

# 1 Fluid Battery

## Distributed Energy Resources (DERs)

DISTRIBUTED ENERGY RESOURCES (DERs) of different types are being installed by many customers driven by their desire to contribute to the reduction of air pollution and support a greener energy production. However, one of the main problems with the renewable energy resources is the fact that they are not always available when we need them and may be available where we do not. That is why finding an adequate form of energy storage is one of the key requirements for the successful implementation of solar or wind based DERs.

One promising commercially available solution is Cellstrom's FB 10/100 - a complete energy storage system (ESS) that consists of a vanadium Redox flow battery with smart controller and configurable power electronics housed in a weatherproof container. The battery can be charged and discharged at up to 10 kW and provides 100 kWh of energy. The smart controller ensures that the battery operates at maximum efficiency at all times and allows remote observation of various battery parameters. The option of different arrangements of power electronics gives almost complete freedom in specification of electrical output (dc, single or three-phase ac).

The output of the FB 10/100 can be configured as: 48 V DC (with suitable inverters/converters); 120 V AC; 230 V AC (1-phase); 400 V AC (3-phase).

A flow battery is a type of rechargeable battery in

which the energy is stored chemically in liquid electrolytes. Unlike conventional batteries, that store all of their reactive materials within the cells, a flow battery stores the electrolytes in tanks. The electrolytes are pumped through the cells when electric current flows and back into the same tanks.

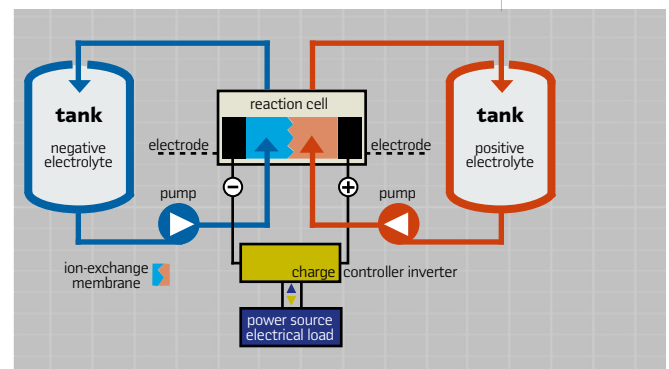
There are two electrolytes, one for the positive reactions and one for the negative. The two electrolytes do not mix but are separated in the cells by an extremely thin membrane that only allows selected ions to flow through. Also in the cells are very stable porous carbon electrodes, where the critical reactions take place. As the reactions only involve the dissolved salts, the electrodes do not change physically or chemically allowing a very large number of charge and discharge cycles without significant decrease in capacity.

The cells are grouped together in blocks known as stacks with the cells being connected electrically in series by bipolar plates, i.e. conducting plates that have positive electrolyte on one side and negative on the other. The stack voltage is the sum of the voltage of the individual cells. The energy of a battery string is limited by the poorest battery (cell). However, each cell of a flow battery is practically identical, because they share the same electrolytes. Therefore, flow batteries do not suffer the same intrinsic limitation as conventional batteries. ■

The battery can be connected to a photovoltaic wind turbine or other sources to form discrete autonomous power supplies or to be part of a micro-, mini- or smart-grid.



Image courtesy of Cellstrom



Fluid battery principle diagram

For more information visit: [cellstrom.com](http://cellstrom.com)

## 2 HyWind – Floating Wind Turbines

Some of the main issues with offshore wind farms are their environmental and esthetic impact, as well as the inconsistency of the wind. One solution to these issues is being developed by StatoilHydro. The company has developed HyWind – a floating wind turbine based on a 2.3 MW Siemens wind turbine mounted on a floating concrete constructions (Spar-buoy) familiar from North Sea oil installations or offshore loading buoys. Moving the wind turbine further away from the shore allows exploitation of the strongest and most consistent wind. The rotor blades on the floating wind turbine will

have a diameter of 80 meters, and the nacelle will tower some 65 meters above the sea surface. The floatation element will have a draft of some 100 meters below the sea surface, and will be moored to the seabed using three anchor points. The wind turbine can be located in waters with depths ranging from 120 to 700 meters. The pilot project will be assembled in Åmøyfjorden near Stavanger and is to be located some 10 kilometers offshore Karmøy in the county of Rogaland. The wind turbine itself is to be built by Siemens. Technip will build the floatation element and have responsibility for

the installation offshore. Nexans will lay cables to shore, and Haugaland Kraft will be responsible for the landfall. Enova is supporting the project with 59 million NOK. The goal of the pilot is to reduce costs so that floating wind power can compete in the power market. "Floating wind power is not mature technology yet, and the road to commercialization and large scale development is long. An important aspect of the project is therefore research and development. The wind turbines must work satisfactorily even when subjected to movements, and it must also be possible to carry out necessary maintenance to the highest of safety standards." says Alexandra Bech Gjør, head of New Energy in StatoilHydro. The company has entered into a technology development agreement with Siemens for the project. The wind turbines must function optimally even in large waves. A three meters high model has already been tested successfully in SINTEF

Images : Courtesy of StatoilHydro, Norway



**HyWind: Floating turbine concept**

Marintek's wave simulator in Trondheim. The goal of the pilot is to qualify the technology and reduce costs to a level that will mean that floating wind turbines can compete with other energy sources. "If we succeed, then we will have taken a major step in moving the wind power industry offshore. Floating wind turbines can make a major contribution to providing the world with clean power, but there are major technical and commercial challenges that need to be resolved." says Alexandra Bech Gjør. ■



The windmill is being towed to its final destination



For more information visit:

<http://www.statoilhydro.com/>

## 3 Ohmer The Self-made Electric Car

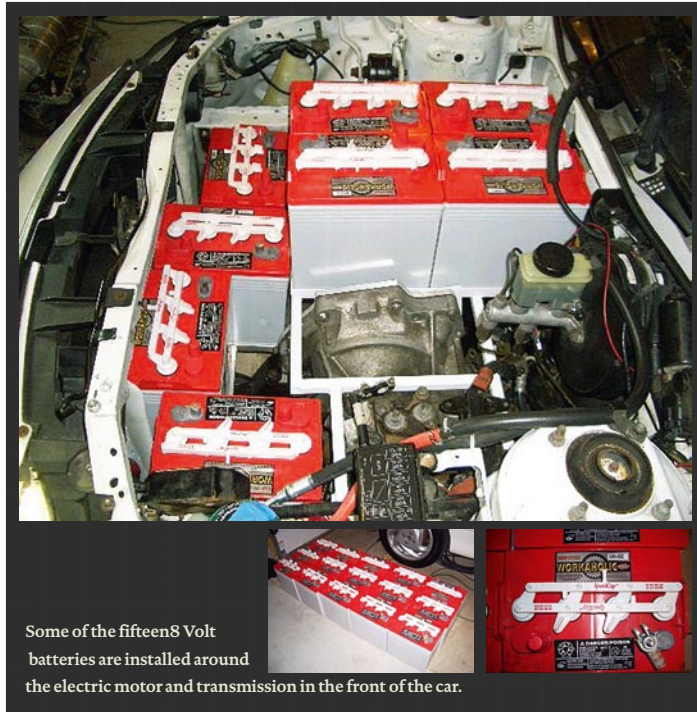
IN ONE OF THE PREVIOUS ISSUES OF PAC WORLD we introduced the Tesla – an electric sports car that an electrical engineer cannot afford. But it appears that even someone who is not an electrical engineer can have an electric car. With the understanding that green is more than just recycling, that it is also finding solutions to sustainable living, Patrick Roth from Indianapolis, Indiana, USA decided to convert a 1998 Ford ZX2 car to an electric vehicle. It was done in his spare time, in his garage and with his own money.

On his web site (see the end) he tells the complete story of the selection of the donor vehicle, the components to use for the conversion and the step-by-step conversion process. Everything is illustrated with many photos and videos.

In just over two months and for less than fourteen thousand US dollars (USD 2675 for the donor and USD 11000 for the conversion) he had completed the conversion and as of the time of this writing has driven more than three thousand kilometers).

The top speed that Patrick Roth has reached with his electric vehicle is 70 mph (112 kmph).

He uses fifteen Interstate U8VGC, 8.00 Volt, Lead-Acid, flooded batteries to drive the Advanced DC 203-06-4001A Series Wound DC Motor.



Some of the fifteen 8 Volt batteries are installed around the electric motor and transmission in the front of the car.



Electric motor



Battery Gauge



Motor and transmission

The range of the car is around 40 miles (64 kilometers), but it depends greatly on driving style and outside temperature. In winter, you may only get 20 miles, but mild driving in summer can get you over 45.

Since the winter temperatures in Indiana can be very low, Patrick Roth has installed a 1500 W ceramic heater with an over-temperature sensor.

The instrumentation includes: ammeter, voltmeter, Curtis battery fuel gauge and the motor over-temperature warning light.

The typical consumption of the car is 300 Wh/Mile.

More information at <http://www.cardomain.com/ride/3155482>. ■



If Patrick Roth can convert a regular car into an electric vehicle, imagine what a PAC specialist can achieve. Please let us know about your car conversion.