Energy Efficient, Cost Saving, Environmentally Friendly, Distributed Energy Storage Battery System

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The U.S. Department of Energy recently initiated funding of the development of a Bipolar Nickel-Metal Hydride battery for a distributed power and energy system. This abstract discusses the opportunity for electric energy power conditioning, factoring, demand charge cost reduction, and the smoothing of peak power requirement of electric utility daily generation. The major challenge to reach commercial viability is to achieve 15 year life and a capital cost of less than $150/KWh for the battery component of the system.

This program has the goal to provide the following benefits:

- Improve efficiency by reducing transmission peaking loses and shifting peak demands to more efficient base load generating equipment.
- Reduce cost of electricity to industrial users and provide reliable backup power.
- Reduce utility environmental pollution by balancing the load to more efficient load.
- Help advance Bipolar Ni-MH technology for distributed power applications.
- Increase reliability of energy storage.

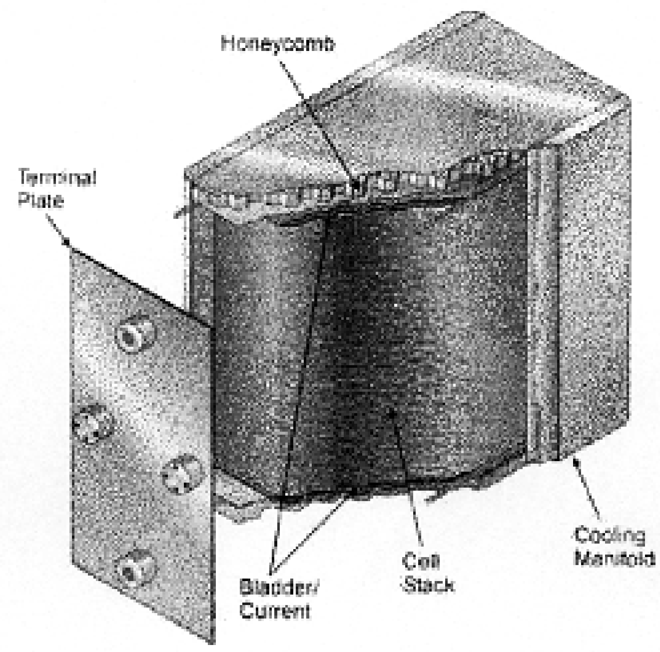
The application is similar to utility energy storage except that in this case the customer relies on the energy to provide reliable voltage and that the storage may be smaller and is dispersed as required. The system can be used to provide short high power burst needs or somewhat longer (about one hour several times per day) peak needs for various industrial processes.

Estimated cost for conventional prismatic Nickel Metal Hydride batteries are approximately $300-$400/KWh. Electric vehicle battery cost goal set by the automobile industry and the US Advanced Battery Consortium is $150/KWh. It is EEI's belief that with the appropriate development efforts and mature manufacturing the Bipolar Nickel-Metal Hydride battery could be produced for $100-$150/KWh, and $300/ KW for stationary energy storage applications.

The initial phase of the program will focus on this capital cost goal for all aspects of the materials and processes used. A detailed cell testing matrix including all cell components and processing procedures has been prepared. Also included is a market study and assessment to define potential applications with the utilities and end users. First phase hardware produced will include two fifty-volt modules (40 cells each of 6"x 12" electrode size) which will be tested at EEI and Sandia National Laboratory. The battery-packaging concept is shown in the figure below.

The EEI wafer cell is the fundamental building block of the design and is characterized by a single positive and negative electrode laminated in an enclosure. The wafer cells are stacked together like playing cards to form a series connected battery, with current flow uniform across and perpendicular to the surface area of each cell. There are no tabs, plates or bus bars connecting the cells as in conventional prismatic battery construction. This design facilitates high voltage batteries to be constructed in a low volume package.

An initial battery design, and cost analysis were



performed based on a customer side of the meter energy storage installation of 100KWh. The anticipated use was a low rate application to eliminate 50KW of utility demand charge to the customer for up to two hours duration per workday. A preliminary pay back cost analysis was prepared using a typical demand charge of $7.42/KW per month and electric rate of 8.9 cents/KWh, and showed a 25% savings of the electrical demand charge. However, the Bipolar design is best suited for high rate applications, in this cost study calculation a 6Ah 450 Volt battery discharging at 25 kW for periods of up to 18 seconds showed the savings could easily exceed 50 percent, along with improved reliability and 15 year life.