THE CONSULTANT

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Chairman's Corner — *John Dunn, President, Ambertec, Inc.*

Some years ago, there was an item on WNYC about this road that was built out west someplace where it was decided to use chopped up, steel belted radial automobile tires as a base underneath the asphalt. What a mistake.

The story was that as time went on, the steel that had been part of the tires gradually rusted and as that oxidation took place, it would release just a little bit of heat that had nowhere to go and just accumulated.

As temperatures rose and rose and rose.... the tires would ignite. Result: The road surface was constantly erupting in flames. Fires would burst out over here, then over there, later on over that-a-way; one never knew where it was going to happen next.

As you can imagine, motorists and the local fire departments did not like that.

I think the episode is really a lesson about unintended consequences. "The best laid plans of mice and men", and all that.

I never did hear if they rebuilt that road.

Meetings

July 2007

Topic: "Contracts With a Bite"
Speaker: Mr. Irwin Weitman, Cedar Engineering Company, East Northport, NY.

The members offered their experiences and solutions for the pitfalls that Irwin pointed out, and added other horror stories. Thanks, Irwin.
Pizza helped the medicine go down. Thanks, Marty.

Our discussion about a new directory and alternative advertising methods is still left for a future meeting.

We continue to inform the members about seminars and other items that might be of interest. E-mail: members@consult-li.com.

August 2007

7:00 PM, Wednesday, August 1, the first Wednesday of the month.

Place: Briarcliffe College, 1055 Stewart Avenue, Bethpage, NY
See website for directions: www.consult-li.com

Topic: "A Brief Introduction to CAD and Solid Modeling."
Speaker: Mr. Stu Senator, Dunton Design Associates, Inc.

Free on-line programs that work will be available for those who want to try it themselves. However, no directions or phone or on-line support will be available.

Light refreshments may be served. Admission is free (no charge), and no pre-registration is required. For more information, contact Chairman John Dunn at (516)378-2149 or e-mail ambertec@ieee.org.

Other Meetings

Consult the Events Calendars on the Section website: www.ieee.li and the LICN site: www.consult-li.com.

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A 100,000 Farad Battery ? *--- Carl E. Schwab*

Your first reaction to the title probably is that any fool knows you measure capacitors in Farads – not batteries. And I must admit when I first encountered this use of the Farad unit I thought it was a mistake.

The Term "Charge"

The term **charge** is used in defining the amount of electrical charge stored in both capacitors and storage batteries. Currently there is great interest in the Li-ion battery and the UltraCap used separately and collectively for energy recovery and storage in the Hybrid Car technology. The amount of charge is measured in Coulombs and the symbol used is "Q".

For batteries the formula is Q=I x T Where: I is in amps and T is in seconds. We normally use the term Ampere-Hours to express the capacity of a cell. (Don't forget to convert the hours to seconds to get the answer for Q in coulombs.)

For capacitors the formula is Q=C x V Where: C is in Farads and V is in volts.

What I have seen recently is equating the Q's and solving for the equivalent C, in Farads, of the battery, taking V as the difference between the battery's fully-charged and almost-empty voltages.

Example: Assume 2000 Mah Nicad cell. We use the formula

$$C=\frac{I \times T}{V}$$

We insert I=2.0 amps
T=60 x 60=3600 sec
V=(1.35 – 1.0)=0.35 volts

C=20,570 Farads.

Now available, UltraCaps or SuperCaps, operating at 2.5 volts max have values of 6000 Farads so that roughly three in parallel can replace the Nicad cell. Amazing!!

Now why would you do that? For the above example, I chose current (old) technology. Nano-engineering has improved both the battery (chemical) storage and the capacitive (electrostatic) storage. In both instances, nano-engineering is enormously increasing effective anode/cathode/plate areas.

In Hybrid Car engineering it appears that the electrical storage will be a combination of nano-engineered Li-ion battery cells AND nano-engineered barium-titanate UltraCaps. Legitimate question, "Why not one or the other?" The answer is, at least at the present time, each technology has a key advantage.

The UltraCap has a very low surge impedance and can absorb or deliver up to dozens if not a few hundreds of ampere surges. Just now the improving Li-ion chemistry starts to really struggle at the 100-ampere level. So the logical thing to do is to use the Li-ion for longer-term battery needs and use some amount of UltraCap to provide acceleration and braking needs. Best of both worlds.

Where's Li-ion now?
Li-ion cells manufactured by A123S are 2.3 Ahr and have a voltage Range of (3.7-2.5) or V=1.2 volts. Each cell weighs 70 grams. Applying the above formula

$$C=\frac{2.3 \times 3600}{1.2}$$

C=6900 Farads

These cells have a long life of 100,000 CCDC(Complete Charge/Discharge Cycle) at a 25 amp level. This company is due to deliver a cell especially for hybrids that will be 4.5 Ahr, weigh 140 grams and have even longer life. They are aiming at 15-year life and 150,000 mile warranty.

NEC and FHI (Subaru) are testing such a cell; they call it a Li-ion CAPACITOR.

Where are the UltraCaps Now?

Nano-engineering the processing of barium-titanate is allowing a permitivity figure of 85,000 and has been demonstrated by a group called EEstore, Inc. in Texas. Their main claim to fame is that complete recharge takes less than 2 minutes and the unit can take and deliver 400-ampere surges. They are funded by venture capital to go after the Hybrid Car market.

Conclusion

Measuring the capacity of a battery in Farads seems like a joke, but you see the simple definitions taught in introductory physics course let you make easy comparisons. The huge gains in both Li-ion batteries and the UltraCap mean convenient packages for hand-tools, toys, garden tools and devices un-imagined now, as well as Hybrid Car vehicles that are going to be reality.

Exciting times.

Holey Turbines !! — *Richard LaRosa, sealevelcontrol.com*

This is the story of the turbine that has been selected by Nova Scotia Power Inc. to harness tidal power in Canada's Bay of Fundy. It has a multi-blade rotor that has no center shaft. In fact, in the center of the rotor there is nothing but a hole whose diameter is about one third of the rotor's rim diameter. The rim turns inside of a housing that contains bearings and the coils of a multi-pole alternator that supplies electric power. Permanent magnets are embedded in the rim and induce voltage in the coils when the rotor is turned by tidal currents.

The inventor of the hole is Herbert Williams, who was a dock-building contractor in Palatka, Florida when I met him. At that time, there was no alternator built into the rim. A hydraulic pump or an external alternator was driven from the rim. He had formed a company, Florida Hydro Power and Light Co., and held some patents covering the center hole. He had observed that the hole improved the performance. It seemed to me that the high-speed water jet exiting the hole reduced the pressure on the exit side of the rotor blades, increasing the output of the turbine.

During our initial discussions he was under the impression that almost unlimited power could be derived from the Florida Current and Gulf Stream, while I was pursuing the idea of slowing down these currents to retard the melting of the Greenland ice sheet and polar glaciers. He obtained permits to put experimental turbines in the Florida Current and was starting to install moorings and power lines. I kept telling him about my estimate that a steady output equal to the peak summer load of the NYC and Long Island area would reduce the Speed of the Florida Current and Gulf Stream by 10%. He had some contractual arrangement with the U.S.Navy, and asked them about how much power would be available from the current. The answer was that they would measure the velocity and see if the turbines slowed it down. This, of course, would have been stupid because it would take many turbines at great expense to produce a measurable change. Intelligent engineering prevailed, and they dropped the Florida Current idea and started looking at currents in tidal estuaries.

There is a commercial rim-driven marine thruster whose rotor is rim-supported and has permanent magnets embedded in the rim and coils for the drive motor in the rim bearing housing. The Navy engineers were probably familiar with it, so it was logical to use the same configuration for the turbine and alternator. The marine thruster is housed in a tunnel that runs from side to side near the bow of a ship. It is used for steering or dynamic positioning, and it does not have a hole in the center of the rotor. I would guess that Herbert Williams' patents are still protecting his "Open Center Turbine" design.

Along with the Navy's contribution to this development, another company, Oceana, seems to have gotten involved. Oceana's General Counsel, Mike Hoover, helped Williams get funding in exchange for shares of Florida Hydro. Funding was obtained from an Irish investment group, Goldeneye Investments Ltd. Goldeneye bought the Florida Hydro technology and changed the name to OpenHydro. This company has been selected to install their open-center turbine at the Bay of Fundy site. But there may be problems. Mike Hoover claims that he did not receive the promised shares of Florida Hydro Power and Light, and has sued Herbert Williams for breach of contract. Mike Hoover's company, Oceana, has been applying for permits to study many promising tidal energy sites. This is analogous to the speculative registration of Internet domain names that can be sold at a profit to legitimate registrants.

One of the sites that Oceana has applied for is Hell Gate, a stretch of the East River just north of a site on the east side of Roosevelt Island, where Verdant Power LLC has at least six turbines in operation. These are conventional-looking units with a three-bladed rotor on the downstream end of the turbine. Each turbine turns 180 degrees about its vertical pivot axis when the tide reverses. When the flood and ebb tides are running, the turbines supply power to a Gristedes supermarket and charge some hybrid electric buses on Roosevelt Island. When the tide is reversing, the Con Ed electric grid takes the full load. Verdant Power has been working for years on this project and is now studying the effect of the turbines on marine life.

Another company that has been steadily working for a long time is Marine Current Turbines in the UK Their turbines face in the same direction for both flood and ebb tides. They use a two-bladed rotor and the blade pitch reverses when the tide reverses. The turbines are mounted singly or in pairs on poles that have been fitted into holes drilled into the ocean bottom. The turbines can be raised out of the water for servicing. This avoids having to work underwater in strong currents. This August, a pair of turbines will be installed on a single pole set into the 8 km-long narrows connecting Northern Ireland's Strangford Lough with the Irish Sea. The lough is an inland body of water with an area of 150 sq km located southeast of Belfast. It hosts seals and basking sharks, which will have to swim past the underwater turbines if they want to get to the Irish Sea. This should demonstrate the safety to marine life. The tidal current in the narrows is 4 m/s and the output to the grid of the two turbines is expected to be 1.2 MW. This installation will serve as the prototype for future projects.