

## A New Year for Electricity Storage

The Board of Directors of the ESA would like to wish our members and friends a Happy New Year and a successful and prosperous 2006.

As we look back on the accomplishments of 2005 we can see that there has been a substantial increase in the level of interest in electricity storage and in the number of systems that are now in operation. With this in mind we are pleased to announce that the theme of our 2006 General Meeting will be 'Energy Storage Systems in Action.' We have also issued the call for presentations (see sidebar) for what we are sure will be a very full and highly interesting program. Haresh Kamath of EPRI Solutions is doing a great job with the arrangements and we are looking forward to another successful meeting.

As we enter 2006, we are close to the halfway mark between EESAT 2005 and ESA 2006 in Knoxville. For those of you who cannot wait that long and need an energy storage 'fix' now, we have included an extensive report on EESAT 2005 in this newsletter (and even more detail can be seen in the full report posted on the ESA website). For those of you who were there, we hope this gives you a broader perspective; for those who could not attend, perhaps this will give you added incentive to join us in Knoxville.

## Call for Presentations

### 16th Annual ESA General Meeting May 16-18, 2006

Mariott Knoxville  
Knoxville, Tennessee, USA

The Electricity Storage Association invites you to submit a presentation abstract or outline for this upcoming conference. The general theme for this year's meeting is:

### Energy Storage Systems in Action

There will be four half-day presentation sessions. Some examples of appropriate topics are:

- ▶ Economics and Applications of Storage
- ▶ New Storage Technologies
- ▶ Wind-coupled Storage
- ▶ Power Conversion
- ▶ Bulk Energy Storage
- ▶ Recent Installations and Case Studies

Prospective speakers should send an abstract or outline with the presentation title, name, affiliation, address, and phone number of all co-authors. Send your summary by **March 3, 2006** to the Meeting Chairman:

**Haresh Kamath**  
**EPRI Solutions, Inc.**  
**942 Corridor Park Blvd.**  
**Knoxville, TN 37932**  
**Tel: 865-218-8068**  
**hkamath@epriolutions.com**

Completed presentations are due by **May 1, 2006**. For more information go to [www.electricitystorage.org](http://www.electricitystorage.org). Hotel information will be forthcoming.

## EESAT 2005 Draws Record Number

**E**ESAT 2005 achieved a record of 163 registered participants from 14 countries, indicating growing interest in the role of electricity storage in the future stability and security of the electricity delivery infrastructure. The conference, held in San Francisco on October 17-19, began with welcoming remarks by two of the conference chairs – Imre Gyuk of the US Department of Energy and ESA's former chair, Bill Hassenzahl.

Kevin Kolevar, Director of the US Department of Energy's Office of Electricity Delivery and Energy Reliability (OE), provided the keynote address. He outlined the responsibilities of OE, for which the mission statement is 'to lead national efforts to modernize the electric grid; enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to energy supply.' The Electric Power Systems Research and Development Division under Bill Parks includes Gyuk's Energy Storage Systems Program. In outlining future plans for OE, Director Kolevar emphasized the importance of energy storage.

The papers fell into two categories: progress reports on DOE- and state-funded storage demonstrations and studies, submitted for peer review; and a variety of independent storage-related papers.

### Economics and Policy Session demonstrates differing views on storage cost and value

The Economics and Policy session kicked off with an interesting paper from Thomas Jenkin of NREL. Having established the relationship between electricity demand and price, Jenkin showed that releasing a block of stored energy as part of an arbitrage program, if the power level were high enough, would actually reduce the prevailing cost of electricity and hence the arbitrage benefit. However – and this is where it gets interesting – in a fully deregulated market all consumers would benefit from the reduced price level, so the use of storage in this way would benefit society as a whole, even though

the owner of the storage system would see a reduced return. Jenkin also showed that increasing fuel prices don't necessarily translate to increased arbitrage benefits. While arbitrage may not generate sufficient value to justify today's prices for storage systems, this was indeed a thought-provoking paper.

Larry Dickerman from American Electric Power discussed the integration of distributed generation

into the grid and the use of energy storage to optimize the utilization of generation, transmission and distribution assets. He then went on to discuss the recently announced 1.2-MW, 7.2-MWh NAS system from NGK and S&C Electric that will be installed in one of AEP's West Virginia substations to defer a system upgrade for 6-7 years. AEP plans to relocate the system twice in its operating life to maximize its value.

Jason Makansi of Pearl Street discussed a few factors for lack of attention to energy storage including lack of a consistent public policy and absence of demonstrated ready-to-go concepts. Reaction of the audience, however, indicated that there is no consensus on this subject.

### Growing support and incentives for renewable generation enhancement

The first presentation in the Renewable and Distributed Energy session came from Germany's Werner Leonhard, ►



Imre Gyuk of the Department of Energy welcomes attendees to the meeting.

*EESAT Meeting, continued from page 2*

a longtime observer and sometime critic of energy policy in his country. Professor Leonhard described the difficulties facing Germany as it attempts to create a sustainable energy system, and painted a possible scenario where storage plays a key role in tying together a system



Attendees enjoy a mixer sponsored by the ESA in the historic Sir Francis Drake hotel.

based primarily on nuclear and wind generation, and with limited carbon emissions. This was followed by another visionary for the future of storage, Denis Smedley of the Australia Greenhouse Office (AGO), who described a recently enacted 5-year, \$20.4 million Advanced Electricity Storage Technology program that will provide a boost for technically and commercially proven storage systems for deployment in Australia. Interestingly, the US Department of Energy has linked up with the AGO to ensure that programs in the US and Australia can share experience and avoid duplication of efforts.

Steve Eckroad spoke about the ongoing work at EPRI to quantify the value of storage in wind-coupled, grid-connected applications. His presentation indicated the types of storage technologies most likely to succeed in this application, and noted that early commercial feasibility will likely be achieved where wind penetration is relatively large or the power system is relatively small, enabling storage to serve

a high-value role. On a similar theme, Mindi Farber-DeAnda presented a progress report on the work SAIC, PacifiCorp and VRB Power Systems have done evaluating a specific wind farm in Wyoming and simulating how a storage system similar to PacifiCorp's VRB system in Utah could add value to the wind farm output.

### **Silicon carbide-based converters an upcoming technology in power electronics**

The session on Power Electronics was separated into two general areas: existing commercial systems and their performance and advanced power electronics.

Mariesa Crow and Bruce McMillin of the University of Missouri, Rolla, described recent studies of the use of FACTS devices in conjunction with electricity storage. The approach taken at UMR is to develop a computer model of a portion of a utility and explore its security in the event of a fault or loss of a line. This method allows an assessment of system security both from hardware failure and cyber terrorism. Their laboratory has the ability to test small hardware devices as part of a simulation of real systems.

Three papers addressed the upcoming technology of silicon carbide-based converters. They were the initial view of some SBIR programs that were started in June this year. First comment was that some systems based on this technology are now in use in specialized converters where size and efficiency are of much greater importance than cost. The purpose of the described research programs is to increase the size and reduce the cost of individual components. Independent of cost and efficiency and high power density, SiC can operate at a higher temperature than Si based components. The future will see the replacement of Si devices, much as Si replaced Germanium 50 years ago. One advantage of a component that can operate at a higher temperature is that it is less expensive to remove a given quantity of heat when the temperature difference between source and sink are greater. ►

*EESAT Meeting, continued from page 3*

## Advanced Battery Session highlights system integration

It is perhaps an indication of the advances being made in the field of energy storage, that the vast majority of battery-related EESAT papers dealt with the integration of batteries in storage applications rather than battery technology itself. The session on advanced batteries therefore



Attendees gather outside the Beacon Power Smart Energy Matrix during the EESAT tour.

comprised just three papers. James Landi of Electro Energy Inc. discussed the progress made on his company's DOE-funded program to develop bipolar nickel-metal hydride batteries. The company has produced a number of high-voltage battery modules in both high-energy and high-power designs.

Showing that you can teach old dogs new tricks, Pat Moseley of the International Lead Zinc Research Organization discussed novel designs for valve-regulated lead-acid batteries used in high-rate partial-state-of-charge cycling applications in various hybrid vehicle designs. By modifying the negative active material and altering the plate geometry and position of the battery terminals it has been possible to demonstrate marked improvements in this type of operation.

## Supercapacitors - from soup to nuts

The session on supercapacitors covered a full span of development activities, from proof-of-principle systems to production manufacturing. It also covered a range of technologies; in addition to supercapacitors, the session included lead acid batteries, and hybrid systems with hydraulic/pneumatic CAES. Some innovative concepts were presented by Sylvain Lemoufouet, a doctoral candidate at EPFL in Switzerland. Lemoufouet described two hybrid system concepts with micro-CAES (pneumatic and hydraulic systems) coupled with supercapacitors and flywheels.

## Flywheels starting to take off

The session on flywheels provided more evidence that flywheel technology is maturing and approaching widespread commercialization. John Herbst from the University of Texas described the progress of demonstrating their 2-MW/130-kWh composite flywheel for locomotive propulsion applications, presenting the status of testing and analysis. He expects the full scale test in early 2006. Octavio Solis from Vycon presented their plans for introducing a low cost steel flywheel for UPS ride-through and local power quality applications. They showed examples how their technology could help power requirements in light rail applications using regenerative braking and short term energy storage with flywheels.

Shuhei Kato from the Tokyo Institute of Technology showed an example of using a very low cost and simple flywheel based device to ride through very short (sub-second) power disturbances that resulted in high economic losses in Japan. Frank DeLatre reported on a Pentadyne's joint project with Liebert Corp where eight composite flywheels were ganged for a 750-kVA UPS for a hospital application. Performance data was shown that highlighted an impressive operating characteristic that the UPS continued to provide its support even when several flywheels were removed to simulate failure. ►

*EESAT Meeting, continued from page 4*

## CAES shows it's not just hot (or cold) air

The Compressed Air Energy Storage (CAES) session provided highlights of this maturing technology with a focus on application and commercialization, utilizing off-the-shelf equipment and industry-accepted economic models.

Jeffery Greenblatt of Princeton University detailed extensive work on comparing CAES/wind farm integration economics with those of using conventional combustion turbines to stabilize wind farm generation capacity, as well as the use of combustion turbines alone. Results established specific ranges of natural gas pricing where each of these systems is commercially compelling, and detailed the complementary value of CAES.

John Sears of Active Power presented a modular 90-kW hybrid system using exclusively commercially proven energy storage subsystems. These included compressed air and thermal storage for bulk energy dispatch and a flywheel for instantaneous power. The market for this system is lead-acid battery replacements for severe applications. Field test units began shipping in December 2004, and a pilot manufacturing line is scheduled for limited production in late 2005. Full production is scheduled for Q1, 2006.

## Meeting includes DUIT tour

On the final day of the conference, EESAT attendees were treated to a private tour of the Distributed Utility Integration Test (DUIT) facility in San Ramon. DUIT is funded by the CEC and is sited within PG&E's Technical and Ecological Services facilities. With dual 230kV transmission feeds and an extensive selection of power equipment and circuits installed, the DUIT facility is the first full-scale, integration test of commercial-grade, utility grid interactive Distributed Energy Resources (DER) in the United States. It is the next step for emerging technologies in assuring safe, reliable, and cost-effective inclusion into the electric system to accelerate market acceptance. DUIT's goal is to advance the state of the art

for integration practices and strategies, through a better understanding of the benefits and challenges associated with substantial penetration into the electric distribution system.

During the EESAT tour, the selection of technologies under evaluation included the exciting new Smart Energy Matrix from Beacon Power. This is a 100-kW precursor to the 1-MW array of flywheels integrated in a shipping container, and designed to provide generation and transmission support services. In addition, other systems under evaluation included 34 residential PV inverters from various suppliers, a 300-kVA diesel genset with advanced anti-islanding control algorithms, and two microturbines.

## Next EESAT meeting likely to move

In addition to the many conference papers there were plenty of opportunities to network with others in the energy storage community, and not just at the breaks. The welcoming reception on the Sunday evening was followed on Monday by an ESA-sponsored reception. The highlight of the social agenda, however, came on Tuesday evening when attendees were able to enjoy spectacular views of the San Francisco skyline and fine cuisine in the Carnelian Room atop the 52-floor Bank of America building. The dinner was complemented by superb Rosenblum wines supplied by ESA's Bill Hassenzahl.

After three successive EESAT conferences at San Francisco's Sir Francis Drake Hotel it is likely that EESAT 2007 will seek a new venue. As always, the ESA will provide support for the conference in its new location and will provide updates as new information emerges. ◀

For a full report of the  
2005 EESAT meeting, go to  
[http://www.electricitystorage.org/pubs/  
2006/EESAT\\_2005\\_Meeting\\_Recap.pdf](http://www.electricitystorage.org/pubs/2006/EESAT_2005_Meeting_Recap.pdf)

## Future Events

### ESA 2006

**Knoxville, Tennessee, May 16-18, 2006.** Hosted by EPRI Solutions. See "Call for Presentations" on page I. Further information will be available in future newsletters and on the ESA Web site at [www.electricitystorage.org](http://www.electricitystorage.org).

**ENERGY STORAGE**  
A Nontechnical Guide

*Energy Storage: A Nontechnical Guide*, by Richard Baxter, is a complete resource on the operation of energy storage technologies and how they interact in the marketplace today.

In this book you'll learn:

- new opportunities for these technologies
- detailed descriptions of the technologies and their market applications
- business trends shaping energy storage technologies

The book explains how, and under what conditions, energy storage technologies can become a vital component of the electric power industry.

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## About the ESA

### Our Mission

To promote the development and commercialization of competitive and reliable energy storage delivery systems for use by electricity suppliers and their customers, thereby bringing financial and technical benefits for energy storage operators.

### Membership Benefits

- ▶ Gain early knowledge of the latest developments in energy storage technology and field/customer applications of new/innovative storage technologies, and information on how these can be used for member's business advantage
- ▶ Early notification of upcoming business leads in US and abroad
- ▶ Enhanced exposure to potential customers for energy storage products and services
- ▶ Ability to network with users, manufacturers, and researchers in the energy storage field
- ▶ Access to ESA contact list of more than 800 names of industry leaders interested in energy storage
- ▶ Ability to actively interface with key representative from government and industry to receive insights into energy storage markets and strategic directions of key industrial firms

### Join Now

General Membership is \$750 per year which includes attendance at meetings, conference proceedings, special tours, and social events.

To join the ESA, complete our on-line membership form. You will be asked to provide credit card information over our secure transaction server.

For questions about membership in the ESA, contact Gerard Thijssen in the Netherlands at +31 26 3 56 26 03 or email [membership@electricitystorage.org](mailto:membership@electricitystorage.org).