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Moving to the Distributed Utility of the Future

Electric assets represent one of the largest categories of private investment in the United States, with investor-owned electric utilities having committed more than \$540 billion. As such, utilization of these assets is critical to the economic health of the country.

While market forces have recently enabled higher capacity factors for generation, transmission and distribution (T&D) assets remain underutilized. Load factor, a common measure of utilization, ranges on average from 50 to 60 percent. A load factor of 70 percent is achieved only 10 percent of the time, coinciding with seasonal peaks in customer demand.

These figures represent only part of the story, since the traditional view of delivery stops at a regulatory boundary known as the meter. Electrons don't recognize the difference.

The delivery infrastructure in place today was designed for an analog society, as well as the reliability needs and communications capabilities associated with such a model.

As customers move toward a digital society, utilities must adapt to support them.

To improve utilization of utility assets and to provide the service levels required by tomorrow's consumers, utilities need a new operating model: a distributed utility system for the future, where proven and emerging technologies such as electronic controls, grid management systems and distributed generation create more value for all participants in the network.

This model encompasses more than technology, however. It also represents a better way for utilities and customers to collaborate on responsibilities such as the shifting, shaping and management of load. The value created by this collaboration will be more than enough to reshape the industry and have a broader impact on society. For example, one of the key sources of value is managing risk in volatile commodity markets, particularly wholesale electricity and natural gas markets. Customers accustomed to life with traditional, bundled utility rates are unfamiliar with the risk exposure of their utilities. And as volatility

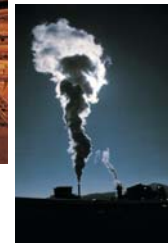
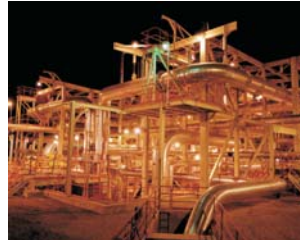
continues, the cost of exposure to this risk, or the cost of mitigating it, will eventually be passed on to them. In deregulated markets, and the increasing number of markets with regulatory mechanisms that more quickly pass through fuel price increases, risk mitigation is emerging as a primary concern of customers.

Implementing the capabilities for customers to participate in demand response will help mitigate these risks as price signals align the interests of customers with those of the utility and enable both parties to take action. These capabilities range from simple controls installed on residential air conditioners that enable the utility to reduce load at peak times, to sophisticated energy-management systems for commercial buildings programmed to respond to real-time prices.

Another example of collaboration is in accelerating the adoption of renewables. From a utility perspective, this can be a means of hedging fuel price volatility and meeting environmental targets. From a customer perspective, participation in green tariffs supports this type of supply planning and, depending on the structure of the tariff or contract, provides a hedge to fuel price adjustments.

Two additional benefits for utilities are improvements in efficiency and risk management. Distributed renewable investments can also provide benefits in utilization of distribution assets, improved reliability and a significant reduction in line losses from more distant central station generation. Distributed generation can assist in both of these areas by moving generation closer to demand. This move would serve to reduce line losses, defer major capital investment and improve reliability. "Demand Response" programs using new metering and communication applications can enable aggregation of customer loads into "virtual peakers" that can be deployed during times of high prices.

Finally, from an overall risk perspective, this approach is a much more robust solution for utilities. Traditional tariff structures subject utilities to market price and environmental risks. From a technological standpoint, a more diversified supply portfolio including much smaller resources (i.e., customers) also reduces the risks of large, single investments.



Designing the Utility of the Future

Evolution of technology is often seen as a barrier. It is not. Proven technologies applied in new ways can yield significant benefits. Although the full realization of the utility of the future requires two-way communication, there is a wide range of e-services that could be offered today without any upgrade at all. The real obstacle to implementation of tomorrow's delivery system is cultural. But the transformational nature of this model is compelling.

We look at culture as the combination of three factors: inspired leadership, engaged employees and disciplined performance management.

- Inspired leaders grasp the transformational aspects of the model.
- They engage employees, who develop new skills along with the implementation.
- Performance management aligns the organization and rewards success.

One key area of cultural change is in developing a better understanding of customers. Utility culture is traditionally focused on infrastructure.

Without a strong partnership with customers, the technology investment will never realize its potential.

At Great Plains Energy, we have taken several steps to improve our partnership with customers. We started by including customers, community leaders and regulators in a comprehensive strategic planning approach. Within Kansas City Power

& Light, our regulated utility, the partnership has continued through focus groups, community meetings, regulatory workshops and a newly chartered team of customer, community and utility participants. These developments have led to energy efficiency and demand-response programs in the context of a comprehensive regulatory agreement.

Better understanding of customer needs will lead to a new level of dialog that will improve program design and implementation. It will also create a positive cycle of reinforcement for change in utility culture. Employees working directly with customers, and learning along with them, will be more engaged and ultimately become more inspired leaders of others. This cultural change will break down traditional silos, just as new technology eliminates the traditional distinction

between the two sides of the meter.

A winning utility culture will also drive change in the culture of utility commissions. Change begins by creating a level of trust and shared understanding that enables the early steps. These steps include "partnership payments," often in the form of free, smart thermostats, subsidized distributed generation and upgraded commercial energy-management systems.

As regulators see the benefits and the positive customer response, they will create new incentives and mechanisms that will further accelerate

adoption. These can include treatment of program costs in rate base, incentive payments and higher returns.

Across the industry, companies are taking steps to implement this new model. The ones that will be the first to realize the vision will be the ones that start not with technology or regulation, but with changing their culture.

*Michael Chesser, Chairman and CEO,
Great Plains Energy*

Source: World Energy Source

Distributed Generation Hybrids

The National Energy Technology Laboratory (NETL), in partnership with private industries and others, is leading the development and demonstration of high efficiency solid oxide fuel cells (SOFCs) and fuel cell/turbine (FCT) hybrid power generation systems. These are promising systems offering possibly the only option for meeting the DOE's efficiency goal for advanced coal based power systems of 60 percent (HHV) for fuel-to-electricity, with near zero emissions and competitive costs for multi-MW class central power plants.

Fuel Cell/Turbine Hybrid Systems

A fuel cell is a device that uses hydrogen (or hydrogen-rich fuel) and oxygen from air to create electricity by an electrochemical process without combustion. The absence of the combustion process eliminates the formation of pollutants including NO_x , SO_x , hydrocarbons and particulates, and significantly improves electrical power generation efficiency. Further efficiency gains are realizable by integration of a turbine with the fuel cell.

In the direct operating mode, the fuel cell serves as the combustor for the gas turbine. Residual fuel in the already high temperature fuel cell exhaust mixes with the residual oxygen in an exothermic oxidation reaction to further raise the temperature. Both the fuel cell and the gas turbine generate electricity, and the gas turbine provides some balance-of plant functions for the fuel cell, such as supplying air under pressure and preheating the fuel and air in a recuperator. In the indirect mode, the recuperator transfers fuel cell exhaust energy to the compressed air supply, which in turn drives the turbine. The expanded air is supplied to the fuel cell. The indirect mode uncouples the turbine compressor pressure and the fuel cell operating pressure, which increases flexibility in turbine selection. Critical issues are the integration of pressure ratios and mass flows and the dynamic control through start-up, shutdown, emergency, and load-following operating scenarios.

The application of fuel cell systems and ultimately FCT hybrids is limited by the high cost of the fuel cell. To address the cost issue, the DOE is implementing the Solid-State Energy Conversion Alliance (SECA) program. The SECA program is dedicated to developing innovative, effective, low-cost ways to commercialize SOFCs. NETL is partnering with Pacific Northwest National Laboratory in developing new directions in advanced materials, processing and system integration research under the SECA initiative for the development and commercialization of modular, low cost, and fuel flexible 3- to 10-kWe SOFC systems by 2010.

DOE has estimated that a 5-kWe planar SOFC system can reach \$400/kW at reasonable manufacturing rates. With this low-cost, the SOFC has the potential to move out of limited niche markets into widespread market applications. SECA developed technologies will provide the basis for the development of SECA-based SOFC FCT hybrid systems that achieve 60 percent electrical efficiency and near zero emissions when integrated in FutureGen power plants.

SOFC Hybrid System for DG

The Hybrid Power Generation Systems Division of General Electric is collaborating with NETL to develop SOFC/gas turbine hybrid systems for distributed power generation applications. The objectives for this project are to analyze and evaluate SOFC/gas turbine system concepts. Technical barriers in pressurization and scale-up of preliminary design concepts will be resolved for both the feasibility demonstration system and the conceptual system. A preliminary design for high-temperature heat exchangers for hybrid system applications has been developed, and pressurized operation of SECA-type planar SOFC stacks has been demonstrated. The SOFC is based on thin-film electrolyte technology fabricated with the tape calendaring method and thin-foil metallic interconnects leading to a low-cost, high-performance, compact planar SOFC. The gas turbine is based on commercial products. The

proposed hybrid system has a potential for efficiency greater than 65 percent.

A 220-kWe FCT hybrid demonstration was recently completed through a multi-year collaborative effort led by Southern California Edison in partnership with Siemens-Westinghouse Power Corporation (SWPC), NETL, and the University of California at Irvine's National Fuel Cell Research Center.

The project was the world's first demonstration of a pressurized SOFC generator, and the world's first demonstration of a SOFC coupled with a microturbine generator (MTG). The SOFC stack was contained in a pressure vessel and operated at 3 atmospheres (absolute) pressure and a temperature of 1000°C. The hot, high-pressure exhaust gas from the SOFC generator drove an Ingersoll-Rand 70-kWe MTG. The SOFC stack produced 170-kW DC and the MTG produced 20-kW net AC. The system accumulated more than 3,200 hours of run-time, while operating at a calculated net AC electrical efficiency of 53 percent. Pre-commercialization efforts by SWPC are being redirected to smaller sizes for combined heat and power applications.

300-kWe Atmospheric Hybrid Demonstration

DOE/NETL and FuelCell Energy (FCE) are working collaboratively to develop and demonstrate an atmospheric molten carbonate Direct FuelCell/Turbine (DFC/T) hybrid system. To date, the R&D efforts have resulted in significant progress in validating the DFC/T cycle concept. FCE has completed successful proof-of-concept testing of a DFC/T power plant based on a 250-kWe DFC integrated initially with a Capstone 30-kWe and then a 60-kWe modified MTG.



Photo: www.fuelcellenergy.com

The sub-MW system tests have accumulated over 6,800hrs of successful operation with efficiency of 52 percent. This proof-of-concept demonstration has provided information for the continued design of a 40-MWe DFC/T power plant that is expected to approach 75 percent efficiency (LHV natural gas), as well as to serve as a platform for optimization of sub-MW class DFC/T hybrid systems.

One of the significant challenges for this technology is the development of high temperature heat exchangers that offer differential pressure operation. Pre-commercial sub-MW alpha and beta units will be demonstrated over the next two years.

Hybrid Performance Simulation Facility

Researchers at NETL have completed shakedown of an experimental facility capable of physically simulating the dynamic operation of a FCT hybrid system. The objective of the Hybrid Performance (Hyper) project at NETL is to conceptualize, simulate, analyze and demonstrate critical operability issues inherent in hybrid fuel cell systems.

The hardware-in-the-loop simulation facility enables researchers to identify dynamic issues related to the interdependencies of fuel cell and turbine technology integration without risk to expensive fuel cell stacks. This is accomplished by operating a burner with a real-time control algorithm that mimics the expected dynamic behavior of an SOFC stack. In this manner, the remaining integration/control functions can be optimized before operating with a fuel cell. This approach will allow the development of validated models and control architectures that can avoid potential issues with load following and load shedding scenarios.

The facility will ultimately accommodate a variety of fuel cell gas turbine configurations, but will initially focus on a direct-fired solid oxide fuel cell gas turbine configuration. The planned experiments for the facility are being carried out in the following four phases: Phase 1: Speed Control and System Characterization; Phase 2: Fuel Cell Simulation; Phase 3: Independent APU Speed Control and Load Following; and Phase 4: Integration of a Commercial Fuel Cell.

Battery Storage System Marks Second Year of Operation

Distributed generation technologies can sometimes dramatically enhance the economics and reliability of grid power systems. In August, 2003, Golden Valley Electric Association (GVEA), which serves 90,000 customers across a 2,000 square mile service territory in and around Fairbanks, Alaska, installed the world's most powerful battery energy storage system (BESS). Since then, the system has prevented an average of more than three electrical outages per month.

The battery watering system, one of several systems supplied by Philadelphia Scientific passed its first test in April 2005 when half the batteries were watered for the first time since the system was activated. The other 6,880 batteries were watered in November.

Although back-up power to stabilize the grid and reduce vulnerability to blackout is critical in an area with such harsh weather, but traditional solutions would have required



Photo: www.abb.com



Photo: www.abb.com

building and maintaining transmission and generation capacity well in excess of normal demand. Adequate power is usually maintained through spinning reserve, whereby more power is generated than demanded, which wastes fuel, adds hours of operation to equipment and produces emissions with no corresponding power consumption.

At the heart of the BESS are 13,760 Saft SBH 920 high-performance rechargeable nickel-cadmium cells and an ABB converter, which changes the batteries' direct current into alternating current ready for use in the GVEA transmission system. Arranged in four parallel strings, the cells provide a nominal voltage of 5,000 volts and a storage capacity of 3,680 Ampere-hours. The complete battery weighs approximately 1,300 metric tons and occupies a space measuring just more than 10,000 square feet. The system is configured to operate in seven different modes, the most important being the ability to respond to remote generation trips in the system. Other functions include voltage support under steady state and emergency conditions; power system stabilizer; automatic scheduling; scheduled load increases; automatic generation control, and charging.

With all four battery strings operational, the BESS provides 27 MW for 15 minutes, long enough for GVEA to start up local generation when power delivery from in Anchorage - about 350 miles away - is interrupted. Although the GVEA battery system was initially configured with four strings, it can be easily expanded to six strings to provide 40 MW for 15 minutes. The facility can ultimately accommodate up to eight battery strings, giving flexibility to boost output or prolong the useful life of the system.

Highly reliable and accurate battery monitoring is critical to the operation and maintenance of such back-up battery supply systems. The Philadelphia Scientific monitoring system measures, records and reports module voltage, string current, cell electrolyte level and cell internal temperature. Data collection and transfer are organized hierarchically. The lowest-level

device in the hierarchy is the sentry unit. There is one for each 10-cell module, and its task is to measure the module voltage, cell electrolyte level and cell internal temperature. Each sentry unit reports its collected data to a sergeant module. Every string has its own sergeant module, which also measures the string float current as well the air temperature at the top and bottom of the string. In turn, the

sergeant module reports its collected data to the supervisory computer, which analyzes and displays the data. This computer also forwards summary data to the human machine interface and is the main terminal for personnel who need to access the monitoring system.

Optical couplers carry the data from the sentry units to the data bus, which is insulated to withstand a minimum of 5,000 volts. Approximately 5,560 readings are taken every 30 seconds, for a total of 5.8 billion readings per year. These numbers can be doubled if required.

The batteries were designed to maintain a four-year water reserve. But when water is required, the system must be taken offline during the watering process. That means watering must be done quickly. And if a single cell is missed, the entire system can fail. The Philadelphia Scientific single-point system was six times faster than the next fastest watering system considered, and in testing reliably filled each battery cell to the proper level.

The BESS passed a critical benchmarking test in December 2003 when it produced 27 MW for 24 minutes, exceeding the guarantee of 27 MW for 15 minutes. By March 2005, the system had passed another benchmark. When GVEA first contracted to have the BESS designed, the agreement included an 18-month availability guarantee. The guarantee required that the BESS maintain 98 percent or better availability during its first 18 months of operation. During the 18-month availability guarantee period, the BESS provided a 99.2 percent availability, meaning it was available to pick up load 99.2 percent of the time.

The GVEA BESS earned one other distinction in the first few months of operation when during a test of the system's maximum limit in December, 2003, it discharged 46 MW for five minutes, earning a Guinness World Record certificate acknowledging the BESS as the world's most powerful battery, surpassing the previous record of a 21 MW BESS in Puerto Rico.

Power Engineering January, 2006

Definitions of DG

US DOE I

Distributed power is modular electric generation or storage located near the point of use. Distributed systems include biomass-based generators, combustion turbines, concentrating solar power and photovoltaic systems, fuel cells, wind turbines, microturbines, engines/generator sets, and storage and control technologies. Distributed resources can either be grid connected or operate independently of the grid. Those connected to the grid are typically interfaced at the distribution system. In contrast to large, central-station power plants, distributed power systems typically range from less than a kilowatt (kW) to tens of megawatts (MW) in size.

US DOE II

Distributed energy resources (DER) refers to a variety of small, modular power-generating technologies. DER systems range in size and capacity from a few kilowatts up to 50 MW. They comprise a portfolio of technologies, both supply-side and demand-side, that can be located at or near the location where the energy is used.

Electric Power Research Institute (EPRI)

Integrating distributed energy resources. The new system would also be able to seamlessly integrate an array of locally installed, distributed power generation (such as fuel cells and renewables) as power system assets. Distributed power sources under 20 MW per unit could be deployed on both the supply and consumer side of the energy/information portal as essential assets dispatching reliability, capacity and efficiency. Today's distribution system, architecture, and mechanical control limitations, prohibit, in effect, this enhanced system functionality.

EPRI II

Distributed resources are small generation (1kW to 50MW) and/or energy storage devices typically sited near customer loads or distribution and sub-transmission substations,

American Gas Association

Distributed generation (DG) is the strategic placement of small power generating units (5 kW to 25 MW) at or near customer loads. Situated at a customer's site, distributed generation can be used to manage energy service needs or help meet increasingly rigorous requirements for power quality and reliability. Located at utility sites such as substations, distributed generation can provide

transmission and distribution (T&D) grid support and expand the utility's ability to deliver power to customers in constrained areas. Distributed generation technologies include such resources as industrial gas turbines, reciprocating engines, fuel cells, microturbines, wind-power, and photovoltaics. California Energy Commission

Distributed energy resources are small-scale power generation technologies (typically in the range of 3 to 10,000 kW) located close to where electricity is used (e.g., a home or business) to provide an alternative to or an enhancement of the traditional electric power system.

Toward a Consensus Definition of DR/DG

Taking the common attributes of the preceding definitions, a consensus definition might be:

Distributed Resources (DR) include conservation, load management, and electric generation and/or storage located near the point of use either on the demand or supply side. DR includes fuel-diverse fossil and renewable energy generation (known as distributed generation or DG) with or without waste heat utilization and can either be grid-connected or operate independently. Distributed resources typically range from under a kilowatt up to 50 MW. In conjunction with traditional grid power, DR is capable of high reliability (99.9999%) and high power quality required by a digital society.

Point of Conflict

Wind energy presents a very special case in regard to distributed generation that makes it difficult to categorize. While individual turbines clearly fall within the generally agreed upon size parameters, a wind farm may lie outside the uppermost limit. For instance, is a 300 MW wind farm distributed generation? While it is a renewable source, exceeding the 50 MW upper limit may throw it out of the category. In addition, even if it is below 50 MW, if it is on a contiguous wind farm, it may not be adequately decentralized. Finally, because it may be located in a remote area far from the loads that it will serve, it requires vulnerable and costly transmission. On the other hand, a small wind installation whose loads have the ability to be used locally may satisfy all parameters to be considered DG.

Joel N. Gordes,
Environmental Energy Solutions



Photos: NREL Photographic Information Exchange (www.nrel.gov)

UK Sustainable Energy Bill

A Ballot Bill seeks to promote microgeneration, energy efficiency, renewable heat and renewable power generation and to increase the accountability of Government in respect of its sustainable energy policies.

If passed the bill would put a duty on the Secretary of State (SoS) for Trade and Industry to promote renewable heat and to report annually on measures taken under this duty. It would also provide for a government review which might result in micro-generation technologies being granted permitted development status under planning law outside National Parks, Area of Outstanding Natural Beauty and conservation areas. Electricity suppliers would have a duty to offer a "fair" price for exported electricity from household micro-renewable energy systems and there would be changes to Building Regulations and the Renewables Obligation to promote microgeneration.

A copy of the amended Bill can be viewed at: www.publications.parliament.uk/pa/cm200506/cmbills/133/2006133.pdf

High Temperature Superconductors

American Superconductor Corporation (AMSC) announced the company has been awarded three new government contracts for second generation (2G) high temperature superconductor (HTS) wire and applications development. These contracts, which have a total value of \$1.35 million, were funded under the Department of Defense's Small Business Innovation Research Program (SBIR) and Small Business Technology Transfer Program (STTR), and are expected to be completed over the next two years.

The contracts include a Phase II SBIR contract through the Office of the Secretary of Defense and the Air Force Research Laboratory for basic development of coil technology using 2G HTS wire for military applications such as rotating machines and magnets. For this project AMSC will be working with the Francis Bitter Magnet Laboratory at the Massachusetts Institute of Technology. In a second Phase II contract under a STTR program through the Air Force Office of Scientific Research, American Superconductor will work with Florida State University to develop and test 2G wire for ac losses and quenching in a simulated coil environment. A third contract is a Phase I STTR program, also through the Air Force Office of Scientific Research. This contract, in collaboration with the Applied Superconductivity Center at the University of Wisconsin-Madison, focuses on enhancing the current carrying capacity of 2G HTS wire.

HTS wire offers high power density and high

efficiency compared to conventional copper wire, opening up a broad range of applications in the military and commercial sectors. Military applications include ship propulsion motors, airborne generators and magnets for microwave power sources, while commercial applications include power transmission cables, electric motors and generators, transformers, synchronous condensers and fault current limiters. Electrical systems that incorporate 2G HTS wire are expected to be dramatically smaller, lighter and more cost effective than systems based on copper wire because HTS wire conducts more than 150 times the electrical current of copper wires of the same size.

Voltage regulation system to be deployed in pilot scheme



ScottishPower has announced that it will be running a pilot scheme to introduce point-of-use voltage regulators to deal with low voltage issues. SP Power Systems, a subsidiary of ScottishPower, has announced that it will install 100 Low Voltage Regulators

(LVRs), produced by MicroPlanet of the USA. The intention of the scheme is to improve grid reliability and efficiency.

As part of the agreement, SP Power Systems and MicroPlanet will: develop Microplanet LVRs for use on the ScottishPower network in the UK, deploy and demonstrate how distributed electronic voltage regulation could improve the effectiveness of an existing distribution infrastructure and provide guidance in securing relevant regulatory and EU safety agency approvals.

The technology will help to resolve the problem of utility customers receiving voltage at levels either above or below the design levels, resulting in brown-outs for voltages below design levels or excessive wear on electrical appliances for voltages above design levels. These regulators control the voltage levels actually delivered. Studies have shown that by regulating the incoming line voltage, the average amount of electricity used can be reduced by an average of 10%.

Selling Capacity at Peak

As it has done in New York City for the past four years, ConsumerPowerline (CPLN), a for-profit energy consumer advocacy organization, will be bringing its energy conservation, efficiency and distribution expertise to New England to help

alleviate stresses on the power grid by selling excess electricity back to the market in times of crisis.

The Company is entering New England due to the regional independent system operator's (NEISO's) request for help that was issued by the ISO's Demand Response Working Group, on November 2nd, 2005. CPLN immediately registered to provide system relief. Last week, the New England Power Pool (NEPOOL) Membership Committee voted to admit the firm. CPLN will be working with some of the region's largest energy consumers to prepare for and mitigate against a potential looming winter electricity crisis, due to weather-induced instability in the natural gas and electricity markets.

"Electricity consumers in New England have been living under a cloud since Hurricane Katrina drove up the price of natural gas, fearing that with the coming winter season they will be faced with the potential of rolling blackouts. As we have done with the metro-New York City market, CPLN is going to help large New England power users to earn money by providing load reductions to ensure against blackouts or brownouts at moments when the power supply could be short," said Michael Gordon, founder and President of ConsumerPowerline. "By aggregating massive pools of electricity from our clients, we will be able to create a virtual power plant that the local power company's can tap into on 1/2 hour notice. This electricity can be used to help power homes, businesses, hospitals, etc. across all of New England avoiding the worst of a electricity crunch."

CPLN works by negotiating with local and regional power authorities for capacity energy savings for its clients, sells the extra energy supply back to the independent operators and then splits the revenue with its clients. The client does not pay CPLN for its services, but benefits from real-time data on electricity pricing, enabling them to "buy and sell smart" in the volatile energy sector. They also receive what amounts to free ongoing "energy audits" from the energy advocate, where company experts advise on how to make the facility more energy efficient.

Distributed Generation Certification

ABB applied for Underwriters Laboratory standard certification in late 2004, and received it in 2005. Ravi Dodballpur, Manager, Power Conversion Products, for ABB's Advanced Power Electronics group, indicates how important this certification is, not just in North America, but worldwide. "Customers are looking to ABB for a system that can ensure both worker safety and system reliability. This certification helps further the trust our customers put in our product technology and safety; and they expect it from

ABB, given our role as a global leader in power generation."

The standard UL1741, titled "Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources," is an Underwriters Laboratory (UL) standard essential to the distributed generation market. While UL1741 is only a few years old, the market has adopted it as a requirement for anyone building products and systems for distributed generation applications.

The key parts of this standard involve safety and reliability. UL1741 addresses the safety concern, above other industry standards, for "unintentional islanding." Islanding is the action of separating a power source, from the electrical grid. Unintentional islanding happens when a utility grid is down, for maintenance as an example, and the distributed generation (e.g. a fuel cell stack) may continue to feed the grid.

This scenario has the potential for devastating consequences, as the power lines may still be energised without the knowledge of the utility, and consequently, the maintenance workers. In addition, major equipment can be damaged and the system reliability could be compromised, reducing overall power quality. Therefore UL1741 requires a feature called "anti-islanding" that automatically shuts down the distributed generation site in such a condition.

The other important feature of the UL1741 standard addresses system reliability. By addressing harmonics and power quality, ABB's UL certification assures that the power conversion systems we build in the field of fuel cells, wind power, battery storage or any other distributed generation field, will meet or exceed the highest standards in harmonics and voltage regulation.

"The UL certification is essential to market our power conversion system," notes Kevin Dennis, manager of ABB's Advanced Power Electronics team in North America. "While we already have the most efficient and reliable fuel cell power conversion solution in the market, the UL 1741 certification gives our customers the peace of mind that ABB has the best solution for their needs in the field of distributed generation."

Flywheel Storage System

Beacon Power Corporation, a company that designs and develops advanced products and services to support more stable and reliable electricity grid operation, demonstrated the performance of its scale-power Smart Energy Matrix for journalists from statewide television, radio and print outlets, as well as industry



and wire service reporters. Presentations were given by executives from the California Energy Commission, U.S. Department of Energy, the California Independent System Operator (ISO), and Beacon Power, followed by a close-up demonstration of the flywheel system's capabilities.

"This was a great opportunity to share the story of Beacon's flywheel technology, and the promise it holds for making California's power grid more reliable," said Bill Capp, Beacon Power president and CEO. "We are pleased to see the enthusiasm of visitors to the facility, who can walk inside this scale-power Smart Energy Matrix and see for themselves that this integrated group of flywheels can switch easily and repeatedly from full power charge to full power discharge in a few seconds. They come away with a good understanding of the technology and its performance."

Ken Wiseman, Chairman of the Board of Governors of the California ISO, was one of the speakers. He pointed out that 200,000 new homes are built in California each year. "These homeowners want dependable power, and they expect us to provide it," said Wiseman. "The ISO is very interested in new and better ways to manage the grid, especially with the expected addition of significant new wind generation in the next few years."

One benefit to having the full-power Smart Energy Matrix, which Beacon is looking to build in 2007, available for frequency regulation is that it may free up other conventional generation assets from being used for this purpose. This would enable the state's grid operator (the ISO) to reallocate valuable power plants to deliver power that will help avoid shortages. In addition, California's commitment to wider statewide deployment of renewable energy sources, such as wind and solar, will necessitate even more regulation services because of their inherently variable output.

Dr. Imre Gyuk, head of energy storage programs at the U.S. Department of Energy, praised the collaboration that produced this first-of-its-kind system. "The successful development and delivery of this high-performance flywheel energy storage system is the realization of a vision the Department of Energy shares with the California Energy Commission and the ISO," he stated. "We wanted to prove that flywheel technology has the capability to provide the essential service of frequency regulation. I am most pleased with the results, and I look forward to being able to test the larger, higher-power flywheel that Beacon has begun working on. I also expect that the Department of Energy will be able to continue to support the development of the larger flywheel and its deployment in a commercial-sized Smart Energy Matrix."

The demonstration used a pre-recorded remote signal feed to drive the Beacon system and graphically display a wide range of performance characteristics in a short period of time. The California ISO has been working to establish a

secure data feed to transmit signals from its Energy Management System in Folsom, California (where the grid is operated), to the Smart Energy Matrix. Response to live ISO signal transmission, as well as formal acceptance by the Energy Commission, are expected to take place soon, assuming completion of the communications link and final system-level testing.

Beacon Power is also building a scale-power Smart Energy Matrix demonstration system for the New York State Energy Research and Development Authority (NYSERDA). A recent contract change calls for Beacon to incorporate additional functionality in the system to supply uninterrupted power to the location in Amsterdam, New York. In addition, at the request of the customer the demonstration unit will be modified to be able to provide volt-amperes reactive power, or VARs, which help stabilize the power supply to electrical equipment. It is anticipated the demonstration system will be installed early 2006.

World Alliance for Distributed Energy

After an eventful end to 2005, with a successful annual conference in New York and a strong presence at the international climate change negotiations in Montreal, WADE is looking forward to increased activities in 2006.

To download a copy of its most recent report, entitled "Building Integrated Cooling, Heat & Power For Cost-Effective Carbon Mitigation. 2005 Status and Prospects for Canada, China, India and the USA", see: www.localpower.org/documents_pub/report_de_in_buildings.pdf

WADE is helping organize a one day event focusing on decentralized energy at the Asian Energy Week event in Beijing China (www.asianenergyweek.com).

Also it will be holding the 2nd International DE/CHP conference in Beijing (16-17 May 2006).

The European Union counts on Decentralisation

During the conference on local energy initiatives, which took place at the beginning of February in Brussels, the Cogen Challenge began. For the next 18 months, the project collects and documents technical data and calculations from 1,000 small co-generation facilities (up to 1 MW of electrical capability). This online-overview, together with regional information offices, should answer all questions pertaining to planning and construction of co-generation facilities.

COGENchallenge, which is lead by COGEN Europe, aims at raising awareness for micro and small-scale cogeneration. The web-based information campaign will gradually build up an on-line showcase of 1,000 small-scale cogeneration installations from around Europe to demonstrate

the reliability and adaptability of this technology.

Cogen Europe, a European association for the promotion of co-generation, manages the project, while the city networks Climate-Alliance and Energie-Cites as well as numerous European national institutes provide support.

Owners, operators and suppliers are invited to include their unit by signing up for the campaign.

Biogas on a farm: a farmer as energy supplier



The "Sonnenhof" (sun farm) in the north west of Saarland, Germany, is a farm with 120 "livestock units" (pigs and cows). This is an ideal size for the installation of a biogas plant. The farmer family began with the production of biogas in 1999. In biogas CHPs the electricity is

welcome but the heat represents a kind of by-product which is difficult to place. On the "Sonnenhof" the conditions are different. Because of its size and the heat demand for the integrated slaughterhouse, the heat demand is sufficient and the economic conditions are fulfilled.

The investment sum of €325,000 was raised from grant programmes and bank loans with a duration of 20 years. A return of the capital is insured by the feed in tariffs of the German renewable energy act (EEG) which is 10 cents per kWh electricity.

Presently, the whole installed and approved performance is 90 kWe. 44 kWe are fed in the public grid and the rest is used on the farm itself. The input is 1800 t of sanitised leftovers, 2500 t solid dung and 1000 to 1500 m³ used water from the butcher's shop.

For the future, the owners of the "Sonnenhof" want to enlarge their plant up to 500 kWe with the possibility to enlarge it later once more up to 700 kWe. Then the inputs will be 7000 t leftovers, 6000 t of solid dung and 200 t grass silage. This enlargement of the plant could be realised by different investors and without bank credits.

On the technical level the organic input is mixed with straw which improves the fermentation process and the gas production. The fermenter is a laying steel cylinder with an integrated slow agitator. On a temperature level of 40° C a kind of acid is produced by different microbial strains and based on this the biogas. During this process all smelly and caustic substances are decomposed. The solid residues can be used as fertilizer.

The biogas plant is producing a surplus of electricity which is sufficient for approximately forty households. It also avoids 183 t of CO₂ emissions per year by replacing fossil fuels.

E21 Work Programme 2006

The 2006/07 Programme of Activities from CAE to Promote Distributed Generation/ Distributed Energy Resources

The following programme of activities has been devised after consulting with a variety of organizations and individuals throughout the industry. The programme aims to provide a leadership role on behalf and for the benefit of the wider electricity industry.

Sponsorship is gratefully acknowledged from the following supportive companies/ organizations whose logos are shown on page 12:

Power Hire, Mainpower, Orion Network, Water Care Services, Vector, MED, Power Net, Powerco, WEL Networks.

E21 News Bulletin

This quarterly information publication deals with national and international information and events on the topics of distributed generation/ distributed energy including regular progress reports on the other activities in the CAE "2DG" programme. Articles and information is welcomed. Email contributions to energy21@caenz.com.

Policy Level Advice

Responding to calls for advice on industry matters and preparing briefing papers for the government.

Annual Workshop

In conjunction with The Electricity Engineers' Association annual conference, and supported by the Institution of Engineering and Technology from the UK (formerly the Institution of Electrical Engineers), an annual one-day workshop/ seminar with keynote speakers. The 2006 event will be at the Sky City on the day prior to the annual EEA Conference, 15 June. An announcement will be made soon on the keynote speakers and presentations. Support Group sponsorship (annual fee \$3,750 + gst) includes one free registration to the workshop.

Industry Meetings

Meeting two to three times a year, with site visits and/or invited speakers on current DG activities.

The first meeting for this year will visit several DG locations in Canterbury. Announcement to be made shortly. If you are keen to attend this event please pre-register your interest by email to energy21@caenz.com.

News Items

Electricity Commission Announcements

The Electricity Commission made the following announcements recently:

- The decision on the Whakamaru-to-Otahuhu (Waikato-South Auckland) transmission line upgrade has been put back a month or so to "late April";
- The EC decision on charging the full costs of the HVDC link to South Island generators is now final, but note that (at least for now) the existing HVDC, and not any future extension, is what's involved: the decision is specific to the "Benmore to Haywards" HVDC link;
- Transpower are being asked to review their current "12 peaks" approach to interconnection charges;
- Transpower's connection charges should recover costs from connected parties with no cross-subsidies, and Transpower should develop a consistent and transparent approach for defining "deep connection". A well-developed deep connection policy is desirable if large capacity distributed generation is to capture any sort of locational price advantage from the transmission system.

Deep connection charges, used for instance in the United Kingdom, bring into account all the cost of connection of a generator into the network, including the cost of network adjustments beyond the point of connection. Not only are the cost of deep connection charges usually high, they are also much more uncertain as the cost depends on the actual location, generation capacity and mode of operation. Thus the cost has to be independently assessed for each new project. The methodology of assessing what technical adjustments are necessary and how the cost of these is assessed is quite often non-transparent.

With shallow connection charges a major project developer, aiming to export to the grid, would generally aim to connect to the nearest point to the grid, as this will be the cheapest solution from the project developer's point of view. However, determining the point of connection with deep connection charges is more complicated, because the location-specific cost of grid adjustments will be taken into account both by the generator and the network operator. Both the project developer and the network company will seek to minimize their cost.

In the case of deep connection charges it is important that both the procedures for requesting and negotiating connection and the cost assessment methodology are transparent and non-discriminatory. When they are not transparent, there is scope for discriminatory practices. A number of international case studies provide examples where the grid company has delayed connection. This has partly to do with the lack of clear procedures and partly with the lack of an

incentive structure to stimulate the fast and efficient handling of connection procedures.

Mainpower goes Solar

The MainPower office in Rangiora recently had 83 solar PV panels added to the front of the building. The array, which will generate enough power on average to run all the office's computers, is claimed to be the largest in the South Island and the second largest in the country.

MainPower is also keeping up with solar technology through projects involving the community. These include continuing to monitor results from an array of solar PV panels at the Rangiora High School, which MainPower had installed in 1998, and which was the largest in the country at the time

Fourteen 75W solar PV panels were installed at Oxford Fire Station in December last year. Similar installations will be provided to The St. John's Ambulance depot, Culverden, and Takahanga Marae, Kaikoura.



Ontario unveils feed-in law

The Canadian province of Ontario has become the first administration in North America to introduce a feed-in tariff for electricity generated from renewable sources.

The new law will cover projects built since 1 January 2000 and provides a 20-year guaranteed top-up on each kWh of electricity sold to the grid.

The amount of money received by generators varies depending on the technology, providing a level playing field for technologies which are currently more expensive, such as solar PV. There is no limit on the number of projects which can be built, although each individual project is capped at 10 MW.

The subsidies available to developers are CAN\$0.11 / kWh for wind, biomass and small hydro (although the latter can each receive an additional 3 cents for producing power during peak times). Photovoltaic generation meanwhile receives \$0.42 per kWh. This is on top of the Canadian national subsidies available for renewable projects.

The feed-in law will come into force in Autumn 2006 and be reviewed every two years.

NZ Energy Information Handbook

First published in 1984, the New Zealand Energy Handbook was last revised in 1993. While most of the data in the 1993 edition is still relevant, there have been considerable changes in the New Zealand energy scene in the intervening years. For this reason work has now started on a completely new edition, which is scheduled to be released later this year.

As with the preceding editions, the intention is to bring together in a single, concise, ready-reference format basic technical information describing New Zealand’s energy resources and current energy commodities.

Currently in the planning stage, comments on current and potential content or on the scope of the new volume would be welcomed by the editors. Comments can be sent to: energyhandbook@caenz.com.

BP tops leaders versus laggards chart of climate change response

After years of inaction, a growing number of leading companies are confronting the business challenges of global warming, although many are still ignoring the climate issue with business-as-usual strategies.

Using a 100-point scoring system, most credit was given to companies with a sustained commitment to controlling greenhouse gas emissions, disclosing data and strategies, supporting regulatory actions and taking practical, near-term steps.

BP came out on top in the oil and gas sector, scoring 90 points compared with 35 points for last placed ExxonMobil. Alcan (77) outperformed Newmont (24) in the mining sector, while Toyota topped the automotive sector with 65, well clear of Nissan (33).



Contact Information

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