, transformers, generators, electrical controls, transmission equipment, and SCADA (Supervisory Control and Data Acquisition) systems all have the potential to catch fire. This risk is amplified when there are loose or broken electrical connections, or there is an overloading of electrical circuits. Braking systems pose a particularly high risk of fire. Overheating can cause hot fragments of the disc brake material to break off, rupturing hydraulic hoses, and resulting in the highly combustible hydraulic fluid being expelled under pressure and coming into contact with the hot disk brake fragments. Hydraulic pumps and connections can also fail, allowing the fluid to erupt into flames when it comes into contact with a hot surface.

A case in point was a fire where a slip-ring fan of a double-fed induction generator broke. Sparks were generated by the rotating fan impeller, which set the filter cabinet's filter pad alight. The fire then spread to the hood installation, causing $800,000 worth of damage.

With the fire risk becoming greater as more turbines come into operation, the National Fire Protection Association (NFPA) has added wind turbine and outbuilding fire protection standards to NFPA 850 ("Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations;" 2010 Edition). This provides fire protection recommendations for the safety of construction and operating personnel, physical integrity of plant components, and the continuity of plant operations. The revised 2010 edition includes detailed recommendations relating to wind turbine generating facilities.

Wind farms are usually built in isolated locations with restricted access, placing them beyond the prospect of immediate attention by the fire service. Even when emergency services are able to respond quickly, few have the equipment capable of firefighting at the height of modern wind turbines. The solution is an effective fire detection and suppression system. Such a system should be intrinsically safe, not require any external power that can fail or put the system out of operation, and it needs to be able to stop a fire precisely where it breaks out before it can do irreparable damage to the turbine or spread elsewhere. It also needs to be purpose-designed to contend with the vibration, dust, debris, airflow through the nacelle, and the extreme temperature variations. An effective system also has to be capable of providing 24/7 unsupervised wind farm protection.

Wind farm fires do happen, and many in the industry suspect that they occur far more frequently than statistics suggest. This is because a significant number of turbine fires go unreported due to their remote location. Emergency services are not always involved and there are no regulatory requirements to report related fire incidents. Hardly surprising, many insurers are becoming increasingly concerned, and the opinion of many can been summed-up by the following statement: "Fire. It's not a matter of if, it's a matter of when." Better safe than sorry.

Scott Starr is the director of marketing at Scottsdale, Arizona-based Firetrace International.

Firetrace International | www.firetrace.com

The Siting Process for Offshore Wind

Are environmental & visual impacts stalling the process?

By David P Flynn

ONE OF THE MOST exciting growth opportunities for renewable energy in the United States is offshore wind. Offshore wind development in other areas of the world, including Europe, has made significant headway and is well established. To date, however, there has been little, if any, commercial development of offshore wind power in the US.

Given the physical size of this country, the extent of our shoreline, and the fact many of our population/load centers are along a coast, offshore wind has the potential to become an important component of the renewable energy supply mix. In fact, this industry in the US is not only limited to near-shore, ocean-based projects, but could also include significant offshore wind resources in the Great Lakes—some of the strongest potential wind resources in the entire country.

As with any emerging industry, there are several issues that should first be addressed to create a sustainable, commercially viable resource. As evidenced by the siting process associated with proposed offshore projects in Massachusetts, and elsewhere, the siting of offshore wind projects can be a difficult, expensive, divisive, and protracted exercise. Concerns about avian and other environmental impacts are significant, and should be studied regionally and on a project-specific basis. These studies support informed decisions while including relevant information about a project's attributes and potential impacts, such as location, configuration, tower height, and so forth.

These issues are not that different from concerns associated with landside wind projects. However, other environmental issues, such as potential impacts to aquatic resources, disturbance of contaminated sediments as a consequence of project construction, and possible EMF impacts to marine life, can be unique to offshore wind projects, and are currently less understood. The ability to develop a comprehensive base of reliable information to support an informed decision about these potential impacts is critical to understanding them and moving the offshore wind industry forward.

Even more problematic for any offshore development, however, has been siting concerns related to visual impacts. In fact, the majority of projects that are stalled appear to have visual impact concerns among their key issues. Efforts to develop meaningful, related criteria and protocols, on a national and regional basis, may well determine how significantly the US develops this resource. What is necessary entails thoughtful, inclusive, and equitable approaches to assessing visual impacts. Do we want a project that places The Statue of Liberty in the shadow of a field of 7 MW offshore turbines? Of course not. Alternatively, should we not allow a project where a turbine tower just barely appears over the horizon? To move forward, it's important to make some collective value judgments about the benefits of offshore wind relative to these perceived or actual impacts. Identifying ways to mitigate visual impacts and developing technologies that allow cost-effective turbines in deeper waters, more distant from the shoreline, are essential.

Development of a robust, integrated supply chain for offshore wind is also important, as any significant or sustainable offshore development likely won't occur until a domestic supply chain is in place. Not only does a supply chain directly support the development of offshore wind projects by providing the necessary people and materials, it also facilitates economic growth through the creation of new business opportunities and jobs to support the industry. Although it may be argued that a turbine is a turbine regardless of where it's located, on land or in water, an offshore turbine has significant differences that require an independent supply chain for certain components. For example, towers and foundations for offshore projects are very different. Turbines for offshore applications can be larger; underwater cabling and voltage conversion is required; and, barges, tugs, and divers are required to construct and maintain it. Until some key components for the offshore wind supply chain are put into place, there will likely be limited growth potential in the United States.

Though it won't be easy, informed decision making regarding the benefits of offshore wind, together with strategic investment in information gathering and supply chain development, could prove tremendously beneficial to the US and the growth of offshore wind power in this country.

David P Flynn is a partner at Phillips Lytle LLP, concentrated in the areas of environmental law and energy. As the firm's Energy Practice team leader, he has represented multiple developers on land-based and offshore wind projects.

Phillips Lytle LLP
www.phillipslytle.com

Fiber optic encoder

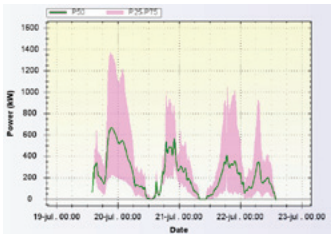
Scancon, a manufacturer of encoders, has introduced a fiber optic encoder for use with wind turbine generators. The Scancon SCH94FO is a heavy-duty encoder offering both incremental and fiber optic output, ideal for those applications requiring safe signal transmission over long distances. The SCH94FO incorporates the rugged design features of Scancon's SCH94 hollow shaft encoder with the high-transmission distance and noise-resistant qualities of fiber optics. The encoder protects against signal disruption by electrical disturbances often encountered during wind turbine operation. The encoder provides an added safety feature by utilizing two redundant fibers. The SCH94FO also offers the option of either red light transmission (transmission distance of 250 meters), or infrared light transmission (transmission distance of up to 2000 meters).

Scancon | www.scancon.dk

Wind farm software tool

Owners and operators are under increasing pressure to reduce operational costs while improving the efficiency of their wind farm portfolios. GL Garrad Hassan has developed a new software tool to help facilitate this. WindHelm provides a single platform for the monitoring, optimization, and control of any combination of operational turbines, farms, and portfolios. It gives owners and operators uniform access to, and analysis of, their SCADA data. This facilitates intelligent operational decisions, maximizing availability, efficiency, production, and financial return. WindHelm was developed out of GL Garrad Hassan's independent SCADA product, so clients benefit from the related international consulting experience and can be confident of a robust and intelligent product. With a rich reporting environment and an advanced analysis engine, WindHelm enables clients to get real value out of their wind farm data.

GL Garrad Hassan
www.gl-garradhassan.com



Wind farm & turbine forecast

To facilitate grid energy trading, increase profit from feed-in tariffs, and improve maintenance scheduling, Meteodyn has developed a software to forecast accurate and reliable production for a whole wind farm and for each turbine. Among the Meteodyn Forecast assets, the company can quote: the capacity to interface with any mesoscale numerical weather prediction (NWP), as well as the use of a CFD solver to increase the accuracy by taking into account the local effects, including wake effects at each turbine. Meteodyn Forecast provides: short-term production forecasting system; meso-to-micro downscaling; 0 to 72 hours up to seven-day ahead predictions with a 15-minute time step; a statistical analysis of the errors; computation of speed and production uncertainties; ands, real-time data assimilation and automatic correction. Mesoscale forecasts are available all over the world, updated four times a day.

Meteodyn | www.meteodyn.com

Case Study:
The Evolution & Development of Medium Voltage Switchgear
Designed for special wind farm applications

By Jose María Torres, Iñaki Blanco & David Goiricelaya

A worldwide increase in energy demands, and supportive renewable energy policies, have been key factors in the growth of renewables over the last decade. Between 1998 and 2007, wind power's installed capacity has grown by 30.4% each year, and international organizations are expecting similar figures until the year 2030.

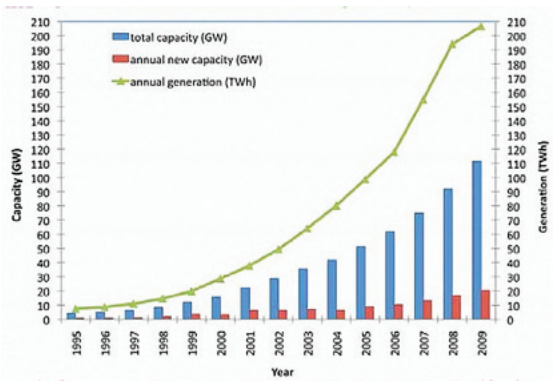


Figure 1. *Growth of installed wind power capacity by year.*

The expected expansion of wind power, along with the development of bigger turbines, has allowed us to build wind power farms not only on land, but now also out at sea. In such cases, requirements of medium voltage (MV) equipment are even higher. As access is more limited in water, turbine reliability and its safety features become more vital to operation. Guaranteeing maximum and continuous supply during operation and personnel safety when inside an offshore turbine are serious considerations during construction.

As a consequence of this new reality, MV switchgears have undergone developmental changes. A switchgear now must accomplish higher insulating levels and operate under much harder salinity corrosion, humidity, and temperature conditions than those established by international standards. The following describes the main developments with MV switchgear, as well as the particular type tests performed, which reproduce sea transportation conditions and the environmental conditions of offshore wind turbines. This was done by means of accelerated aging tests in salinity chambers, which has allowed certification of MV switchgears for use in offshore wind turbines, as well as on wind farms with extreme climate conditions.

Figure 2. *CGM.3-V unit installed inside wind turbine tower.*

Environmental impacts

Driving mechanisms are the devices responsible for opening and closing a turbine's three-position switch-disconnector and circuit breaker. It would only be opened when a fault occurs within the wind farm's MV grid, or during maintenance or operation checks. Of course, the reliability of this device is vital from a safety and performance point of view, especially if you're the wind farm operator.

In geographical places like the US and Canada, temperatures at a wind farm can be as low as -22° F (-30° C) during operation and -40° F (-40° C) while equipment is being stored. In these conditions, operation of the driving mechanisms must be verified according to the mechanical endurance category they are listed under, and verified for leakage levels from the MV gas tank so they don't increase, losing insulating properties.

In one case study of this nature, the specific type test performed to study performance under the above conditions was to operate the circuit breaker and switch-disconnector driving mechanisms inside a climatic chamber for 12 hours at -40° F. This was done to ensure the amount of operating sequences were achieved and the speed (rad/sc), torque operation value (Nm), and rebounding (mechanical degrees) remained within the required parameters.

Another related issue to take into consideration is corrosion. International standards for indoor installed switchgears state: "Air must not be significantly contaminated with dust, smoke, corrosive/explosive gas, steam, or salt." The environmental conditions in any offshore wind farm cannot guarantee the above statement, however, due to high levels of salinity in the atmosphere. Therefore, it's necessary to apply special surface treatments for the galvanized steel elements and, most importantly, to extend the driving mechanisms lifecycle against corrosion, ensuring it will accomplish the number of operations it was designed for.

As per the above case study, the specific type test performed on driving mechanisms and small components (such as tripping coils, motors, relays, and steel elements) was to introduce them in a salt-spray chamber for 720 hours at 95° F (35° C), and spray a solution of five percent in weight of NaCL. The goal attained: to achieve successful results and a high-corrosion resistance classification, according to international standards.

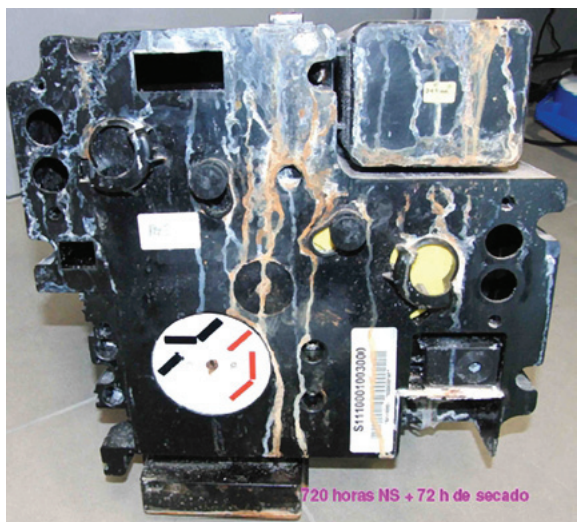


Figure 3. *Driving mechanism after a 720-hour salt-spray chamber test.*>

Transportation of the switchgear

Every wind project developer knows that one of the most important parameters to optimize during construction of a wind farm is the installation time because of the high costs associated of the required resources. That's why it's common to install the MV switchgear horizontally inside a turbine tower and, then, transport the tower to its offshore platform in a special vessel. However, transporting the MV switchgear under these conditions adds another challenge, as the equipment must withstand horizontal forces due to the positioning of the tower. It also must withstand the vibrations that occur during sea transportation.

To reproduce these transportation conditions on the MV switchgear, a horizontal axis 3D vibration test was used, applying a 4Hz frequency value and an acceleration of 0.875sc with a maximum amplitude of 27.2mm. The

test was fixed at a low frequency, and performed to a group of three modular functional units. Afterwards, the copper circuit resistance was measured to ensure the values did not change during testing. In this case, all joint connections, screw drive connections, and the welding successfully passed.

Figure 4. *Modular functional units during vibration test.*

Power & design

The power capacity of wind turbines and wind farms has increased dramatically over the last years. The power capacity of the first turbines ranged between 200 kW to 300 kW, whereas, most offshore turbines today have 3 MW machines in place. Some experimental wind farms are even being developed with 6 MW machines.

To decrease the electrical loses within a MV wind farm's grid, there's a tendency to increase distribution voltage levels, which requires higher insulation levels than those established by international standards. This is why a certain amount of wind farms use 40.5 kV units, which determine insulating levels of 95 kV for one minute at industrial power frequencies (routine tests in all compartments of the MV unit) and 185 kV for the lightning impulse test (BIL).

The particular position in which the MV switchgear is installed inside the wind turbine tower requires different designs to maximize safety in the case of an internal arc fault inside the switchgear. Though some turbine manufacturers choose a layout where the switchgear is installed above ground level, making an alternative design necessary for the gas release duct.

Keeping this requirement in mind during testing, the bottom of the unit was sealed (the cable compartment), and a backside gas-release duct designed to guarantee nobody in front of or underneath the unit would be harmed. The testing of this special design was performed according to the IEC & IEEE standards accomplishing IAC AFL (R as an option) arc fault resistance classification for 21 kA short circuit current.

Conclusion

Wind energy technology and the construction of new wind farms in places where the operational requirements are high due to salinity, temperature, or humidity, require an MV switchgear adapted to those particular conditions—which international standards do not take into consideration. The case study described above concluded with the implementation of special solutions for the MV switchgear used in these kind of environmental conditions.

ORMAZABAL | www.ormazabal.com

Cables for nacelle & wind towers

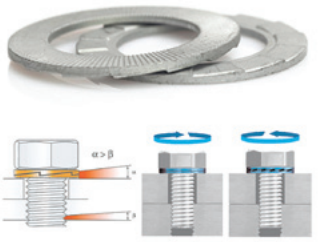
General Cable has specifically designed its WindGen suite of cables for use throughout the nacelle and tower, and have demonstrated performance to withstand the harsh operating environments of wind turbine generators. Features include: stable electrical properties over a broad temperature range (-40° C to 90° C); superior UV/sunlight-, oil- and, ozone-resistant for use in a wind turbine generator and tower; excellent flexibility and resistance to high-torsion stress even in sub-zero conditions; flame-retardant for maximum safety; 20-year service life; as well as, complete offering of low-voltage signal, control and power cables, and medium-voltage cables up to 35 kV.

General Cable | www.generalcable.com

Crawler & boom cranes

KR Wind owns several narrow track crawler cranes that allow clients to save cost on road construction. The CC2800-1NT and/or LR1300W (NT) can crawl fully boomed between turbines, and only require 18 feet (5.4m) of road width, crawling up to a 17% longitudinal inclination. They also own a fleet of truck-mounted lattice boom cranes that are suitable in complicated areas with mountain conditions or obstacles. These LG 1750/1550's and/or TC2800's offer road savings compared to other main erection wind farm cranes, and only require road width similar to the transport equipment delivering the turbine components.

KR Wind | www.krwind.com



Bolt securing system

Mudge Fasteners, Inc. is proud to offer the NORD-LOCK bolt securing system to customers in the wind- and solar-power industries. The NORD-LOCK bolt securing system uses geometry to safely lock bolted joints in the most critical applications. This unique wedge-locking system offers the following advantages: maximum safety; resists loosening caused by vibration and dynamic loads; ease of assembly and disassembly; locking function unaffected by lubrication; positive locking at low and high pre-load levels; controllable pre-load; same temperature characteristics as standard bolt/nut; and, it's reusable.

Mudge Fasteners, Inc.
www.mudgefasteners.com
www.solarfastenerexpert.com

Gearbox protection filter

The HYDAC 2-Stage element uses an integrated protection filter to guarantee that only filtered oil can reach the gears and bearings. These 2-Stage elements are now available for applications where higher dirt holding capacity is needed to avoid unscheduled filter changes, or to extend the service intervals. The 2-Stage Premium filter element with higher capacity and extended performance was especially designed for gearbox lubrication such as those in wind energy systems. Through the optimization of the filter mesh pack, the BN4HX Premium Element increases dirt-holding capacity by up to 140%. As a result, the Premium BN4HX 2-Stage element is appropriate for applications where higher dirt loads are expected and compromising the safety of the element is not an option.

HYDAC | www.hydacusa.com

Wear-resistant bearings

The Timken Company's new wear-resistant bearing technology is a breakthrough that extends predicted life up to three times longer than standard cylindrical or spherical wind turbine bearings—thanks to a proprietary coating that works like a reparative fix to address damage such as smearing, scuffing, brinelling, and micropitting in main shaft and gearbox original equipment and aftermarket applications. Timken's new main shaft UltraWind double-row tapered roller bearings, which measure roughly two meters (six feet) around, boast a simplified drivetrain design that saves capital equipment costs.

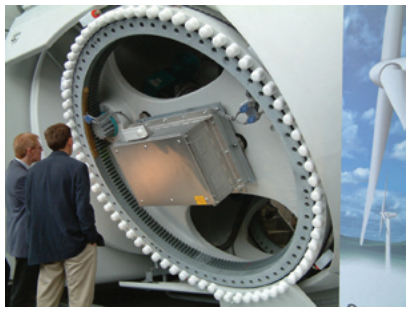
Timken also has introduced three wind seals including the EcoTurn Labyrinth Seal, which features a non-contacting design to prevent grease migration and contamination; the Elastomer Wind Seal, engineered with a flexible sealing lip to handle bearing deflections while minimizing friction and cone wear; and, the low-friction PTFE Wind Energy Seal.

Timken | www.timken.com

Copper compression connectors

SureCrimp copper compression connectors from ILSCO, with a conductor range 1/0 – 8, are now UL 467 Listed for grounding and bonding. SureCrimp is available in various configurations including bent and narrow tang, standard and long barrel, with one hole or two hole tang, as well as sight hole or no sight hole. SureCrimp reduces inventory requirements as the connectors accept multiple conductor classes including fine stranded, flexible cable, DLO, and building wire. UL Listed, CSA Certified, and range taking when installed with approved tools and dies. Circumferential dies produce strong, long-lasting crimps with a tight crimp profile for greater pull-out strength. The increased contact area reduces resistance and eliminates the potential for flash. Applications include wind turbines, solar panels, and more.

ILSCO | www.ilsco.com



Corrosion protection

Radolid Protection Caps with Volatile Corrosion Inhibitors (VCI) protect nuts and bolts from destructive corrosion. VCI's are a class of colorless vapor corrosion inhibiting compounds that block the corrosive effects of electrolytes. Caps are easily pressed onto nuts and bolts by hand, snapping into place when in position. Loading caps with APS's high-melt corrosion inhibitor grease gives added protection.

Advance Products & Systems
www.apsonline.com

Bearing heater

EDDYTHERM micro-processor controlled induction heater for bearings allows precise setting of time or temperature to prevent premature bearing failures due to overheating. Temperature probe continuously measures and displays actual temperature, while a stand-by feature permits holding temperature at a pre-set level for an indefinite time. It automatically demagnetizes bearings after heating, and light and buzzer signal termination of the heating/demagnetizing cycle. There are three models available. Shrink-fitting bearings, sleeves, couplings, crane wheels and gears, etc. of up to 880lbs is made easy, clean, and quick.

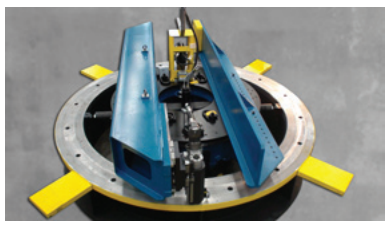
LUDECA, INC.
www.ludecawind.com
www.ludeca.com/prod_eddytherm-bearing-heater.php

Onsite machining of large flanges

The new CM6200 Portable Circular Milling Machine introduced by Climax Portable Machine Tools expedites onsite machining of large flanges from 73.5 inches to 199 inches (1866.9mm to 5054.6mm) in diameter. It can achieve the extremely tight flatness tolerances required for wind tower flanges, as well as a surface finish of 63Ra (1.6Rm). The circular mill can be configured for milling or single-point machining, as well as grinding operations.

Circular mills are used extensively on the assembly line during wind tower fabrication, or in field services to machine flanges back to spec that may have warped during the welding process. Because the machine can mill equipment *in situ*, customers find they can machine two to three large flanges in one shift, significantly expediting the machining process by cutting machining time up to 75% compared to single-point machining tools.

Climax Portable Machine Tools, Inc.
www.cpmt.com | www.cpmt.com/products/circular-mills/cm6200-circular-mill



Micro turbines

Effsun's micro-wind turbines are visually appealing and offer a high-end performance. The 150 MW model can generate a maximum 360kW/hr of electricity per year, working well between -13° F (-25° C) to 131° F (+55° C). This turbine can also work safely 35m/s wind speeds, and is lightweight and small.

Effsun Wind Power
www.effsun.com

Software for turbine shaft alignment

Fixturlaser XA Pro comes with an increased software and hardware package. The software package contains all that's needed for performing shaft alignment of rotating machinery (e.g. horizontal and vertical shaft alignment, alignment of machine trains, Hot Check, and Softfoot). A new function is the "Machine Defined Data," which makes it possible for users to save machine configurations as templates. All data for each specific machine, such as machine dimensions, measurement distances, tolerances, and target values, are readily available in the Fixturlaser XA Pro alignment tool.

Fixturlaser XA Ultimate is also a measurement tool with a complete software package for both shaft alignment and geometric measurements, such as flatness and straightness. This tool gives users access to all the software and hardware required for a successful machine installation, ensuring optimal running conditions.

Services Techniques Claude Drouin Inc.
www.stcd.ca

Energy system control enclosure

The SEL POWERCORE-M is a turnkey substation and energy system control enclosure ideally suited for renewable energy projects. It is engineered, constructed, prewired, and tested to customer specifications, then delivered to the project "job ready." The POWERCORE-M comes with utility-grade SEL protective relays, meters, controllers, and communications equipment. The integrated design satisfies substation and electrical system protection, communication, and control requirements for developers and local utilities in a single, highly reliable system. The POWERCORE-M includes pull-out shelters for access to equipment during inclement weather. In addition, it costs less, has a smaller footprint, and requires less maintenance than conventional control structures. All SEL equipment is backed by local support and a 10-year, no-questions-asked warranty.

Schweitzer Engineering Laboratories, Inc.
www.selinc.com

Tilt-up wind tower

In response to industry demand to measure the wind at taller heights, NRG Systems now offers an 80-meter tilt-up tower. Built on the same reliable platform as the company's 60-meter XHD system, the 80-meter tower incorporates bolted joints for a stiffer, stronger tower, while offering familiar installation and performance. The complete 80-meter XHD system includes a galvanized 10-inch diameter tilt-up tower with a steel baseplate, a SymphoniePLUS 15-channel datalogger, NRG Systems sensors to measure wind speed and direction, side-mount booms, and other accessories. The high-visibility package, required by the FAA in the US, includes an orange-and-white painted tower, a compliant lighting system, and marker balls. The 80-meter XHD system ships via surface freight free of charge in its efficient Enivocrate packaging.

NRG Systems
www.nrgsystems.com

ASES National Solar Conference SOLAR 2011

May 17th to 21st, 2011 • Raleigh Convention Center—Raleigh, North Carolina

The National Solar Conference is the longest-running educational event for solar energy professionals in the US. In its 40th year, the SOLAR 2011 program will be developed by solar energy experts in all areas of the industry, including technology, buildings, policy, professional education, workforce development, and consumer education.

www.nationalsolarconference.org

Show in Print
Features just some of the companies and technologies attendees will see at this year's show.

Solar project consultancy

GL Garrad Hassan is one of the world's largest dedicated renewable energy consultancy and is a recognized technical authority on the subject. It offers independent technical and engineering services, products, and training courses to the solar sector, as well as the onshore and offshore wind, wave, and tidal sectors. Although the GL Garrad Hassan name is new, the company has a rich heritage. It is borne of the integration of specialist companies that, united, form the renewable energy consulting division of the GL Group. GL Garrad Hassan is a consulting company; it has no equity stake in any device or project. This rule of operation is central to its philosophy, something that sets it apart from many of its competitors.

GL Garrad Hassan
www.gl-garradhassan.com

Solar mounting systems

CreoTecc mounting systems, manufactured in the USA by Session Solar, are proven to reduce module installation time while providing increased flexibility and durability. With over 125 MW installed worldwide, CreoTecc roof and ground-mount systems are compatible with all common mounting fixtures and module frame widths. Modules are inserted between parallel horizontal rails and rest with the force of gravity, eliminating the need for clamps. CreoTecc mounting systems allow contractors to compete with aesthetics and cost.

Session Solar
www.sessionsolar.com

Large-scale ground-mount system

The Power Peak is engineered to meet the growing demand for larger utility-scale PV solar installations. The innovative ground-mount system features fewer components, resulting in faster build rates. Combined with the field-proven DPW Solar Power Rail mounting system, the Power Peak provides a secure mounting structure for most framed and frameless PV modules. The Power Peak ground-mount system assembles on either "H" beams or galvanized rigid steel pipes, offering a variety of installation options. The single row of vertical supports greatly reduces the number of ground penetrations over traditional ground-mount structures, and provides unlimited horizontal expansion and scalability. The horizontal strong backs require no field modifications and assemble without any lifting equipment or machinery. Adjustable fittings assure hassle-free alignment, and they are manufactured from high-strength steel. All components in the Power Peak mounting system feature corrosion-resistant materials to assure long-term service and reliability.

DPW Solar | www.dpwsolar.com

Copper & aluminum compression terminals

BURNDY, manufacturer and provider of connector and tooling solutions to the solar industry, announces the expansion of the wire range for its BREAK-AWAY HYLUG line of copper and aluminum compression terminals for the solar energy market. The BREAK-AWAY HYLUG provides maximum field flexibility by allowing the installer (using the BREAK-AWAY feature) to easily convert a two-hole terminal to a one-hole terminal to best suit the specific application. The BURNDY UL Listed and CSA Certified BREAK-AWAY HYLUG line of terminals is rated to 90° C, and 600 volts to 35kV. With a slotted second stud, the BREAK-AWAY line of terminals can conform to various bus bar dimensions. For additional flexibility, the Narrow Tongue design allows the terminal to fit into tight spaces. Additionally, the BREAK-AWAY line of terminals accommodates a wide range of conductor combinations including AWG, Compact, DLO, Flex, and Metric.

BURNDY | www.burndy.com

Simply Supporting Solar.

All*

AET

Applied Energy Technologies

*Solar Mounting Solutions for all panels available on the market. Industry-leading installation time. Fewer parts to order. No cutting or drilling required. No heavy equipment required. Full layout and loading analysis for every project.

AETenergy.com **Contact AET: 586.466.5073** **Email: info@AETenergy.com**

Thermal solar water heating systems

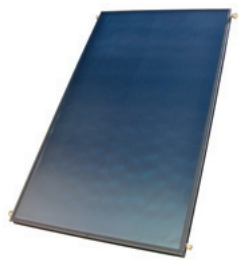
Stiebel Eltron SOLKITS 2 and 3 thermal solar systems are Energy Star Rated and have SRCC OG300 system certification. Each solar closed-loop system includes SOL 27 PREMIUM flat plate collector panel(s) and mounting hardware, SB/SBB storage tank with heat exchanger(s), pump station with expansion tank, temperature/pressure gauges, pressure relief and check valves, and controller unit with corresponding sensors. It is the culmination of over 30 years of experience in the thermal solar business. There is an industry leading 10-year warranty on Stiebel Eltron solar panels and tanks.

Stiebel Eltron | www.stiebel-eltron-usa.com

Solar support systems

Baja Solar Support System is now being used to bring solar power to RV/Boat Storage facilities. Baja delivers unrivaled, in-house experience that includes: designing highly-specialized, engineered solar support structures; engineering light gauge steel structures to perform under any condition, or load; and delivering a fully installed system to any jobsite, nationwide. For example, in a recent project, Baja's Solar Support System was used for 144,000 square feet of shade canopies for 280 parking spaces. Solar panels were attached to Baja's structures, creating the backbone of a 1.75 MWdc solar energy system that was fed back to the grid and monetized using the local utility's Feed-in-Tariff. Baja was able to erect the 280 solar canopies (each space approx 12' to 14' x 52') in eight weeks, which also included a wash bay area using the same materials.

Baja Solar | www.bajacarports.com



Flat plate collector

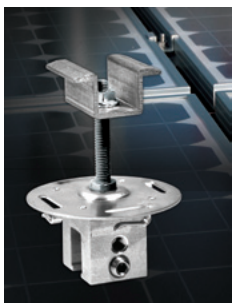
California based solar hot water manufacturer Heliodyne has re-designed their flagship product, the GOBI flat plate collector. It has undergone several changes, which have resulted in aesthetic improvements along with higher energy production. Structurally, the frame of the collector has been reshaped with rounded edges and a thinner profile. The GOBI's thickness has been reduced from 3.9 inches to 2.8 inches, making it the thinnest collector available in North America. Inside, a full plate, laser welded absorber has replaced the fin absorber plate used in previous GOBI models. A new type of foam insulation has been implemented, which helps minimize heat loss. The collector was tested and OG-100 certified by the Solar Ratings and Certification Corporation (SRCC), which recently published improved energy performance calculations for the GOBI. The GOBI is made in Richmond, California and will be available immediately through authorized Heliodyne distributors.

Heliodyne | www.heliodyne.com

Solar thermal systems & mounting options

Solar Skies Mfg., LLC now offers complete solar thermal systems that help reduce installation costs for contractors up to 30%. Solar Skies is the only manufacturer that offers numerous corner and mounting options for faster installation and superior durability. Contractors can attract more customers because of Solar Skies' quality with all products manufactured in the USA. Where other solar products are guaranteed for five to seven years, Solar Skies offers a seven- to ten-year guarantee on the solar collectors and tanks. Solar Skies' partners also avoid costly shipping delays and maintain project profits with the Solar Skies guaranteed lead-time. EZ Array collectors will ship when they say it will, or Solar Skies will issue a two percent credit toward the next invoice.

Solar Skies Mfg., LLC
www.solarskies.com



PV roof-mounting kit

The challenge has been in how to attach PV modules to standing seam metal roof systems without jeopardizing roof material and weather-tightness warranties. The answer is the newly improved S-5-PV Kit, which secures the framed PV modules without penetrating the roof's surface. The S-5-PV Grab now has broader ears, making installation easier and more precise. Plus, the S-5-PV Stud is longer to accommodate frame thicknesses from 1.3 inches to 2.5 inches (32mm to 64 mm). The universally directional mounting disk features four under-disk hooks to help with wire management, has strategically placed holes for zip-tie connections, and comes with a module guide to make module placement easier. A 30-year power source on a 40-year roof, along with S-5!'s zero penetration technology, creates the most sustainable roof system available.

S-5! | www.S-5-solar.com

Solar installation extension kit

Solmetric is a supplier of tools for solar installers, including the SunEye Extension Kit, which enables accurate measurements up to 5.4 meters above ground level. The Extension Kit consists of a telescoping extension pole with a cradle at the top to hold the SunEye 210 secure and protected without obstructing the field of view of the SunEye's camera lens. When using the Extension Kit, SunEye skylines are captured by rotation of the pole, combined with audio feedback from the SunEye. The SunEye will automatically correct the measurements for azimuth and tilt using inputs from the on-board sensors. Also featured: the PVA-600 PV Analyzer, SunEye 210, and the PV Designer software.

Solmetric | www.solmetric.com

LPC244 & LPC247 watt monocrystalline modules

SunWize Technologies, a wholesale distributor in the solar industry, has been selected by Samsung Electronics Co. LTD to introduce and distribute its solar modules to the North American market. The LPC244 and LPC247 are now available. Samsung modules stand out in today's marketplace with their 15+% module efficiency, higher than any other product in its class. They set a new benchmark for price/performance and narrow the performance gap against premium priced modules.

SunWize Technologies
www.sunwize.com
www.sunwize.com/info_center/Samsung-solar-module-info.php

Assembly tool for MC3 couplers

For 30 years, Rennsteig has been manufacturing tools to the highest standards with top-of-the-line tools engineered for the wires and terminals specific to the solar industry. Rennsteig has the knowledge, skill, and capacity to meet any specification, and they specialize in meeting customer requirements. Rennsteig's ergonomic new "Assembly Tool for mounting of MC3 couplers" offers users the opportunity to do their job faster, better, and easier. The Rennsteig Assembly Tool simplifies assembly of MC3 connections. Its lightweight, compact shape allows for easy storage and carrying, and its spindles can be stored in grip. This tool also permits work with 14/12/10/8 AWG solar cables.

Rennsteig Tools, Inc. | www.rennsteig.us

Renewable energy batteries

Rolls Battery is pleased to offer two additional 2V models to their Renewable Energy line-up: 2V S-1590 & S-1725. Similar to the popular 2V S-1380 and standard L-16 size, the S-1590 & S-1725 models include the four-post configuration, two posts per terminal, used to support the potential loads of 1,200 AH (S-1590) and 1,300 AH (S-1725) per cell or a 20Hr rate.

Rolls Battery
www.rollsbattery.com

Pyranometers

To maximize the effectiveness of a solar energy system, it's important to know how it is performing. A Kipp & Zonen pyranometer accurately measures the solar radiation available to a system in real time. Comparing this with the power generated allows users to calculate the efficiency of the system. A drop in efficiency indicates the need for cleaning, ageing, or a fault, allowing for scheduled preventive maintenance and a monitored return on investment. Test laboratories around the world use these pyranometers to test and certify PV cells for power plant projects. The output of the cells is compared to the solar irradiance measured by the pyranometer. These pyranometers are also a precise solution for site selection and prospecting of the optimum location for a solar plant. Together, with a sun tracker and pyrheliometer, the complete system calculates the actual solar radiation on site. Customers can accurately decide on location and direction of view for the solar panels or thermal set up.

Kipp & Zonen | www.kippzonen.com

Solar pumping station

SOLARHOT announces the release of the 2011 model of the solar pumping station, the Solvelox. In addition to the existing integrated heat exchange package, the unit will have the following new features: a more compact design; larger heat exchanger for better overall performance; easy mount system to speed installations; easy access of maintenance ports to reduce long-term maintenance costs; new insulated cover for better heat retention; and, a three-speed pump for the glycol model to match a wider range of customer applications. The 2011 Solvelox also comes with an optional advanced controller, which provides: variable speed pumping; energy production monitoring; and, SD recording of system operating parameters. With these new Solvelox features, SOLARHOT redoubles its commitment to providing one of the most efficient, easiest to install solar water heating systems on the market.

SOLARHOT
www.solarhotusa.com

Solar water heating

In the next couple of months, EDS USA will introduce a new green solution for solar water heating: the Liberty Box. With a worldwide, patented DC Power Box, the Liberty Box will change the way people have been using solar water heaters. It's 100% transportable from home-to-home, and installation is very simple. The Liberty Box has no need for copper, soldering, pumps, or pipes, and there's no freezing. Users can also utilizes their existing solar water heater, and with the Liberty Box, hit water with pure sun DC power.

EDS USA | Premium Solar
www.presolarnet.com

Recirculation pumps

Designed for the recirculation and transfer of fluids, GRI's new integrated magnetic drive pumps bring a uniquely engineered design to GRI's portfolio of custom OEM pumps. GRI's new Integrity Series integrates the pump's components into a compact, lightweight design, eliminating motor bearings, and leaving the impeller assembly as the only moving part. Fewer parts promote longer life, quieter operation, and lower power consumption. GRI's Integrity Series Mag-Drive Pumps will impact OEM applications in the solar and renewable energy markets.

GRI | www.gripumps.com/integrity

Solar mounting solutions

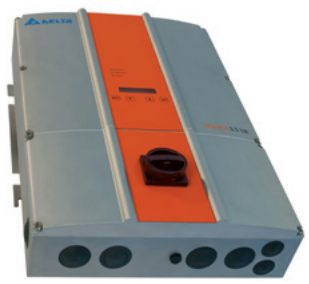
Featuring their innovative solar mounting solutions, AET designs, engineers, and manufactures solar mounting solutions for any type of solar installation.

Applied Energy Technology
www.aetenergy.com

High-efficiency inverters

Solectria Renewables' SMARTGRID Series of Inverters boasts a 97.5% CEC measured efficiency, which translates into hundreds of thousands of dollars gained per year for utility-grade, grid-tied PV systems. The SGI series of transformer-based inverters are rugged and durable with the transformer acting as a filter when grid voltage transients occur. The SMARTGRID series features six power classes, ranging from the SGI 225 to the SGI 500, and offers utility options such as VAR support, low-voltage ride through, controlled ramp rate, and remote power control. Such critical utility options, combined with unsurpassed efficiencies and the lowest nighttime tare loss in the industry, earmark the SGI Series as the inverter for the next-generation of utility systems.

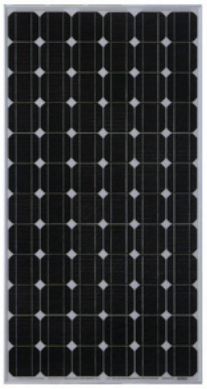
Solectria Renewables | www.solren.com



Grid-connected solar inverters

Delta is offering four new models of reliable grid-connected solar inverters: SOLIVIA 2.5, 3.3, 4.4, and 5.0 NA G4 TR. Each offers a nominal output power ranging from 2.5 to 5.0 kW. The SOLIVIA solar inverters from Delta feature a durable die-cast aluminum chassis and NEMA 4 enclosure rating. They operate within a wide temperature range, up to 122° F (50° C) with full power output (without derating) due to integrated industrial grade components. This ensures high yields even for installations in warmer climates. The inverters are suitable for all commonly used solar modules (also for thin-film and rear-side contact PV modules) due to the implemented galvanic isolation and the integrated DC wiring box that accommodates either positive or negative DC grounding.

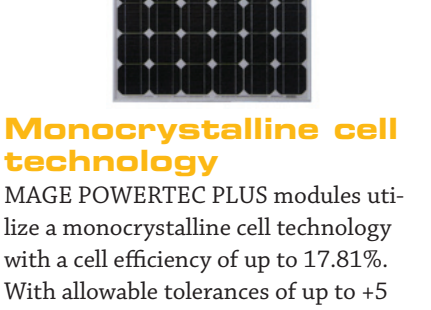
Delta Energy Systems (Germany) GmbH
www.deltaenergysystems.com | www.solar-inverter.com



Monocrystalline cell technology

MAGE POWERTEC PLUS modules utilize a monocrystalline cell technology with a cell efficiency of up to 17.81%. With allowable tolerances of up to +5 watts, maximum power is guaranteed without any compromise and nominal power is obtained or even exceeded. MAGE SOLAR's competitive 10-year product warranty far surpasses industry standards, and the added guarantee of 90% nominal power for 12 years and 80% for 30 years provides customers with three full decades of reassurance. The German-engineered MAGE POWERTEC PLUS modules meet maximum demands with regards to stability and corrosion-resistance. Starting this spring, MAGE POWERTEC PLUS modules will be produced at the North American headquarters in Dublin, Georgia, which also is home to the new MAGE SOLAR ACADEMY, a 10,000 square feet facility with classroom technology and an indoor and outdoor simulation area for hands-on training.

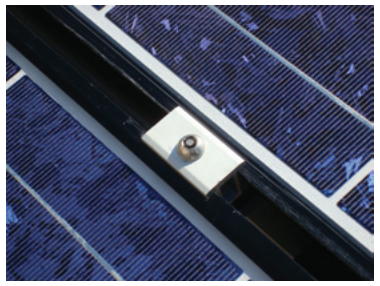
MAGE SOLAR U.S.A., LLC.
www.magesolar.com



Solar PV batteries

Deka Solar Photovoltaic Batteries, manufactured in the US and deployed on all seven continents, exceed the highest quality standards of the alternative energy industry. The Deka Solar line includes sealed lead acid GEL and AGM batteries, in multiple configurations, as well as select flooded products. Deka Solar provides quality and environmentally conscious battery solutions.

MK Battery | www.mkbattery.com



Solar panel locking fastener

Solar panel theft is a growing problem. Bryce Fastener, Inc. has developed a keyed locking fastener, which replaces standard fasteners of any size. The Key-Rex fastener is keyed and licensed to each new customer, ensuring only the licensed owner of the key code can gain access to the drivers. The Key-Rex fastener is made from 302 stainless, and will last for the life of the panel. These keyed fasteners are the lowest cost, yet the most effective theft solution available for securing solar panels. They are so effective that the largest national insurance underwriter offers a full 10% discount to its customers that specify and use Key-Rex.

Bryce Fastener, Inc. | www.brycefastener.com

Cost-efficient solar modules

Renogy develops and delivers some of the most reliable and cost-effective solar energy solutions. Their production of high-quality solar cells and use of high-end accessories enable them to produce high-performance solar modules that maximize the energy yield of the solar system per unit area—and, most importantly, reduce the system cost per watt.

Renogy | www.renogy.com

Remote display solar monitoring

Steca Elektronik GmbH provides a new Internet remote display that allows permanent monitoring and performance analysis for solar thermal systems. The Steca TK RW2 IFA router was developed to visualize solar thermal systems in combination with the Steca TR 0603mc U solar thermal controller. Temperature and performance data are clearly displayed for analysis in an Internet browser window and changes in temperature, over time, are visualized using diagrams. If a heat meter is used, the system is even capable of displaying energy balances and CO_2 savings. By logging online, with a personal username and password, the operator can monitor system information worldwide. The historical data archived on a server is permanently available and can be downloaded for detailed analysis with the applicable software, Steca TS Analyzer 1, at any time.

Steca Elektronik GmbH, Germany
www.stecasolar.com
www.solarthermalweb.com

Solar racking solutions

Since 2005, TTi has been a solar pioneer in the US, providing innovative racking solutions for roof and ground-mount photovoltaic (PV) systems nationwide and overseas. TTi offers a robust and cost-effective line of products, from the flexible and sleek Adjustable Tilt Ground Mount (ATGM) to the durable and reliable TTi Sunseeker, a single-axis tracking system. All products are streamlined for quick installation and designed to maximize the return on a solar investment. The TTi Flat Jack is the world's first ICC Certified residential PV solar roof-mounting bracket. With only three components, the installation for the Flat Jack is up to 25% faster, and is 100% watertight and sealant-free. With a low profile, and made from the highest quality materials, the fully flashed Flat Jack safely protects and secures solar roof installations. The TTi Flat Jack is certified quality at its best.

TTi | www.ttisolar.com

Solar thermal water heating system

Cirrex from A. O. Smith is the latest advancement in solar thermal water heating, and could be the greenest solution available to homeowners today. Cirrex is an all-in-one solar thermal water heating system, which simplifies specification and installation. The Cirrex system offers a high-volume tank, allowing users to capture even more solar energy. With Energy Factors up to 10.1, the Cirrex system is tax credit eligible.

A. O. Smith | www.hotwater.com

Data acquisition packages for solar monitoring

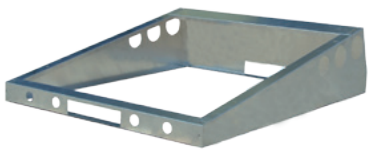
Campbell Scientific offers pre-configured and custom automated data acquisition packages, specifically designed for solar monitoring applications. A full range of pre-configured packages are available for photovoltaic (PV) and concentrated solar technology (CST) arrays of all sizes. Two such packages are the SOLAR1000 and CST100, designed to meet CaISO EIRP Solar Telemetry Standards. The SOLAR1000 is an automated data acquisition package designed for flat panel PV monitoring applications. Typical uses include pre-construction phase solar resource assessment, baseline data collection, and performance monitoring. The CST100 is an automated data acquisition package specifically designed for CST monitoring applications where active, direct normal, and diffuse irradiance measurements are required. Typical uses include research and development, resource assessment, and performance monitoring of concentrated solar power (CSP) and concentrated photovoltaic (CPV) technologies.

Campbell Scientific
www.campbellsci.com/solar-energy

Solar rating & certification

The Solar Rating and Certification Corporation (SRCC) was incorporated in 1980 as a non-profit, independent, third-party certification entity. The SRCC provides authoritative performance ratings, certifications, and standards for solar thermal products, offers expert recommendations and advice to governments and other entities, as well as guidance and protection for consumers and stakeholders. They help promote the development of reliable solar thermal technologies and accountable performance claims.

SRCC | www.solar-rating.org



Solar mounting system

The AluLight solar mounting system is designed for large commercial roofs requiring a high concentration of modules. Easy and fast to install, the AluLight is an optimized ballasted solar mounting system offering a fixed tilt of 12°. Modules are quickly connected using top-down clamps, while rows are interconnected by the system's unique design. With the use of concrete pavers, the system ensures a well-distributed transfer of compressive forces to the roof.
Schletter | www.schletter.us | www.alulight.us

Surge protector

CITEL's DS50VGPV Surge Protector is designed with their patented VG Technology, a hybrid Metal Oxide Varistor (MOV) + Gas-filled Spark Gap (GSG) surge protection circuit, which dramatically increases the life expectancy of the surge protector and eliminates working current and leakage current. Rated for DC Power Applications up to 1200Vdc and UL 1449 3rd Edition.
CITEL | www.citel.us

M&A: The Growing Solar Value Chain

By Jack Calderon & Chaim Lubin

In all estimations, the photovoltaic (PV) market installed somewhere between 16GW and 18GW of solar during 2010. This level is almost three times the total solar installed in 2009. In an industry that has been growing more than 43% annually during the last decade, it's no wonder thousands of companies exist in all areas of the global solar value chain. The solar industry seems ripe for consolidation and re-alignment through mergers and acquisitions (M&A). Although, there has already been a lot of M&A activity throughout the last few years, the first significant wave of consolidation activity has yet to materialize.

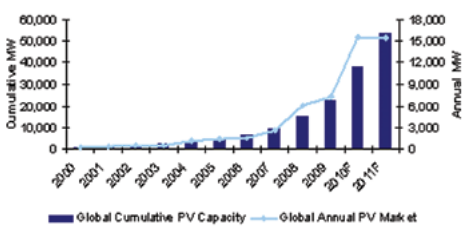


Figure 1

A clear example of how industries mature and consolidate over time can be garnered from the automotive industry. At the dawn of the automobile in the early 1900s, there were more than 400 car manufacturers in the United States. Within the next 40 years, almost every one of those companies had consolidated or gone out of business, with less than 60 companies surviving by the 1950s. Fast-forward to today, and the industry has consolidated even further, with less than 25 automotive manufacturers in existence.

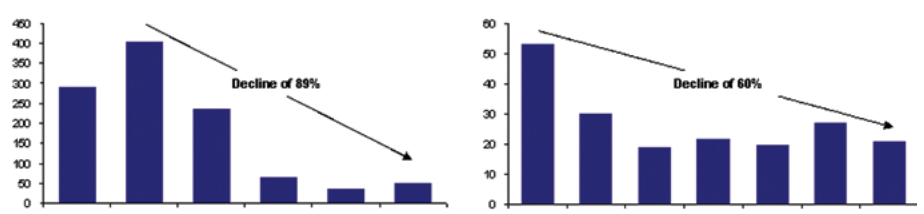


Figure 2

Of course, these trends are not exclusive to the automobile industry. Every industry as it matures goes through waves of consolidation, enabling companies to strengthen their business plans, scale, technology, and market position by acquiring other companies. In most industries, consolidation occurs in multiple waves, with each wave having a significant effect on restructuring that particular industry. These waves also differ in the average valuations the acquired companies are able to achieve. Most often, every successive consolidation wave will have a lower average valuation for the companies being acquired than the ones prior.

For example, the Printed Circuit Board (PCB) industry witnessed two consolidation waves in succession during the last decade. The first occurred between 1999 and 2001, as consolidation activity spiked to 50% higher than the surrounding years, while the second wave occurred between 2006 and 2008. Each wave was effective in restructuring the industry, leaving companies stronger and more competitive. However, the waves also exhibited declines in valuations of companies being consolidated within the industry.

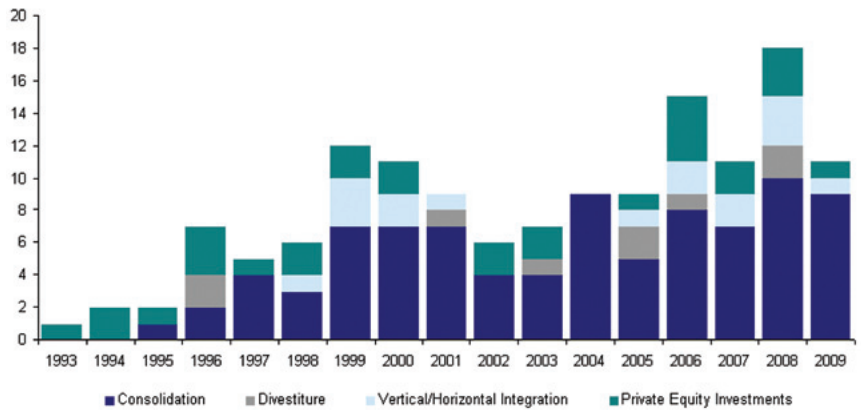


Figure 3

From 1991 to 2001, the average EBITDA multiples in the PCB industry ranged from approximately eight times to 10 times, while from 2006 and 2008 the average dropped to between five and seven times. These findings indicate companies that consolidated through M&A exhibited valuation multiples 30% to 40% higher in the first consolidation wave as compared to the second.

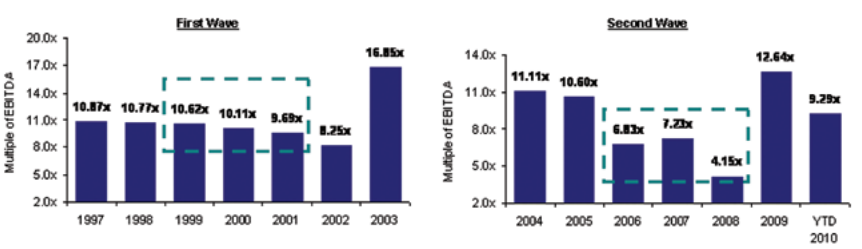


Figure 4

In most industries, each subsequent consolidation wave typically yields lower valuations as seller and buyer disparities are more acute and pricing pressure increases. Although it's necessary to note that each individual merger or acquisition is different (and, therefore, has nuanced valuation characteristics), on average, there is an overall decline in valuations during a subsequent wave. Based on the data, an industry post-consolidation emerges stronger with fewer, large companies that can leverage scale, enhance technology, and invest in low-cost manufacturing regions.

Consolidation activity within the solar industry has been steadily increasing at a 34% quarterly rate for the last five quarters, representing 51% of total transaction activity during 2010. For the time being, however, the majority of consolidations have been relegated to the acquisitions of EPC Integrators or development companies to secure "pipelines" of projects—not to mention the consolidation of the highly fragmented EPC/installer community. The industry has yet to witness a major consolidation along the equipment, module, or cell area of the values chain where a large amount of fragmentation and opportunity still exists. Furthermore, the valuations of these companies remain high, with EBITDA multiples often exceeding 10 times the average for public companies in these sectors.

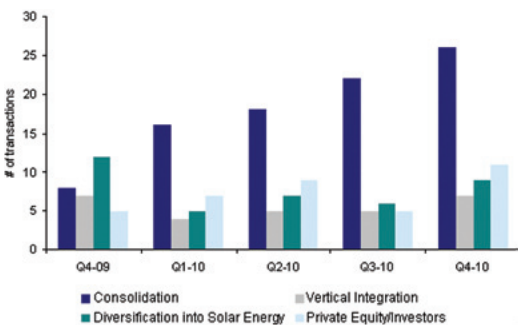


Figure 5

As the solar industry matures and becomes more competitive on a global scale, the pressures for consolidation will increase. Currently, solar seems well on its way, as larger incumbents desire to secure additional market shares and grow scale, globally. Though this is being done organically, the recent market success in solar has infused many companies with cash, making acquisitions an attractive avenue for growth. This dynamic, in conjunction with the overall fragmentation that exists in the value chain, should drive the first large consolidation wave in solar.

Once this first consolidation wave hits, valuations are expected to be driven down as the industry matures with fewer large players. Now is time for companies in the solar industry to evaluate their strategies and determine whether they are buyers or sellers. If the latter, it's important to remember that selling early in an industry consolidation often results in premium valuations and should be a key consideration in timing a successful sale.

Jack Calderon is managing director at Lincoln International, and co-heads the firm's Renewable Energy Group.

Chaim Lubin is an associate at the firm, and also part of its Renewable Energy Group.

Lincoln International | www.lincolninternational.com

EMI: Maintaining Turbines While Capping Costs

By Holly B McGlinn, CPCU, AU

Image courtesy of Jim Hatch | www.hatchillustration.com

IN THE WIND INDUSTRY, turbine maintenance costs have far surpassed anyone's initial projections. This is why a proactive and efficient approach to maintaining turbines is essential to keeping projects in the black. The American Wind Energy Association's (AWEA) Wind Project Performance & Reliability Workshop, in January of this year, opened with a shocking statistic given by AWEA's Stephen Miner: In the coming year, approximately $40 billion dollars worth of turbines are facing warranty expiration.

Now is the time to take a serious look at the future, and the options available. Controlling maintenance costs can make the difference between a profitable wind farm and an unprofitable one. Turbine maintenance is a reality—whether scheduled and preventative, or unscheduled and done in a crisis situation. However, there's no need to wait until a crisis arises before investing in maintenance protection. There's a new solution to this problem: Equipment Maintenance Insurance (EMI).

EMI makes sense for the long term, especially considering the significant financial investment required to get a wind farm up and running. Maintenance costs for an individual wind farm vary considerably, based on turbine size and age, as well as overall project size. For newer, larger utility-scale projects, $9 per megawatt-hour is a reasonable estimate when determining maintenance costs per the 2009 Department of Energy Wind Technologies Market Report. Keep in mind, maintenance costs tend to increase as a project ages. Using $9 per megawatt-hour as a starting point, it would cost $41,391 per year to maintain a single 1.5 MW turbine, assuming a 35% capacity factor. This doesn't account for the economies of scale that larger projects realize. Nevertheless, costs like this turn scheduled maintenance into a substantial monetary commitment.

Not surprisingly, multiple surveys site a staggering number of turbines are behind in scheduled maintenance. Yet, maintenance performed in a crisis situation can be costly on a number of fronts. Because a crisis can occur at any time, there's little way of predicting or properly budgeting for it. If a wind farm owner doesn't pay immediately to rectify the damaged or malfunctioning turbines, he can end up in default of his power purchase agreement, in addition to the lost income of those idle turbines. Furthermore, an owner can be boxed into a corner when negotiating the cost of repairs with a potential vendor because, at this point, there's no time to shop around for the most competitive prices on parts and labor.

To date, the status quo in the industry has been to set up a maintenance program, either through an Operations & Maintenance (O&M) company specializing in servicing wind turbines, or by purchasing a service contract or extended warranty through an Original Equipment Manufacturer (OEM). By adhering to a preventative maintenance schedule, the stage is set for a fleet of efficient and reliable turbines. However, maintenance programs often require a large up-front commitment and, during unexpected, non-routine breakdowns, the required service can go beyond the standard service contract.

With EMI, project owners can maintain complete control of who services their equipment and can cap their overall maintenance costs knowing there's coverage in place for unexpected breakdowns. EMI is new to wind power, but the concept has a proven track record in other industries. Historically, rates average 15% to 30% lower than traditional maintenance plans. The insurance contract is based on the payment of a premium and a deductible. This combined amount of premium and deductible equals the total annual maintenance cost. Scheduled maintenance, including in-house repairs, accrue to meet the deductible. Once this is met, the insurance company takes over the scheduled and unscheduled maintenance payments, subject to the limit in the contract. A total equipment failure necessitating replacement can also be covered in this agreement.

EMI is different than traditional property, equipment breakdown, and warranty insurance, as there's no overlap between these policies. EMI covers and reduces the cost of predictable maintenance expenses while providing an added benefit of coverage for unscheduled, emergency maintenance and repairs. For example, assume a wind farm has an annual service contract at a price of $1,000,000. If an EMI is selected for purchase, the premium would be $250,000 and the deductible would be $600,000. The maximum out-of-pocket cost to the project owner in this scenario is $850,000. This model works because EMI is running on a leaner profit margin than traditional maintenance contracts, and the risk is spread over many clients and industries.

Not all EMI policyholders will max out their deductible, however. With more consistent maintenance practices over the long term, overall maintenance disasters and costs are reduced. The deductible can be met through any combination of scheduled, preventative, and unscheduled maintenance calls. Once the $600,000 threshold is met, future invoices are submitted directly to the insurance company for payment to the service provider or reimbursement for in-house labor and repairs. The premium, deductible, and contract terms are highly customized according to the needs of each project and their capacity to take on risk.

Although it's up to an owner's discretion as to who services his turbines, it's worth noting that he'll have to restructure his agreements to fit within the context of EMI. So, instead of engaging in an annual contract with an OEM or an O&M firm, the owner would need to go forward on a parts and labor basis. This might result in some pushback on the front end, but once the deductible is met, the service provider can rest assured that they'll be paid directly by the insurance company. The service provider loses some stability that comes with an annual contract, but gains some stability in guaranteed payments from the insurance company.

EMI can also work to a wind farm owner's advantage when seeking financing. With EMI, owners have hard proof to show potential lenders their turbines will be serviced; plus, they can pinpoint what the maximum maintenance expenses will be. The risk of turbines sitting fallow for lack of funds for repair is neutralized. Likewise, the risk of an owner defaulting on other debt due to overspending on maintenance is controlled. EMI can have a direct impact on securing financing and negotiating favorable rates.

The cost of wind turbine maintenance is significant and can cripple a project if ignored or not managed properly. It's critical that earlier generation turbines are maintained in a way to keep them spinning and profitable. EMI gives wind farm owners the ability to commit to preventative and affordable maintenance, so maintenance cost uncertainty becomes certain.

Alcott Wind Insurance Agency
www.alcottwindinsurance.com

Investing with a Conscience

Socially responsible investing

By Evan Cohen

MANY INVESTORS have strong opinions that don't involve their views on interest rates and stock prices. For example, this might include support for a "clean" environment and a reduction in greehouse gases. Increasingly, these investors want their holdings to reflect their social or ethical values. They wish to avoid companies that profit from activities they oppose, and support companies that behave in ways they consider appropriate or responsible. At the same time, however, most investors still want or need to earn a reasonable return on their portfolios.

Socially responsible investing (SRI) seeks to reconcile these two objectives by helping investors create diversified portfolios designed to deliver an acceptable level of performance, while at the same time excluding companies that don't meet certain ethical standards. SRI investing recognizes that corporate responsibility and societal concerns are an important part of many investment decisions—particularly with the world's increased focus on sustainability and climate change, among others.

SRI investors encourage corporations to improve their practices on environmental, social, and governance issues. SRI-like approaches may also be referred to as responsible investing, ethical investing, mission investing, double or triple bottom-line investing, sustainable investing, or green investing.

Increasing interest

Over the last several decades, many investors have shown an increased appetite for social investors. The Social Investment Forum, a nonprofit group that promotes socially responsible investing, calculates the total number of assets under professional SRI management, which rose from $629 billion in 1995 to $2.71 trillion in 2007. In fact, the Forum estimates that one out of every nine dollars under professional management in the US today—or 11% of the $25.1 trillion in total assets under management tracked in Nelson Information's Directory of Investment Managers—is involved in socially responsible investing.

Why has socially responsible investing gained in popularity? One of the reasons may be that investors posed themselves a question similar to this one: "While my number one investment goal will always be to create a properly diversified portfolio based on my personal risk tolerance levels, how can I also do a bit of good for the environment, for the world, or to improve the condition of mankind?"

A second reason for SRI's popularity is that some of the nation's most prominent institutional investors have increasingly added a social focus to their investment decisions. These institutions, many with significant assets and often with great public, political, and media clout, often carry both a big stick and use a loud voice. Some have become well-known advocates for social issues, and this is often carried out through their investments in socially responsible projects.

A third reason for increased interest in SRI is the simple fact that it's now much easier to access professionally managed SRI vehicles. Many investment firms have created specific investment processes that exclude companies that, in the investor's view, focus on non-socially responsible or acceptable activities. Once these decisions have been made, the manager constructs a diversified portfolio within the desired constraints. The goal is to deliver performance consistent with the investor's return objectives and tolerance for risk.

Structuring investments consistent with social, environmental, or ethical objectives offer investors a way to align their portfolios to their own objectives.

Evan Cohen is a financial advisor at Morgan Stanley Smith Barney located in Carlsbad, California.

Morgan Stanley Smith Barney LLC | www.mssb.com

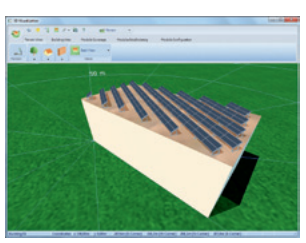
Intersolar Europe

June 6th to 10th, 2011 • New Munich Trade Fair Centre—Munich, Germany

At Intersolar Europe, attendees will gain valuable information on the latest topics and technologies in the solar industry at the numerous sessions and workshops offered.

www.intersolar.de/en

Show in Print
Features just some of the companies and technologies attendees will see at this year's show.



Solar mounting software

PV*SOL® Expert 5.0 offers a major new feature that makes it possible for users to visualize mounted PV systems in 3D mode using a standard PV*SOL mounting system. The mounted systems are automatically sized to the roof, and the software includes tools to optimize the distance between rows and the mounting angle. The PV*SOL standard mounting system is fully editable, independent from the statics. Individual rows of PV modules can be edited, or added and removed in groups, and can be jointly configured to operate as a sub-array. The graphical configuration of the PV modules has also been extended, so that the modules can now be reassigned to a particular configuration across rows. The software's animation shows the inter-row shading, which is accounted for in the yield simulation. The parallel calculation and visualization of the shade frequency distribution for all of the module rows means users can adapt the design to prevailing shade conditions.

Valentin Software
www.valentin-software.com

Grid interconnection solutions for utility-scale PV plants

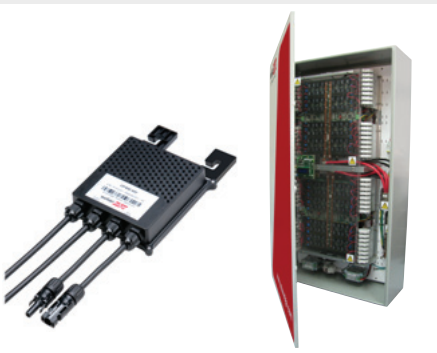
American Superconductor (AMSC) offers a range of proven solutions for the renewable energy industry. Based on its proven D-VAR reactive compensation technology, AMSC recently launched its SolarTie Grid Interconnection Solution, designed specifically for megawatt-scale PV power plants. AMSC's D-VAR STATCOM solution stabilizes grid voltage levels on a real-time basis, and is currently enabling more than 70 wind farms around the world to meet local grid interconnection requirements. The SolarTie incorporates AMSC's D-VAR technology and proprietary PowerModule power converter systems to create the first fully optimized solution for utility-scale PV power plant developers. This solution is the only to incorporate sub-cycle detection and response times to grid disturbances of less than 16 milliseconds, enabling solar power plants to meet local grid interconnection requirements in a single solution. The SolarTie incorporates a proprietary Smart Grid Interface (SGI) Controller, which provides efficient energy production and precise regulation at the Point of Interconnection.

American Superconductor (AMSC)
www.amsc.com

New generation solar module

Multisol Vitro is the first crystalline glass-glass product for a broad range of applications. It provides impressive value because of its sturdiness against snow and wind loads, robustness against salt-spray and ammonium, and best-in-class optical performance—thanks to its highly transmissive f | solar HT float glass. With these unique features, Multisol Vitro enables improved functionality and is an aesthetically pleasing PV solution: roof-applied, roof-integrated, and facade-integrated. Multisol Integra Vitro is also the next-generation of Scheuten's Integra (in-roof) solution, suited for almost any sloped roof. This new generation Integra Vitro features a full glass-glass Multisol Vitro laminate, resulting in superior strength (5400Pa) and an even better durability of the module. This aesthetic PV in-roof installation system replaces the conventional tile covering, either for part or for the entire roof.

Scheuten
www.scheutensolar.com



Next-generation power optimizer & combiner box

SolarEdge Technologies introduces its next-generation of power optimizers. With a new, highly efficient ASIC chipset and 32% lower part count, the new power optimizer is not only 40% smaller in volume, but also boasts world-record efficiency. Selection of cutting-edge components and improved dynamic control are combined with a new MPPT algorithm that dynamically tracks the global maximum operating point for both modules and inverter, enabling maximum power optimizer efficiency of 99.5%, (98.8% EU weighted efficiency). This ensures peak system performance in mismatched and unshaded conditions. The power optimizers, with a 25-year warranty, provide enhanced SafeDC features: electric arc detection and termination, and automatic module shutdown in case of inverter or grid shutdown. Yet another innovation is the SolarEdge Smart Monitoring Combiner Box with Ground Fault Detection and Interruption (GFDI). The string combiner cabinet with internal disconnect per string, provides unprecedented safety, performance monitoring, and control for commercial and utility-scale PV sites.

SolarEdge Technologies
www.solaredge.com

Slewing drives for solar trackers

Kinematics Manufacturing Group manufactures slewing drives especially for solar trackers, using a low-cost energy efficient model. Kinematics has installed over 133,000 drives worldwide, offering a wide variety of model sizes, performance ranges, and custom-designed solutions. Each slewing drive undergoes environmental, lifecycle, strength and accuracy testing, and is backed by a 30-year warranty. Models specially suited for PV, HCPV, heliostats, and dish designs.

Kinematics Manufacturing | www.kinematicsmfg.com

Highly configurable connector

Manufactured by Anderson Power Products, the Solar SPEC Pak is a highly configurable interconnect with power capabilities up to 1000 volts. The rugged, IP68 shell is flame resistant in accordance with UL 94 V-0 and has a F1 weatherability rating. The locking latch conforms to the NEC 2008 requirements, requiring a tool to release the locking latch. Its touch-safe shell is available for wire-to-wire or panel-to-wire applications that range in temperature from -40° F to 230° F (-40° C to 110° C). This highly configurable connector provides thousands of design options for the most demanding applications.

Anderson Power Products | www.andersonpower.com

2011 BIOPOWER BUYERS GUIDE





2011 BIOPOWER BUYERS GUIDE

AIR POLLUTION CONTROL

McGill AirClean LLC

McGill AirClean has over 40 years of experience solving air pollution control problems, controlling emission and particulate for a wide variety of industrial applications including furnaces, boilers, incinerators, kilns, and dryers. Specialties include Boiler MACT and SCR solutions. They engineer, manufacture, install, and service a full range of products including dry and wet electrostatic precipitators, fabric filter systems, spray-dry scrubber systems, and regenerative thermal oxidizers.
www.mcgillairclean.com

Tri-Mer Corp.

The UltraTemp filtration system incorporates proprietary low-density ceramic filters that are lightweight, strong, and self-supporting. With over 80% open area, the filters feature low flow resistance while maintaining 99+% capture efficiency on submicron particulate. Typical outlet concentrations of PM are below 0.001 grain/dscf (2 mg/Nm3), even with high inlet loadings. UltraTemp filters have a maximum operating temperature of 1650° F (900° C). The UltraCat catalyst filters feature the addition of nanobits of NOx catalyst embedded throughout the walls of the filters. High catalyst surface area and proprietary formulation allow destruction of NOx and dioxins at temperatures as low as 350° F. Typical NOx removal is up to 95%, and dioxin destruction is over 99%. The UltraTemp and UltraCat filter systems are specified for Boiler MACT and CISWI MACT compliance.
www.tri-mer.com

BIOFUELS PRODUCTS & EQUIPMENT

FCI FLUID COMPONENTS INTERNATIONAL LLC

Fluid Components International

Fluid Components International (FCI) has released its Model ST51 Mass Flow Meter for owners, operators, and manufacturers of biogas production and methane capture and recovery systems. These users will find the new Model ST51 provides the high performance and features required of these applications in an explosion-proof instrument that is easy to install, safe, and requires virtually no maintenance to deliver a truly best cost solution. FCI's ST51 Flow Meter is designed specifically to measure biogas and all methane composition gases including natural gas. ST51 features a thermal mass, insertion-style flow element with flow accuracy to ±1% of reading over a broad flow range, from 0.3 to 400 SFPS (0.08 to 122 MPS), and repeatability of ±0.5% of reading. The flow element is available for use in line sizes from 2 to 24 inches (51 to 610 mm) diameters.
www.fluidcomponents.com

Novozymes

Through bioinnovation, Novozymes creates tomorrow's industrial biosolutions, improving their customers' businesses and the use of the planet's resources. Novozymes delivers advanced bioinnovation solutions to the bioenergy industry by setting new standards in performance and viability—helping the world realize the promise of renewable energy.
www.bioenergy.novozymes.com

BIOMASS PRODUCTS & EQUIPMENT

CBI

Continental Biomass Industries, Inc.

Continental Biomass Industries is a provider of biomass processing systems. CBI's grinders and chippers handle demanding materials in the forestry, construction and demolition debris, municipal solid waste, biofuel, pulp and saw mills, mulch, and yard waste markets. For more than two decades, CBI has supplied the most durable, reliable, and productive equipment in the industry. Additional products include shingle grinders/re-grinders, wood waste hogs, shredders, and screening systems.
www.cbi-inc.com

HURST BOILER

Hurst Boiler & Welding Co., Inc

Hurst Boiler offers their OXY-MISER Feed Water Deaerators and packaged deaerator systems from 5,000 to 200,000 PPH. Conditions: feedwater to 0% CO_2 and .005cc/liter of oxygen. The HURST OXY-MISER Deaerating Boiler Feedwater system eliminates the need for expensive oxygen scavenger chemicals. It also offers the following advantages: removes carbon dioxide, as well as oxygen; raises the boiler feedwater temperature, eliminating thermal shock in boilers; and, improves overall boiler room efficiency.
www.hurstboiler.com

Metso Power

Metso Power provides engineering, construction, and manufacturing services, as well as technology (CFB&BFB) products, along with automation, instrumentation, and integrated solutions by delivering environmentally friendly combustion solutions to the power sector. Metso boilers use Fluid Bed technology, combining high-efficiency combustion of high-calorific value fuels with low emissions—even when burning various fuels simultaneously. Boiler service comprises of rebuilds and repairs including, but not limited to: chemical cleaning consulting, boiler inspections, maintenance, replacements in kind, made to order, pressure parts, spare parts, life-cycle service, and local USA manufacturing and service facilities. Pressure parts include: membrane wall panels, economizers, generating banks, tubular heat exchangers, superheaters, and loose tube bending. Full metal fabrication is also available including 2D/3D laser cutting, engineered solutions, alignments bars, headers, air heater seals, machining and saw cutting, assembly, shearing, bending, welding, plating, and powder coatings. Plus, a complete range of tube shield styles to solve tube wear problems fast, as well as significant spare parts inventory including off-the-shelf replacements, straight tubing, and stainless sheet.

www.metso.com/energy
www.metsopowerservice.com

Percival Scientific

Percival Scientific represents a rich tradition of product ingenuity and reliability throughout the world. They provide clients with reliable custom solutions designed to meet their specific research requirements. Customers rely upon Percival to meet their unique needs by providing chambers that are engineered and manufactured to their specifications. Every Percival chamber is designed and manufactured in Iowa.

www.percival-scientific.com

Rotochopper, Inc.

Rotochopper two-stage fine grinding systems offer turnkey solutions for processing raw wood fiber and agricultural residue down to short fiber specifications for pellets, suspension burner fuel, and other fine texture fuel products.

Combining the versatility of Rotochopper horizontal grinders with the fine grinding efficiency of hammermills, these two-stage systems can process a wide range of raw materials from round corn stover bales to urban wood waste, down to short fiber specifications in a single pass. The advanced particle size control of a Rotochopper horizontal grinder optimizes the efficiency of the in-line hammermill, minimizing wear costs and downtime. Available with up to 1,200 combined horsepower, Rotochopper two-stage fine grinding systems can be sized to match unique raw material and end product needs with unmatched efficiency.

www.rotochopper.com

Indeck Energy

For more than 25 years, Indeck Energy has demonstrated the determination and know-how it takes to succeed in the ever-changing energy industry. Indeck Energy produces wood pellet fuel for industrial and co-firing applications at the Indeck Ladysmith BioFuel Center in Ladysmith, Wisconsin. Industrial-grade wood pellet fuel burns at up to 8,250 BTUs per pound and has an ash content of less than three percent, as compared to the eight percent ash content of coal. Indeck Energy wood pellets are produced from sustainably harvested hardwood, along with a quality blend of sawmill and forest residuals. Indeck Energy Services was established in 1985, and is a privately held developer, owner, and operator of renewable and conventional energy projects, offering biofuels production and electrical generation facilities.
www.indeckpellets.com

Fecon, Inc.

Fecon offers the RTC22/500 as a turnkey mobile chipping package. Mounted on a TimberPro 830B forwarder, it's the fastest American-made all-terrain chipper. It is highly productive in land clearing, biomass, pipeline, and R.O.W. applications. The eight-wheeled off-road chipper gets to work at up to 12mph, so unproductive time hauling material to a trailer-mounted chipper is avoided. The Fecon RTC22/500 more than triples speeds of typical track chippers. Production speed is further enhanced by both loader reach and lifting capacity. It sets new standards with 12,880lb capability at 15', and up to 31.5' of total reach and 360° rotation. The in-feed power of over 16,000ft pounds of torque provided by Fecon's Power Feed Management and optional dangle head felling saw make the RTC22/500-8 a highly effective stand-alone chipping system.
www.fecon.com

Vermeer Corporation

The Vermeer WC2300 whole tree chipper is powered by a 440-hp (328.1 kW) C-13 CAT diesel engine that allows for maximum output while consuming less fuel than higher-powered machines. A six-degree slope of the in-feed table lowers the "break-over" point where long material first contacts the machine, reducing the likelihood of limbs or a tree canopy from snagging on the end of the machine. The in-feed system features a variable-speed, dual in-feed conveyor chains, a conveyor head pulley with integral grip bars, and an aggressive large-diameter in-feed roller with crush capability. These design elements provide efficient feeding of difficult material types. Two drum knife options are available allowing the operator to select the type of knife that best suits their operation, jobsite, or customer requirements.
www.vermeer.com

West Salem Machinery

From feedstock to premium quality finished fuel, West Salem Machinery's (WSM) field-proven grinding, screening, milling, and conveying equipment is the core of each customized and fully engineered package. Primary processing of raw feedstock and green fiber is available with WSM's rugged horizontal grinders and screens, as is secondary processing of pre-hogged fuel with WSM's high-volume disc screens and vertical grinders. Finish milling is accomplished with WSM's heavy-duty hammermills. WSM supplies metering feed hoppers, motor starters/controls, infeed and discharge chutes, support structures, access platforms, and associated conveyors to deliver a complete system. Their solution-oriented approach and application expertise in processing systems is demonstrated at successful fiber prep systems in operation throughout the world.
www.westsalem.com

BIOMASS THERMAL ENERGY

Helmick Corporation

Helmick Corporation is a US manufacturer that has produced boiler tube shields since the 1950s. Located in West Virginia, Helmick also manufactures abrasion-resistant components for use in the maintenance and upgrade of bottom and fly ash handling systems that were originally furnished by Allen-Sherman-Hoff and United Conveyor Corporation.
www.helmickcorp.com

HRS Heat Exchangers

Scraped Surface Heat exchanger is an ideal solution for difficult products that foul when heated due to process requirements. Unicus is a S&T heat exchanger with rods and scrapers inserted in its tubes. Tube bundles of up to 80 inner tubes have been manufactured for many difficult applications. Other thermal technologies available include the corrugated tubular heat exchanger, which replaces the smooth tube heat exchanger due to its enhanced heat transfer coefficients.
www.hrs-americas.com

BIOREFINERIES

Mascoma Corporation

Mascoma Corporation is an innovative biofuels company committed to developing environmentally sustainable, low-cost, low-carbon biofuels from cellulosic biomass. The company's Consolidated Bioprocessing method converts non-food biomass feedstocks into cellulosic ethanol through the use of a patented process that eliminates the need for costly enzymes and additives. Their corporate office and R&D laboratories are based in New Hampshire.
www.mascoma.com

CONSTRUCTION & CONSULTING SERVICES

Aevenia, Inc.

Aevenia, Inc. is a premier energy and electrical constructor providing design-build services for collection systems, transmission, tower wiring, interconnection, substations, and fiber optic systems. The company offers design, installation, and management to cover every critical aspect of a project, as well as a guarantee of safety, efficiency, and quality maintenance when the job is done. Aevenia companies provide electrical construction, heavy industrial wiring, power transmission and distribution, fixed security systems, data and fiber-optic networking, as well as service and technical support.
www.aevenia.com

AGRA Industries Inc.

AGRA Industries Inc. (AGRA) has three business units: AGRA Industries, Merrill Fab, and AGRA Construction; all focusing on offering comprehensive design, quality steel fabrication, and construction services to renovate or design-build new or existing facilities. AGRA manufactures a complete line of bolt-together bin systems, chopping, and material handling systems, as well as catwalks and towers, to name a few. Their field-erected wet/dry tank design is more cost-effective/efficient than the conventional style.
www.agraind.com

Fagen, Inc.

Fagen, Inc. is the largest merit shop green energy design-builder in the United States. Utilizing a database of over 25,000 direct-hire employees, Fagen, Inc. is prepared to meet industrial demand growth with a large inventory of cranes, including several Manitowoc 18000â€™s, and a new 16000WA.
www.fageninc.com

JH Kelly, LLC

JH Kelly is an electrical, mechanical, and civil/structural contractor that performs inspection, maintenance, and construction services for biopower developers, plant operators, and owners.
www.jhkelly.com

McCormick Construction Company

McCormick Construction Company (McC) is a trusted partner and contractor that builds, supports, and maintains premium renewable energy facilities. They specialize in bulk storage, material handling, and processing of feedstock. McC brings value to each project, offering lower operating costs and greater plant productivity. Their objective is to provide a safe working environment for all employees, while delivering a high-quality product backed with service and long-term customer satisfaction.
www.mccormickconstruction.com

ECONOMIC DEVELOPMENT

Pittsburgh

The Pittsburgh region is a nexus of natural resources, engineering expertise and innovation, R&D, and advanced manufacturing capacity to support traditional and alternative energy related products and solutions. Pittsburgh is the largest metro atop the Marcellus Shale, one of the world's largest unconventional natural gas reserves. Currently, in the region, there's a critical mass of 700+ global energy supply chain companies producing parts and components for various renewable energy services. The country's only federally funded and the largest privately funded research laboratories exploring carbon capture and cleaner coal technologies, respectively, are also here.
www.pittsburghregion.org

EMISSIONS MONITORING SYSTEMS

Altech Environment U.S.A.

Altech Environment U.S.A. provides Continuous Emissions Monitoring Systems (CEMS) for the biomass industry. With over 20 years experience, Altech provides one-stop shopping for compliance monitoring needs. Their clients count on them for regulatory expertise, reliable and proven equipment, and top-notch service.
www.altechusa.com

Custom Instrumentation Services Corp. – CiSCO

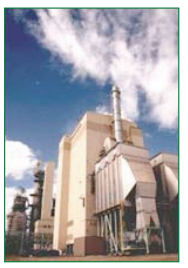
Custom Instrumentation Services Corp. (CiSCO) provides complete high-quality Continuous Emission Monitoring Systems (CEMS) and Data Acquisition and Handling Systems (DAHS) to monitor and report stack gases, flow, and opacity for EPA compliance and process control. The steady growth of the company since 1985 is attributable to CiSCO's service, products, referrals, and repeat business.
www.ciscocems.com

ENGINEERING & EQUIPMENT

Newpoint Thermal

Newpoint Thermal designs and manufactures custom equipment that can convert waste gas into energy. The waste gas is converted into useful energy, in the form of process heat. Their equipment can reduce operational costs, especially compared to conventional energy sources. Newpoint Thermal will also evaluate the process requirements for each customer. Process heating equipment offered includes: thermal fluid systems (gas- and oil-fired); direct-fired API heaters; convection process heaters; process bath heaters; waste heat recovery systems; high-pressure steam generators; and, engineered skid packages. Service and maintenance offered includes: pre-commissioning check-out; commissioning and start-up support; operator training; regular maintenance support; as well as, replacement parts.
www.newpointhx.com

ENVIRONMENTAL CONSULTANTS & BUSINESS SERVICES



ecology and environment, inc.
GLOBAL ENVIRONMENTAL SPECIALISTS

Ecology and Environment, Inc.

E & E brings over 40 years of worldwide environmental consulting experience to biopower projects. They can identify and measure available biomass and waste-to-energy resources, and model and monitor air emissions, surface, and groundwater supplies, as well as wastewater effluents and noise. They also assess project land use, transportation, and socioeconomic and cultural resource impacts. E & E's highly multidisciplinary teams include specialists in outreaching to a broad range of stakeholders and specialists in obtaining all of the required federal, state, and local government regulatory permits. E & E can help get the "green light" for biopower projects throughout North America and overseas.
www.ene.com

Navigant

Navigant's energy practice includes more than 270 experts focused on issues across the entire energy value chain including renewables, climate change, energy efficiency, demand response, emerging technologies, generation, resource procurement, transmission, markets, performance improvement, fuel sourcing, as well as rates and regulation.
www.navigant.com/energy

TRC Solutions

A pioneer in groundbreaking scientific and engineering developments since the 1960s, TRC is a national engineering, consulting, and construction management firm providing integrated services to the energy, environmental, and infrastructure markets. They serve a broad range of clients in government and industry, implementing complex projects from initial concept to operations. TRC is 2,400 technical professionals and support personnel at more than 70 offices throughout the US. Clients depend on TRC's multidisciplinary teams to design solutions to their toughest business challenges in the energy, environmental, and infrastructure markets.
www.trcsolutions.com

FINANCIAL SERVICES

Plante & Moran

Plante & Moran is a public accounting and business advisory firm serving more than 260 energy-related clients, including alternative energy clients comprised of companies and projects in biomass, as well as wind, solar, and geothermal energy. Their team of experts specialize in tax credits and incentives related to the renewable energy industry, including proper structuring to maximize the tax benefits and cash flows of the related credits.
www.plantemoran.com

Sustainable Energy Financing

Sustainable Energy Financing, LLC (SEF) is a consulting firm that assists its clients in the identification, negotiation, and acquisition of financial incentives such as grants, tax credits, and environmental assets. Founded to promote sustainability related initiatives domestically and abroad, SEF works with project developers, renewable energy technology providers, and private businesses to maximize return on investment. SEF staff are certified in Greenhouse Gas Inventory Quantification and authored the first validated Project Design Document in the USA utilizing AMS I.C., providing carbon credits for the utilization of biomass in place of fossil fuels for thermal heating purposes. SEF has leveraged over $40 million of project investment in the past three years.
www.sef-llc.com

Taylor-DeJongh

Taylor-DeJongh (TDJ), an energy and infrastructure investment banking firm, has expertise across a broad spectrum of alternative technologies and renewable energy projects including bioenergy, geothermal, solar, wind, fuel cells, and hydropower. The firm is advising on several conventional and renewable power projects internationally, including transactions in biomass, geothermal, solar, and wind, and is a financial advisor to the USDOE Loan Guarantee Program. TDJ has advised on over 240 power projects globally. TDJ offers project development, capital structuring, and project financing services, and has 30 years of experience in closing energy projects. TDJ provides tailor-made capital solutions to its clients. The firm also advises on corporate finance, capital raising, and M&A transactions.
www.taylor-dejongh.com

FOREST & WOOD PROCESSING

Acrowood Corporation

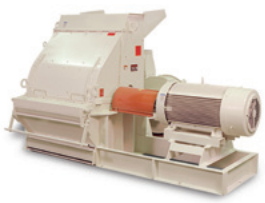
Acrowood is a long-time supplier of debarkers, chippers, chip screens, and associated products for the forest products industry. They also offer high-density contaminant removal using their Air Density Separators. Their heavy-duty disc scalping screens have been an industry standard for decades. Recent developments include specialized slant disc chippers for the production of uniformly sized microchips.
www.acrowood.com

Brunette Industries Ltd.

With a focus on R&D, Brunette Industries has developed new technologies for the biomass industry—a natural fit given the experience Brunette has gained as a manufacturer of wood processing machinery for the past 70 years. Brunette specializes in wood processing machinery and material handling systems for the biomass and forestry industries including the Grizzly Mill and BioSizer, as well as drum chippers, whole log chippers, micro-chippers, rotary debarkers, and vibrating conveyors. They offer custom engineered solutions to help take control of fiber supply and to get more from a mill. Brunette Industries' commitment to quality and technology gives customers an important advantage as they compete in an ever-changing global economy. Brunette has four offices across North America.
www.brunetteindustries.com

Morbark

Morbark manufactures equipment for a variety of applications involving wood and organic materials including biomass energy, pulp and paper, forestry, sawmill, tree care, and recycling. The product line includes hand-fed chippers to self-feeding whole tree chippers, tub and horizontal grinders, debarkers, and sawmill equipment, as well as attachments to get the job done. Morbark's extensive line of equipment is known for uniform, predictable quality, and is tailored to meet customers' needs for many years.
www.morbark.com



Schutte-Buffalo Hammermill, LLC

Schutte-Buffalo Hammermill has been involved in the design and manufacture of wood grinding hammer mills for more than 80 years. Choose from 10 different grinder series, with many models suitable for both green and dry wood applications. From single units to complete turnkey systems, all models are custom configured to suit the specific material and processing goals. Schutte-Buffalo Hammermill offers free material testing service and a complete line of replacement parts.
www.hammermills.com

The Parton Group, Inc.

The Parton Group provides project development support with technology assessments and feedstock availability and cost studies. Their client base includes utility companies, independent project development companies, and financing/lending institutions. Their staff of technologist, engineers, and foresters provide decades of forest industry understanding and insight.
www.thepartongroup.com

FUEL PRODUCTION

Natural State Research, Inc.

Natural State Research, Inc. has developed a unique technology (patent pending) to dispose of any type of waste plastic by converting it into a liquid hydrocarbon fuel. The process can produce approximately 1.3 liter of NSR fuel from one kilogram of waste plastic. Yield depends on the type of plastic, and the grade of NSR fuel desired. The fuels work for any internal combustion engine, as well as produce electricity.
www.naturalstateresearch.com

LEGAL SERVICES

Hawley Troxell Law Firm

One of Idaho's major law firms, Hawley Troxell has added a business group specializing in renewable energy. Response to client need and rapid growth of the industry in Idaho prompted the addition. Currently, the firm provides legal assistance regarding several dairy farm anaerobic digester projects. Hawley Troxell works with developers and investors to provide legal and business services for biomass, as well as wind, solar, geothermal, and hydro energy projects in all phases. Their professionals assist with project formation, organization, management, financing, and transitioning.
www.hawleytroxell.com

Michael Best & Freidrich LLP

The Energy and Sustainability Industry Practice Group at Michael Best & Friedrich LLP provides one of the industry's foremost legal perspectives to assist its clients in evaluating and creating sustainable business practices. This multi-disciplinary team is well informed on a number of segments within energy and sustainability, including renewable energy, clean technology, sustainable practices, and utility. By tapping into the team members' diverse backgrounds, Michael Best is able to provide its clients with the latest and most in-depth knowledge of the legal issues facing their rapidly changing industries.
www.michaelbest.com

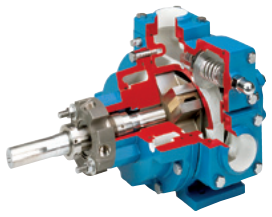
MATERIALS HANDLING SOLUTIONS

BEDESCHI AMERICA, INC.

For over a century, BEDESCHI has been supplying raw material handling equipment and services around the globe. Their markets include the cement, brick, mining, power, and biomass industries. Their product line encompasses: apron feeders, crushers, stackers, reclaimers, ship loaders, as well as dust collection and air filtration. BEDESCHI fabricates, assembles, and tests all machines in their 500,000 ft^2 manufacturing facility, equipped with an experienced staff and the most modern tools. Their field technicians follow the erection/assembly, along with providing start-up and commissioning assistance. Throughout their history, BEDESCHI's first priority has been to improve the quality of their products and the service to their clients—which has allowed them, even in competition with the most recognized names, to supply their brand to companies throughout the world.
www.bedeschiamerica.com

Almatec

Almatec is a premier manufacturer of air-operated diaphragm pumps specializing in plastic pumps with solid housings. Almatec's E-Series line of plastic air-operated diaphragm (AOD) pumps offer improved efficiency and performance. E-Series pumps feature solid-block construction that increases their strength and lifecycle, eliminating many maintenance concerns. E-Series pump housings are constructed in either polyethylene (PE) or PTFE, giving them resistance to abrasion while also offering high-chemical compatibility. Diaphragms and ball valves are available in EPDM or PTFE/EPDM with cylinders of PTFE. E-Series pumps also feature the patented PERSWING PA maintenance-free air-control system, which allows for greater flexibility. Almatec is an operating company within Pump Solutions Group (PSG).
www.almatec.de



Blackmer

Blackmer is a global provider of innovative and high-quality rotary vane pump and reciprocating compressor technologies for the transfer of liquids and gasses. For more than a century, the Blackmer name has stood for product performance, services and support, well-timed innovation, and a commitment to customer satisfaction. Supported by a worldwide network of distributors and original equipment manufacturers, Blackmer pumps and compressors are used in a multitude of applications in the process, energy, and military marine markets. For biofuels and storage terminal operators, Blackmer sliding vane pumps provide consistent volumetric-output performance, even after significant in-service time. Blackmer is a member of Dover Corporation's Pump Solutions Group.
www.blackmer.com

Hallco Industries, Inc.

HALLCO Live Floor Systems are used for the self-loading and unloading of all forms of woody biomass, demolition debris, tree trimmings, mill residues, and green wastes. They can fit a number of Hallco drive units and deck styles to fit a 45'' trailer or a pull-behind.
www.hallcoind.com

KEITH Mfg. Co.

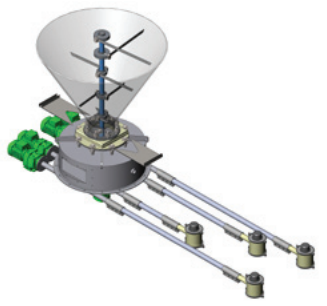
KEITH's WALKING FLOOR systems automate the receiving, storage, and metering of difficult bulk materials. WALKING FLOOR systems are also used at the back end of these processes to collect ash, filter cake, sludge, and spent distiller grains for transport to the next process. When engineers and plant managers recognize and address these challenges early in the design process, equipment can be selected to ensure efficient and reliable flow.
www.keithwalkingfloor.com

Precision Machine & Manufacturing, Inc.

Biomass raw material is one of the hardest on material handling equipment. Precision Machine & Manufacturing rotary valves and feeders last longer in harsh, corrosive biomass applications because they are built to tighter tolerances and their metallurgy has been designed to match the chemistry of the fuel used in biomass plants. Because of Precision Machine's experience with advanced metallurgy and quality control, customers that were servicing their rotary valves every three months are now doing so once per year. The payoff for the plant is lower costs and increased efficiency. Using equipment with longer operating lifetimes also helps keep the cost of maintaining spare parts inventories under control.
www.premach.com

Robert White Industries, Inc.

Before biomass can be converted into power, heat, fuels, or chemicals, it must be safely and efficiently conveyed to a bioenergy plant. Processors need to respond to the safety and degradation risks of handling biomass—whether it is wet or dry. In nearly every case, the biomass material must be pre-treated to some degree before it's acceptable for end use. Robert White Industries, Inc. specializes in equipment integration for raw biomass pre-treatment to provide on specification raw material for the final process. They offer biomass handling, fuel preparation, storage, and equipment for converting raw biomass into a finished raw material. RWI provides system design services, experience, and expertise for receiving, conveying, screening, grinding, metal removal, storing, unloading, and metering biomass.
www.rwii.net



Sodimate, Inc.

Sodimate has over 30 years experience in bulk storage, discharge, and conveying systems in the municipal environmental, agriculture, and biomass industries, and more.
www.sodimate-inc.com

Van Beek BV

Van Beek from The Netherlands is the specialist in the area of superb stainless steel screw conveyor systems. °Celsius is a division of Van Beek schroeftransport. Based on year of experience, °Celsius has established itself in 2002 as a specialist unit for the development and realization of thermal screws (screw heat exchangers).
www.van-beek.nl

NEXT-GENERATION BIOFUELS

IDAHO DEPARTMENT OF COMMERCE

Idaho Department of Commerce

Idaho is working on next-generation biofuels. The Idaho National Laboratory has 35 full-time employees working on biomass projects, such as using herbaceous materials like grasses and wood "slash" and waste from wheat and barley. A $40- to $60-million gasification plant has been engineered, designed to convert 250 tons of garbage, unloaded daily at a landfill, into electricity. A second plant is on the way.
www.renewable.idaho.gov

PLANT OPERATIONS

NAES Corporation

As a worldwide provider of third-party power plant operations and maintenance (O&M) services, with a portfolio of 179 projects and 52,000 MW, NAES operates energy facilities with best practices to deliver the highest levels of safety, compliance, and performance. NAES operates the broadest range of technologies and fuels in the industry. NAES also provides specialized services to improve plant technical and economic performance while enhancing personnel effectiveness.
www.naes.com

PELLET PRODUCTION & EQUIPMENT

Bliss Industries, LLC

Bliss Industries, LLC is a manufacturer of wood and biomass pelleting equipment for residential, commercial, and industrial pellet fuel. Founded in 1981, Bliss Industries maintains a reputation of manufacturing the most efficient, reliable, and well-built equipment in the industry. Developed from a design concept proven worldwide, the range of Pioneer Pellet Mills continues to expand. Overall, reliability, maximum efficiency, ease of operation, and maintenance combine to provide lower operating costs to each owner. Bliss also manufactures an extensive line of hammermills and coolers for biomass size reduction, processing, and cooling.
www.bliss-industries.com

TECHNOPHRAG Inc.

TECHNOPHRAG Inc. offers a supply of pellets made of Phragmites, as well as a French-made pelletizing unit. The company is also currently working on techniques to process water reed (*Phragmites australis*). Pellets made out water reed, rather than wood, mean reduced greenhouse gases. A tree takes several years to grow before being processed, whereas, water reed is a yearly growing grass that's not cultivated. TECHNOPHRAG/OLIOTECHNOLOGY's compact (about 30 m² floor space), automated pelletizing unit for small- to medium-sized operations does not require a steam generator to soften the material or a cooling system for outgoing pellets. No previous drying of the material is necessary: any biomass can be granulated with up to 20% humidity. Without the need for higher pressure, like a traditional extrusion system uses, the result is an increase in energy savings of about four to five times the norm.
http://mediom.com/~nsenga/TECHNOPHRAG

TESTING: QUALITY & CONTROL

Electromatic Equip't Co., Inc.

Ectromatic's complete line of moisture content meters and systems provide quick determination of water content of wood chips, barks, wooden pellets, miscanthus, elephant grass, wood shavings, sawdust, and much more. Solutions include hand-held portable units, as well as online systems for continuous measurement. All models include temperature compensation and are supplied with various calibrations for a variety of materials.
www.checkline.com

LECO Corporation

Established in 1936, LECO is recognized globally in the development of high-quality analytical instrumentation, mass spectrometers, chromatographs, metallography and optical equipment, and consumables. Pictured here is the TruSpec Elemental Determinator, which performs fast analysis of nitrogen, combined carbon/nitrogen, and simultaneous carbon/hydrogen/nitrogen configurations, with the ability to handle sample matrices such as woodchips, biomass, bio-oil, and char in a total analysis time of less than four minutes. To meet the needs of the biomass industry, this versatile instrument is also available with sulfur and micro-oxygen add-on modules, as well as both solid and liquid autosamplers.
www.leco.com

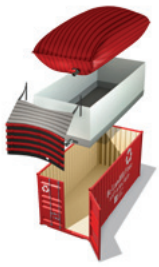
WIKA Instrument Corporation

As a producer of lean manufacturing, WIKA offers a broad selection of stock and custom instrumentation solutions, which are often available for distribution within days. Producing over 43 million pressure gauges, diaphragm seals, pressure transmitters, and thermometers worldwide annually, WIKA's extensive product line provides measurement solutions for any application.
www.wika.com

Wilks Enterprise, Inc.

Wilks Enterprise manufactures rugged, portable, cost-effective analyzers for biofuels, including: InfraCal Biodiesel (FAME) Blend Analyzer, InfraCal Ethanol Blend Analyzer, and InfraSpec VFA-IR Spectrometer. Measurements include ethanol in gasoline, biodiesel in diesel, and production monitoring for FFA and water in feedstock, total glycerides during production, and water in methanol. Easy-to-use with results in less than one minute. Ideal for onsite or laboratory use.
www.wilksir.com

TRANSPORTATION | LOGISTICS



Environmental Packaging Technologies

Environmental Packaging Technologies (EPT) provides innovative bulk packaging solutions for the transportation and storage of liquids and dry flowable products. BIG Red Flexitanks are made in the USA. They safely and cost-effectively convert a 20' container into a 24-ton bulk liquid hauler saving money over tanks, totes, and drums. BIG Red Dry Liners are customized to fit product and equipment needs. Installed in 20' containers, these bulk shipments help save money, reduce waste, and time.
www.eptpac.com

WASTE-to-ENERGY EQUIPMENT & PROCESSING

ADI Systems Inc.

ADI Systems Inc. provides industrial processors with wastewater treatment and anaerobic digestion technologies including low- and high-rate anaerobic digestion, waste-to-energy, biogas treatment and utilization, aerobic and anaerobic membrane bioreactors, and sequencing batch reactors. Solutions from pre-treatment through to producing an effluent suitable for direct discharge and/or water reuse, as well as digestion of waste organic solids are offered. Services offered on a design/build basis.
www.adisystemsinc.com

Peterson Pacific Corp.

Peterson specializes in developing delivery and processing equipment that turns low-grade organic materials into high-value products. The Peterson line of drum chippers are designed for high-volume biomass producers who have a wide variety of feed material, from logs up to 24 inches in diameter to brush and small feedstock. The optional material sizing grates and chip accelerator minimize oversized twigs and branches in the chips, and helps ensure tight chip packing and fully loaded chip vans.
www.petersoncorp.com

R2 Energy Inc.

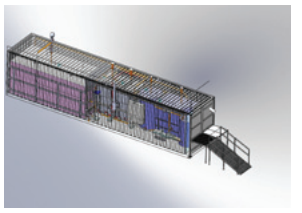
R2 Energy Inc. specializes in renewable alternative energy solutions, utilizing wind, solar, and waste conversion. R2 Energy, Inc. provides expert engineering, fabrication, and assembly of fully automated, turnkey systems. The current R2 Energy, Inc. provides unique engineering, design, and fabrication disciplines all under one roof. The combined staff allows real-time integration of a system design without adversely impacting the originally planned delivery schedules.
www.r2energyinc.com

BIOFerm Energy Systems

BIOFerm Energy Systems is a US provider of dry fermentation biogas technology. BIOFerm delivers turnkey energy solutions that use biomass and organic waste as the primary input. Their technology produces high-quality biogas through a specialized industrial-scale process. This system provides a valuable set of advantages for the client including carbon neutral energy production, system reliability, waste volume reduction, system simplicity, fully automated management control systems, and energy expenditure savings. These attributes make this system ideal for heat and electric energy production solutions and waste management plans that integrate readily with a client's industrial, corporate, agricultural, landfill, composting, institutional, and real estate operations.
www.biofermenergy.com/us

K&K Environmental, LLC

K&K provides equipment systems for shredding, baling, and bale wrapping for waste-to-energy fuel storage and transportation. K&K high-density wrapped fuel bales use the proven Cross Wrap system and are weather tight to allow secure outside storage of plant fuel, and to ensure constant fuel availability. Automated bale opening systems minimize bale handling. Twin shaft slow-speed shredders process biomass and construction waste to increase bale weight and biofuel conversion efficiency.
www.kkenvironmental.com



SEaB Energy Ltd.

SEaB Energy is a UK-based company, which has designed and developed MUCKBUSTER for the distributed micro-energy generation market. MUCKBUSTER is a patent-pending self-contained, small anaerobic digester built in a shipping container. The unit is able to process 400kg of organic or septic waste per day into biogas with fertilizer and animal bedding as by-products. Using a small CHP unit in conjunction with the MUCKBUSTER, users can create their own electricity and heat on site. The product incorporates water recycling to reduce water usage, delivering improved environmental credentials. The MUCKBUSTER can be scaled to larger waste capacities to accommodate a variety of applications. The waste from golf courses, hotels, zoos, equestrian facilities, food shops, and caravan parks are suitable feedstock for the unit.
www.seabenergy.com

Vecoplan, LLC

Vecoplan engineers and manufactures complete alternative fuel systems, including: pre-shredding, separation, screening, air classification, re-shredding, storage, unloading, sampling, and delivery of fuel to its processing destination. Systems are used in the preparation of biomass boiler fuel for co-firing with coal and other fuels, for size reduction prior to gasification, for size reduction prior to pelletizing, and in the conversion process for cellulosic ethanol and other biofuels. Vecoplan shredders provide consistently sized feedstock, the flexibility to change the size desired, high throughputs, heavy-duty construction, low cost, and easily replaced wear parts. Vecoplan is experienced in wood, corn stover, switch grass, miscanthus, any ag fuel crop, and all organic matter used as alternative fuel.
www.vecoplanllc.com

Warren & Baerg Manufacturing, Inc.

Warren & Baerg Manufacturing, Inc., founded in 1966, has years of experience in the biomass and waste industries. They manufacture densifying/cubing systems, which convert various types of grasses, paper, cardboard, plastic, wood, and sludge into high-density cubes for fuel—a clean alternative to coal. They also manufacture biomass grinders, metering/surge bins, small to large conveyors (chainbelt, slider-bed, roller chain, trough belt), and magnet systems, as well as provide engineering services and plant design.
www.warrenbaerg.com

OTHER

Auction

Maas Companies

Maas Companies sells ethanol, biodiesel, and alternate energy plants and equipment via Orderly Negotiated Sales and/or Auction. They are experienced in customizing successful marketing plans that will market surplus assets for maximum price recovery. Maas utilizes top industry consultants and engineers from around the world, and has a unique clientele of buyers from which to draw.
www.maascompanies.com

BioTechnology

ArborGen

ArborGen is a developer of biotechnology tree seedling products, and one of the largest providers of conventional and technology enhanced seedlings to the forestry industry. With more than 50 years of tree improvement research and combined expertise in forestry, ArborGen is developing products designed to meet the challenges facing the global commercial forestry industry.
www.arborgen.us

Buildings

ClearSpan Fabric Structures

ClearSpan Fabric Structures provide design-build solutions for the clean energy industry, including biomass pellet manufacturing facilities, materials storage, and other onsite facilities. ClearSpan buildings feature spacious interiors without support posts, which allow equipment and vehicles to maneuver easily. With minimal foundation requirements, the structures can be permanent or temporary, and are easy to relocate. Made in the USA, they can be built to any length and up to 300' wide.
www.clearspan.com

Environmental Education

Royal Roads University - School of Environment & Sustainability

Royal Roads University's School of Environment and Sustainability is aimed at professionals who understand the implications of human actions on the living world around us. Students undertake research to advance capacity building, collaboration and organizational effectiveness, environmental protection, pollution mitigation, and resource stewardship. Royal Roads University is committed to applied, problem-solving research that supports partnerships with communities, business, industry, and the public sector. This results in innovative responses to complex ecological, social, and economic issues. They offer a unique model that combines online and on-campus learning allowing students to balance career with family life.
www.royalroads.ca

Environmental Monitoring Equipment

MonitorTech Corporation

MonitorTech Corporation Supplies their own Continuous Emissions Monitoring Systems (CEMS) for ethanol, bio-diesel, biomass, heaters, SCR's, and turbines. The MT100 is uniquely suited to these applications and provides the best technology, at the lowest cost and lowest site preparation in the industry. The MT100 is compact, self-contained, easy to install, and does not require a pristine controlled environment. MonitorTech provides ongoing services such as quarterly CGA audits, stack emission reports and maintenance, as well as yearly RATA tests and yearly maintenance. The company also services competitors' equipment and offers used equipment for rent or sale from competitors that have replaced. MonitorTech is a complete turnkey provider of CEMS and services.
www.monitortechgrp.com

Moisture/Ash Analysis

Arizona Instrument LLC

Computrac rapid loss on drying instrumentation from Arizona Instrument LLC has proven to provide a more desirable method of moisture measurement when compared to traditional loss on drying techniques. It addresses the drawbacks associated with conventional loss on drying and maintains the ease-of-use application. The reduction in test times increases manufacturing efficiency, reduces, energy costs, and provides real-time moisture measurements, helping users optimize moisture measurement methods.
www.azic.com

Spark Detection

GreCon, Inc.

GreCon Spark Detection – Extinguishing Systems, as a preventative measure, can reduce the risk of fires and dust explosions in production equipment, dust collectors, and conveying systems. Sensors detect sparks or embers and automatically activate countermeasure to release a fine mist of water downstream, extinguishing without interrupting production, and greatly reducing risk of personnel injury, equipment damage, or downtime. Outlined in NFPA 69, 654, and 664 standards, as well as Factory Mutual Approved.
www.grecon-us.com

Water Treatment

US Water Services, Inc.

US Water Services is a water treatment company that provides integrated solutions combining engineering, equipment, chemicals, and services. They can help find optimal solutions for challenging water, energy, and compliance problems.
www.uswaterservices.com

High Power From Low Temperature

Organic Rankine Cycle geothermal power plants show promise for the future

By Behrooz Ershaghi, Ph.D, Reza Agahi, Ph.D & Susan Bouvette, M.A.

Stillwater (Enel) near Fallon, Nevada.

Geothermal power plants are considered baseload energy sources, producing energy at a constant rate at a relatively low cost per kilowatt (kW). Geothermal is among the few clean, baseload renewable energy sources available, and is of growing interest to utility companies.

Growth of geothermal power in the past few years has primarily been due to global green energy policies and advancements in technology—from core drilling to energy conversion packages. Another growth factor has been the various incentives legislated by different countries. Examples of this in the United States include the US Production Tax Credit (PTC) and the American Recovery and Reinvestment Act. According to a recent GEA 2011 report*, geothermal energy exploration and production is spreading throughout the US, and is no longer limited to the western hydrothermal reservoirs.

To date, the majority of geothermal electrical power is produced in California and Nevada. But there are more than 100 future projects under development across the nation. Based on the GEA report, the current total installed electrical capacity in the US is approximately 3,100 MW, which is equivalent to powering more than two million homes. The world total geothermal power production is approximately 11 GW. According to a recent US geological survey, however, there's potential for more than 100 GW of electrical energy form geothermal resources. Most developing projects to date are from moderate- and low-temperature sources.

Low-temperature geothermal uses

Depending on the region and depth, a geothermal resource can be at a high temperature, above 932° F (500° C), or at a moderate or low temperature of 300° F (150° C), or less. This thermal energy is continuously recharged by magma, hot rocks, and sedimentary reservoirs, which classify geothermal as a renewable energy source.

Low-temperature geothermal resources are typically utilized in direct-use applications such as greenhouses, district heating, fisheries, and industrial process heating. However, some low-temperature resources can be harnessed to generate electricity incorporating the binary cycle electricity generating technology.

Low-temperature geothermal resources are widely available. Power generation and unit installations have doubled in the US over the past 15 years. Because they are so plentiful, low-temperature resources have the potential to contribute largely to the national geothermal portfolio.

The Organic Rankine Cycle (ORC)

The Organic Rankine Cycle (ORC) is the most common method used to recover electrical energy from moderate- or low-temperature geothermal resources. To produce electricity, the geothermal fluid (brine) heats and evaporates a low-boiling point organic fluid in an evaporator. Then, the turboexpander extracts energy from the heated fluid, reducing its pressure and temperature. The working fluid cools, condenses, and is pumped back to the evaporator. This system is a fully closed-loop binary system.

There are several geothermal ORC power plants in Nevada and California that have been in operation for more than 30 years. Examples of the most highly efficient installations are the Enel air-cooled geothermal ORC plants (Stillwater and Salt Wells) located near Fallon, Nevada. These plants were commissioned at the end of 2009, and are equipped with six 15 MW power trains with radial inflow turboexpanders. The machines produce between 65 MW to 85 MW of electrical power during the summer and winter seasons, respectively.

Turboexpanders & ORC systems

The turboexpander is an essential component in the ORC system. Turboexpanders are engineered, designed, and assembled precisely for this specific application, and are optimized for peak efficiency to maximize total electrical power output. Turboexpanders with variable inlet guide vanes (IGVs) are able to cope with a wide range of operating conditions, including resource temperature and ambient temperature fluctuations. The ambient temperature variations can change the condenser's pressure, as well as the turboexpander discharge pressure.

The turboexpanders in the Salt Wells and Stillwater geothermal power plants are operating with a pressure ratio ranging form seven to 10, and a measured peak efficiency of 90%. Radial turboexpanders are the preferred solution for ORC due to the machine's variable geometric design and the capability for a wide operating range without a significant drop in performance.

The capacity of a geothermal power plant is primarily dependent on resource flow/temperature, economics related to an optimal size, available standard equipment, and local regulations and policies. Like any other industrial installation, larger geothermal plants are more cost-effective and competitive due to the economies of scale. For operational flexibility, however, parallel trains are usually considered. Radial turboexpanders with a capacity up to 15 MW are currently in operation. Larger sized expander technology is currently under development for up to 25 MW per expander stage. Innovations in variable IGV design, improved sealing systems, and the increased choice of working fluids have led to improvements in overall cycle efficiency. Smaller geothermal plants (less than 5 MW) may utilize more standard packages equipped with radial turboexpanders.

Geothermal growth

Currently there are 24 countries generating energy from geothermal resources, and another 11 are in development. The US tops this list, currently producing about 3,100 MW of geothermal energy, as mentioned above. Other major producers include the Philippines (1,970 MW), Indonesia (1,197 MW), and Mexico (958 MW). Possible future geothermal projects are also planned in Indonesia, Turkey, Chile, Argentina, Russia, Central America, south Philippines, and more in the States. According to the potential developments, world geothermal energy is expected to grow to three times of the present capacity by 2020.

** References available upon request.*

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Cost-effective Geoexchange Systems

By Ed Lohrenz, B.E.S., CGD

DESIGNING A MECHANICAL SYSTEM for a home or even a complex commercial building can become routine. Rules of thumb are created to make it simple and easy to design a system. Divide the area of the building by 350 square feet, and the cooling load calculation is complete. Using rules of thumb to design a system, however, doesn't foster the creativity needed to optimize the design of a Geoexchange* system.

The cost difference between a Geoexchange system and a conventional heating, ventilation, and air conditioning (HVAC) system is typically the cost of the ground heat exchanger. A Geoexchange system is a mechanical system connected to a ground heat exchanger (GHX). A GHX is simply a grid of plastic pipe buried in the earth with heat transfer fluid circulating through it. Heat pumps warm or cool the building, and transfer energy to or from the ground using the fluid circulating between the building and the GHX. For most building owners, the higher cost of a Geoexchange system must be recovered within a few years, or it's not selected. Therefore, it's critical the GHX is not too large, yet large enough that it will operate sustainably for the life of the building.

It's important to understand, however, the ground around the GHX piping doesn't provide an endless supply of energy, nor will it absorb heat indefinitely. About half the solar energy hitting the earth's surface above a GHX is absorbed into the ground, providing new energy to the ground heat exchanger. Some heat rejected to the GHX will dissipate to the cold winter air. Some energy will migrate from the deeper earth to the ground around the GHX. But, in reality, a ground heat exchanger should be considered a leaky storage medium—or kind of a "leaky bucket."

This means if more heat is extracted from the GHX than is rejected, the temperature of the ground will drop in time, unless enough solar energy is absorbed or enough heat migrates to the GHX field from the deep earth. If the energy loads to and from the ground are balanced, the system doesn't have to rely strictly on solar and deep earth energy migration to operate well over time.

What does this mean for a designer?

Building owners want to be "green," but only if there's a reasonable return on their investment. To optimize a Geoexchange system, a designer must work closely with the building owner and the design team to balance the energy loads as much as possible.

Some things to review include:

- Energy recovery from exhaust air can reduce peak heating loads and annual energy loads by 40% to 50%.
- CO_2 sensors activate fresh air supply to a building as required.
- Peak cooling loads and annual cooling energy loads can be reduced by as much as 25% with appropriate window specifications. Reducing solar gain increases heating loads and can help balance loads.
- Solar shading reduces heat gain and improves the energy balance.
- A white or green roof reduces cooling loads.
- Efficient lighting reduces heat gain and reduces cooling loads and electrical consumption.
- Domestic hot water loads increase heating loads in a building and help offset high cooling loads.
- Waste heat from refrigeration systems can be rejected to a GHX to offset heating loads.

Other options may be appropriate for specific projects to help reduce and balance the energy loads to the GHX. It's possible to achieve energy balance, but only by working closely with the owner and design team in an integrated design process, and spending the time to run several iterations of the energy model.

For a typical 120,000-square-foot retail store, three iterations of the energy model reduced the simple payback of a Geoexchange system from eight years to less than four. In this case, three iterations of the energy model were completed, including:

- Standard building without heat recovery from the exhaust air.
- The same building, but with heat recovery from exhaust air.
- The same building, but with heat recovery from exhaust air and high-efficiency lighting.

Impact on the size and cost of the GHX for each option…

	Feet of Borehole	Land Area (square feet)	Estimated Cost
Current Standard – no HRV	45,540'	133,305	$410,000
Better Building – HRV	42,240'	162,600	$376,000
Better Building – HRV & HE Lighting	28,800'	86,600	$259,000

Adding heat recovery from exhaust air added $1.80 per square foot to the capital cost. Adding high-efficiency lighting added $1.00 per square foot to the building cost. Reduced cost of the GHX and land area needed to build it, however, offset the additional building cost.

The overall impact…

	Heat Pump Equipment	Heat Recovery Ventilation	High-Efficiency Lighting	Ground Heat Exchanger	Total System Cost
Gas Rooftop	$864,000	$0	$0	N/A	$864,000
Geo System 1	$578,000	$0	$0	$430,000	$1,008,000
Geo System 2	$493,000	$225,000	$0	$376,000	$1,093,000
Geo-System 3	$417,000	$225,000	$120,000	$268,000	$1,030,000

Left: *GHX pipes being inserted into a borehole for the first North American IKEA Store with a GeoExchange system currently under construction in Centennial, Colorado—130 boreholes drilled to a depth of 500' will provide the heat source and cooling for the 400,000-square-foot facility.*

Right: *Approximately 750 homes and commercial buildings will eventually be connected to a large horizontal GHX currently under construction in Gibsons, British Columbia. Homes in this climate require more heating and will extract more heat from the ground heat exchanger (GHX). Commercial buildings require more cooling and reject more heat to the GHX. Being connected to the same GHX benefits them both…it's a synergistic relationship.*

Projected energy cost savings increased from $17,300 annually to $41,700, and reduced the land area needed to construct the GHX by 35%. Developing a solid understanding of the building and how it will be used by working with the entire team in an integrated design process provides the owner with the information needed to make an informed decision.

Using Geoexchange to leverage other renewables

An efficient building with a Geoexchange system consumes less energy than the same building with a conventional HVAC system. Renewable energy supplied to a building with a Geoexchange system, be it generated by wind, sun, or biomass, provides a much higher percentage of the energy used in the building. One unit of purchased energy moves four to five units of free energy to heat the building or produce hot water. With careful system design, most of the energy removed from the building to cool the building can be used directly to heat another part of the building or produce hot water, or it can be stored in the ground and withdrawn later.

A good energy model, combined with a creative design team, is the first and single most important step in the design process for a cost-effective and efficient Geoexchange system. Rules of thumb have no place in the design of renewable energy systems.

* **Note:** *GeoExchange™ is a registered trademark of the Geothermal Heat Pump Consortium, an industry trade association. The term is their attempt to find a single name for the geothermal heat pump industry.*

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Pumped Storage Hydropower

Providing reliable storage for wind

By Rick Miller, P.E.

THE UNITED STATES Department of Energy (DOE) recently projected that in order to meet a national goal of obtaining 20% of our electricity from wind generation by 2030, utilities must integrate some 300 GW of wind generation onto the grid. To accommodate the variability of this new wind generation, an estimated 50 GW of new peaking generation, probably from natural gas, would be needed, according to the DOE. However, new generation is not the only way to address this need. In its December 2008 report to DOE, the Electricity Advisory Committee advocates using storage to provide some of this capacity, rather than new-generation sources. Pumped storage from hydropower offers a proven, reliable storage method.

What is pumped storage hydro?

Pumped storage is a type of hydroelectric power generation that stores energy in the form of water in an upper reservoir, pumped from a second reservoir at a lower elevation. Historically, it has been used to balance load on a system, allowing large, thermal-generating sources to operate at optimum conditions. Pumped storage is the largest capacity and most cost-effective form of grid-energy storage currently available.

Pumped storage systems also provide ancillary electrical grid services such as network frequency control and reserve generation. This is due to the ability of pumped storage plants, like other hydroelectric plants, to respond to load changes within seconds. Pumped storage is now being applied to firm the variability of other renewable power sources such as wind and solar generation. It can absorb excess generation (or negative load) at times of high output and low demand, and release that stored energy during peak demand periods, enabling wind power's growing penetration into the United States energy supply system.

The critical need for energy storage

Increasing bulk energy storage capacity has not been a priority of utility planners or energy legislation in recent decades. Since many utilities de-regulated in the 1990s, the industry has had no mechanism or incentive for coordinated integration of new-generation storage and transmission. Yet, these three components of a reliable energy

generation and transmission system require coordinated long-term planning.

Nevertheless, the demand for renewable generation continues to grow. Washington and Oregon are among 29 states that have enacted Renewable Portfolio Standards requiring that renewable sources represent a certain percentage of new generation brought online. Climate policy initiatives are also driving investment in renewable sources. This has created rapid growth in variable generation, such as wind and solar, but there has been no corresponding storage or transmission planning. As a result, in areas such as Texas, California, and the Pacific Northwest, there's excess energy from wind without corresponding demand at times when the electricity is available (typically occurring at night). Alternatively, there isn't enough peaking power supply to provide on-demand capacity when the wind and solar plants cannot generate.

Many advocates of increased renewable generation point to Denmark as the example for integrating large amounts of variable generation and, similarly, how it can be adopted by the US. The key point that's overlooked, however, is the Denmark transmission system doesn't provide its own system balancing services—the two systems (East and West) depend on interconnections with Germany and Norway, countries that are rich in pumped storage and conventional hydro, respectively. Moreover, research has shown a direct correlation between wind generation and power flow over the interconnections with hydro and pumped storage being the generation source to balance wind's variability (Mason 2005; Sharman 2005; White 2004; VTT 2007).

With the emergence of new renewable technologies and the ever-increasing investment in variable generation sources, the need for storage has never been greater.

Reaching the 20% goal

Pumped storage hydro projects are critical transmission system tools, currently providing crucial storage, generation, and ancillary services throughout the US. In response to the growing need for storage, and the exceptional synergy between pumped storage and variable renewable energy sources such as wind, the hydro industry is proposing to more than double the pumped storage capacity in the near future. The Federal Energy Regulatory Commission recently issued 23 preliminary permits for new pumped storage hydro projects, representing approximately 15 GW of new pumped storage capacity. Another 15 applications for preliminary permits were pending before FERC could provide an additional 16 GW of capacity.

With its current proposals the pumped storage sector of the hydropower industry is poised to fulfill an estimated 30% to 60% of the storage capacity needed to meet the national 20% wind initiative. This would reduce the need for additional fossil fuel derived peaking generation and avoid the greenhouse-gas emissions associated with those resources. Importantly, by directing investments in new energy infrastructure to storage facilities that would be used at or near capacity—while also providing many ancillary benefits—we would avoid investing in large fossil fuel generation sources that operate only a fraction of the time.

Rick Miller, P.E., is a senior VP and national client director of the Hydropower Division of HDR, as well as the past president of the National Hydropower Association.

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National Hydropower Association | http://hydro.org

events**calendar**

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08-10 Distributed Solar East 2011
Hilton Newark Penn Station Hotel—Newark, New Jersey
www.infocastinc.com/index.php/conference/dsolar11

8-11 SEL Modern Solutions Power Systems Conference
Hilton Chicago—Chicago, Illinois; www.selinc.com/Events/Modern_Solutions

14-16 EnergyOcean International 2011
Holiday Inn By the Bay—Portland, Maine: www.energyocean.com

15-16 West Coast Energy Management Congress
Long Beach Convention Center—Long Beach, California: www.energyevent.com

15-16 Intersolar Europe
New Munich Trade Fair Centre—Munich, Germany
www.intersolar.de

19-24 IEEE Photovoltaic Specialists Conference
Washington State Convention Center—Seattle, Washington
www.ieee-pvsc.org/PVSC37

21-22 11th International Biogas Networking Conference (Biogas USA East)
Summit Executive Centre—Chicago, Illinois: www2.greenpowerconferences.co.uk

29-30 5th Annual Concentrated Solar Power Summit
Mirage Resort & Casino—Las Vegas, Nevada; www.csptoday.com/usa

JULY

12-14 Intersolar North America
Moscone Center—San Francisco, California; www.intersolar.us

19-22 HydroVision 2011
Sacramento Convention Center—Sacromento, California; www.hydroevent.com

20 GEA Geothermal Energy Finance Forum
San Francisco, California; http://thinkgeoenergy.com/events

26-27 Biomass '11: Renewable Power, Fuels & Chemicals Conference
Alerus Center—Grand Forks, North Dakota; www.undeerc.org/Biomass11

SEPTEMBER

05-09 26th European Photovoltaic Solar Energy Conference & Exhibition
CCH: Congress Center—Hamburg, Germany; www.photovoltaic-conference.com

12-14 4th Annual Utility Scale Solar 2011
San Diego, California; www.infocastinc.com/index.php/conference/525

14 CanGEA Annual Conference Exhibition & Investment Forum
Toronto, Ontario; www.cangea.org

20-22 RETECH 2011
Walter E. Washington Convention Center—Washington, DC; www.retech2011.com

27-28 Optimizing Wind Power Performance – in a Post Warranty Environment
Chicago, Illinois; www2.greenpowerconferences.co.uk

12-13 AWEA Wind Power Supply Chain Workshop
Des Moines, Iowa; www.awea.org

14 CanGEA 3rd Annual Geothermal Investment Forum & Networking Event
Toronto, Ontario; www.cangea.ca

15-17 AWEA Small and Community WINDPOWER 2011 Conference & Exhibition
Des Moines, Iowa; www.awea.org

OCTOBER

03-06 CanWea 2011 – 27th Annual Conference & Exhibition
Vancouver Convention Centre—Vancouver, BC; http://canwea2011.ca

11-12 BioGas West
San Francisco, California; www2.greenpowerconferences.co.uk

16-19 Electrical Energy Storage Applications and Technology (EESAT)
Marriott San Diego Hotel & Marina—San Diego, California; www.sandia.gov/eesat

17-20 Solar Power International
Dallas Convention Center—Dallas, Texas; www.solarpowerinternational.com

23-26 GEA Geothermal Energy Expo 2011
Town and Country—San Diego, California; www.geothermalenergy2011.com

25-27 2011 Algae Biomass Summit
Hyatt Regency Minneapolis—Minneapolis, Minnesota; www.algalbiomass.org/events

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