

**Day 3 at Hannover Messe 2007**

Day three of the Hannover Fair, and visitor numbers are much increased from the first two days. Today we heard presentations from and spoke to mainstream fuel cell companies as well as specialist hydrogen generation equipment manufacturers. On-site hydrogen production from 'difficult' fuels is receiving increasing attention at the moment, perhaps given the perceived sluggishness of the development of hydrogen distribution systems.

Erik Höyem of Nordic Power Systems gave the first interview of the day. His company have been developing diesel reformers combined with high temperature PEMs. Nordic Power approached the market from the perspective of fuel availability, and decided that on-site reforming using diesel was a promising option given the perennial problems associated with hydrogen supply and distribution. Whilst hydrogen reforming from diesel is not novel, they have developed a total reformer/fuel cell system incorporating sulphur traps which gets around the membrane poisoning difficulties normally associated with diesel as a fuel for fuel cells. The system is called "Cool Flame": the diesel is evaporated, then mixed with air to form a homogeneous mixture which is suitable for reforming. Overall conversion efficiencies of the system, incorporating the heat component generated by the high temperature PEM, are around 93%. At the present time, they have developed a 2 kWe unit, and plan to scale up to 4 kW in future. In terms of target markets, new legislation in the US prohibiting truck engine idling for prolonged periods has presented a perfect niche – using the diesel sitting in the tanks of trucks, drivers can switch to the Nordic Power System unit to run air conditioning, lights and heating when parked up.

Brendan Bilton of SOFC developers Ceramic Fuel Cell Company Ltd (CFCL) talked about his company's plans to commercialise their products aimed at the residential market. CFCL was originally a research organisation of the Australian government, which turned into a commercially-oriented body in 2002. Since then they have progressed rapidly, culminating in a flotation on London's Alternative Investment Market (AIM) in 2006 which brought in 60m – funds which will be used to build a manufacturing plant in Germany. CFCLs units are set up to produce a high thermal output compared to electrical, the idea being that excess electricity can be exported on to the local distribution network. In line with this business model, CFCL are partnering with two utilities and two boiler manufacturers with whom they are currently making alpha units. In 2009 they plan to produce beta units, and a year later in 2010, fully commercial units in the tens of thousands. These will be owned by their utility partners, rather than by members of the public, and remotely monitored and controlled. The ability to remotely monitor and control units is vital for utilities, who need to be able to coordinate natural gas as well as bi-directional electricity flow.

Following on from Nordic Power System's on-site diesel reforming technology, Didier Grouset of French company N-GHY presented their onsite "Flexi-Fuel" reformers. These come in three sizes: 2 m<sup>3</sup> / hr (operating at atmospheric pressure), 8 m<sup>3</sup> / hr (operating at 10 bar) and 30 m<sup>3</sup> / hr. N-GHY brought the small and medium sized units with them to the Fair, but the large unit was a little too large). Operating at temperatures of around 1400 degrees C, no catalyst is required, although there are cost implications associated with the need for ceramic linings. It seems that almost any fuel can be used: propane, ethanol, natural gas, diesel, biodiesel, and there are plans to make naphtha acceptable. An interesting and important addition to the Flexi-Fuel's capabilities is the fact that CO<sub>2</sub> traps have been included. Instead of being vented, CO<sub>2</sub> is captured in liquid form, thereby making carbon sequestration a possibility. Alternatively, the idea is that it can be sold to various industries which have a need for CO<sub>2</sub>, including the agriculture and food production. N-GHY plan to scale up their products to a capacity of 500 m<sup>3</sup> / hr, which would be sufficient to fuel 200 cars or 30 buses per day.

Hydrogenics, founded in 1998, has over 250 staff working on hydrogen and fuel cells across three divisions – fuel cell test stations, onsite hydrogen generation and power systems. The power systems division presented three product ranges, all based on the HyPM PEM stack (first released 2002), and which has sold over 50 units last year with a combined power output of 1.18 MW. For their back-up power range, Hydrogenics have partnered with APC who now offer fuel cell based systems as part of their standard product offering. In the material handling range, Hydrogenics produce battery replacement systems for forklifts which are compatible with the trucks of several major manufacturers. In the 'Mobility Power' range Hydrogenics produce a standard module which is suitable for integration into products which require 4-65kW.

Focus at the fair has very much been on the forklift battery replacement application which, as noted by Plug, Ballard, and many others, is a key niche market for fuel cells in which financial benefit from using fuel cells can be realised today. The Hydrogenics system employs pressurised hydrogen storage with the fuel cell providing base-load power supplemented by super-capacitors to meet peak demand. It is interesting to note that Hydrogenics are still considering whether to provide the complete battery replacement product or to supply the fuel cell for a system integrator to assemble the complete system.

Which brings us nicely to H2Logic, system integrators who work with fuel cell manufacturers, end product manufacturers and directly with customers to create products for specific niche markets. H2Logic have 15 employees and base their business model on identifying markets where reasonable customer expenditure, supplemented by public grants, makes fuel cells and hydrogen solutions viable. H2Logic enjoyed great success last year with their hydrogen fuelled PEM-powered light duty truck for use in hospitals, which has now completed over 4,000 of operation.

H2Logic's latest project is a lightweight hybrid car powered by a Ballard PEM stack and supplemented by a high temperature Zebra battery. The car will have a range of 150km running on pressurised hydrogen and a further 150km running on the battery. The battery can be charged using the fuel cell, or more cost effectively, by plugging into a mains supply. The lightweight car, produced by Think Global (formerly owned by Ford), has a plastic body on an aluminium frame, includes dual airbags and surpasses stringent crash worthiness standards. The target 'markets' for the car include the HyNor project (the Norwegian Hydrogen Highway) and Danish Hydrogen Link project. The first prototype is expected to be in operation this autumn with further vehicles on trial in 2008 -2009.

Finally, the originator of the Fair-PR, Arno Evers, gave his take on how he sees hydrogen and fuel cell markets developing. He pointed out that more energy in Germany is lost in flaring and transmission than is used by the whole industrial sector. In terms of solutions, Arno, as always, proved to be an original thinker. The fundamental change that will have to happen is that energy will need to be produced where it is used, and that includes us all personally. Hydrogen can also be produced directly at the top of wind turbines, and our cars (which will produce hydrogen on site), can be plugged into nearby buildings when parked in order to power them – in return earning money for the owner. When it was suggested that all this sounded like science fiction, he pointed out that major technological developments have always seemed like science fiction before they actually happened. Just look at flight.

It's difficult to argue with that.