Halifax fans and WEG motors help ventilate the world's first full-scale liquid air energy storage facility

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A new 5MW Liquid Air Energy Storage (LAES) facility, designed by Highview Power Storage will soon be operational thanks, in part to some slightly less space age, but still very efficient 175kW WEG W22 IE3 electric motors and efficient EU327 Compliant centrifugal fan systems from Halifax Fan.

Large power stations using coal and nuclear fuel are also slow to 'turn-down' if demand drops and usually very, very expensive to get going again if you have to turn them off completely.

So what is an LAES facility?

An LAES or Liquid Air Energy Storage facility is a new way of storing electrical energy, like a battery, but on a grid-scale power plant platform. A lot of electrical energy is created when the daily demand cycle from the grid isn't high enough to receive it – good examples are renewables like wind, solar and tidal power that are generated based on the weather, not demand.

An ideal solution then would be to be able to store electrical energy for a few hours when demand is low and release it again quickly when demand (and in some instances – the price) is higher. An LAES facility uses a large gas compressor to

turn air to a liquid then store it in insulated, pressurised tanks, which keeps it as a liquid. In order to generate power the air is heated and allowed to expand again, the pressure then pushes a gas turbine around to generate power. The only emission created is air…

After having built and tested a successful pilot plant, Highview and project partner Viridor were awarded government funding by the Department of Energy and Climate Change (DECC) to build a pre-commercial scale 5MW Liquid Air Energy Storage technology demonstrator. That LAES plant is now currently undergoing final commissioning in Bury Lancashire.

So how exactly does an LAES work?

Air turns to liquid when refrigerated to -196°C, which is usually achieved by a cycle of compression, cooling and expansion, it can then be stored inconventionally insulated, ambient pressure vessels at very large scale. Exposure to ambient temperatures causes rapid re-gasification and a 700-fold expansion in volume, which is used to drive a turbine and create electricity.

Highview's technology draws from established processes from the turbo-machinery, power generation and industrial gas sectors.

Stuart Nelmes Head of Engineering at Highview, 'The beauty of this system is that each component part of the process is built using tried and tested technology, which we know works and has established performance parameters. The centrifugal fans sourced from Halifax Fan, one of the UK's leading suppliers, driven by WEG motors, one of the worlds most recognised brands, therefore fitted our remit very closely.

‘The LAES system comprises of three primary processes: a charging system, an energy store and a power recovery stage. The energy efficiency of each stage is crucial to the economic viability of the project. Because we have to power the system with the electricity we generate or buy it from the grid the energy efficiency of each component is very important.

Halifax has developed its centrifugal range to maximise energy efficiency and WEG offers a very energy efficient IE3 motor as standard so this also influenced our decision. Every little helps in this situation.

‘There is a big temperature change as the gas is converted to a liquid and back again. It is the same principle used to make your kitchen fridge cold but more akin in scale to the effect you see freezing moisture in the air creating slabs of ice that crack off the surface of a space rocket as the fuel tanks empty. We needed a very reliable, well-proven blown air solution to regulate the temperature and airflow around some of the key components in the system and so the Halifax Fan / WEG combination was a good one for us.

WEG is the main supplier of motors to Halifax Fan, the WEG Regional Sales Manager Russell Auty comments,

‘We have a great long standing relationship with Halifax Fan based on a highly efficient and extensive product range, one that is available next-day off-the-shelf in the UK from fractional kW ratings up to 500kW. It is this mix of range, quality and availability that makes the difference to our customers. That and the fact that we supply an IE3 spec motor with up to 98% electrical energy efficiency as standard.’

Green machines

The green credentials for the LAES technology are off the scale compared to other large-scale energy storage methods; once constructed the commercial installations will be close to environmentally neutral, output is simply air, (or in the case of this test unit inert Nitrogen supplied by BOC, which makes up 78% of the air anyway). Commercial installations are likely to be used as temporary energy banks for larger power stations, which are both slow and expensive to turn down, or turn off.

The solution would also be very effective for storing energy from renewable sources such as wind turbines when there is a grid surplus and then fed back into the grid when demand peaks. The project will operate for at least one year and is intended to demonstrate how LAES can provide a number of electricity grid balancing services, including Short Term Operating Reserve (STOR), Triad avoidance (supporting the grid during the winter peaks) and testing for the US regulation market. Construction on the project began in February 2015 and it is expected to be operational during 2016. Highview's LAES technology can be scaled up from around 5MW output and 15MWh of storage capacity to more than 200MW output and 1.2GWh of capacity. It can be considered as being comparable to medium scale pumped hydro-electricity storage, but without the geographical restrictions of mountains and reservoirs. When scaling up LAES technology, the system will be modular and benefit from scale and convenience, an advantage when locating it to different regions and applications.

The Pros and Cons of LAES technology:

Why Liquid Air Energy Storage?

- *No geographical constraints*
- *Close to environmentally neutral in operation*
- *Competitive capital cost*
- *Long lifetime 25+ years*
- *Scalable to 200MW/1GWh*

- *Components available from a global supply chain*
- *Integration of industrial low-grade waste heat and waste cold*
- *Uses no scarce or toxic materials*

Image captions:

Image 1: The components of Highview's processes were chosen purposefully from large OEMs so they could be readily adapted and have proven operating life times and performances.

Image 2: Fast, effective peak-lopping is an extremely desirable function from an energy grid management point of view and this is one reason why government funding has been provided. It is also a reason for considerable global commercial interest in the project.

Image 3: The centrifugal fans employ 175kW WEG W22 Premium Efficiency IP55 IE3 3~ electric motors. They are foot mounted to a skid and connected using a torque limiting anti-vibration coupling to the fan drive shaft.

About WEG

A global major in the power distribution, automation and control sectors, WEG has just celebrated its 50th birthday. The company's global sales now exceed the US$3-billion mark, representing increasing global success across a wide range of product groups, including the latest generation of transformers, LV control gear, generators, inverter drive systems, soft starters, LV and HV motors, ATEX- compliant explosion proof motors, smoke extraction motors and full turnkey systems. In addition, WEG has recently made a significant strategic expansion of its product portfolio, following the establishment of a joint venture for the manufacturing of wind turbines and the purchase of an Austrian gearbox manufacture, WATT Drive.

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