

Fuel Cells- The Long Road Ahead

THERE IS HYPE BUT ALSO
POTENTIAL FOR PROGRESS



Fuel Cells are obviously where the money is today, and there are people looking for it. The Fuel Cell 2003 conference held in Miami, Florida (Dec. 3 - 7), had more than 2,000 attendees, lots of enthusiasm, and showed that there is a long road ahead.

Generally speaking, the use of refuelable Proton Exchange Membrane fuel cells in battery replacement applications seems destined to happen, relatively soon. These Direct Methanol Fuel Cells designed for Direct current (DC) output vastly simplify the Balance Of Plant (BOP) by eliminating both the reformer and inverter components, and the benchmark price of the incumbents is within commercial reach.

On the transportation scene, there does seem to be an attainable market for fuel cell power scooters, either methanol or metal hydride fueled. The fueling infrastructure seems plausible and range is not a limiting issue, as with cars. Again, the application is DC and there are attractive battery hybrid or regenerative opportunities available.

Derivatives of these are the Auxiliary Power Unit applications. The small Solid Oxide Fuel Cell (SOFC) systems seem to be well positioned here, because they operate on a variety of fuels, requiring only minimal fuel processing. Start-up and shut-down times can be quite long, so early applications will be somewhat limited. The SOFC developers are working to improve transient operating characteristics through the application of thinner and more durable materials and components.

There was a great deal of emphasis at the conference on fuel processing and delivery schemes in support of the "Hydrogen Economy," but I remain unconvinced. Some of the fuel processor participants were obviously driven by "on-board" vehicle reforming opportunities and clearly focused on size and weight. At the other end of the spectrum, one of the air separation companies was offering a supporting liquid delivery system for stationary applications. I guess this would be an opportunity for them to sell merchant products.

When you look at the cost and com-

plexity of these fuel cell systems, it is not at all clear to me who will lead in what must become a more rational system integration effort. The stack itself, although the focus of much discussion and R&D activity, seems to be headed toward becoming a commodity, and destined to be a relatively small contributor to an overall integrated product cost structure. Value chain compression will certainly take place among the many participants, and it would be surprising to me if any of the stack developers actually emerged as viable system integrators, long term. There was continued emphasis on SOFC, particularly as related to the National Energy Technology Laboratory's Solid state Energy Conversion Alliance program and its scale up.

Hybrid gas turbine-fuel cell systems still hold great promise long term, but turbine matching remains a problem. It seems that the guys who do this work are the "fuel cell types," and they have a tendency of thinking that turbines are available "off-the-shelf" to support any set of conditions imposed by the fuel cell. These "fuel cell types" optimize the fuel cell and try to make the turbine fit. In fact, this approach needs to be reversed.

One of the presenters talked about a 3 MW hybrid system that would require 300, five-kilowatt modules, and would feature a 1.5 MW recuperated gas turbine with a pressure ratio of 3:1 and a turbine inlet temperature of 800 C. The turbine was budgeted 34 percent of an estimated \$430/kW BOP; \$150/kW more or less. This would be a heavily de-rated machine at about 50 percent of the full rated power output, with efficiency in the 30 percent range. In reality, the full rated price would be \$650/kW, and at the de-rated conditions, the presenter's turbine price estimate is off by an order of magnitude. Draw your own conclusions. **■**

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