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# First IE4 synchronous reluctance motor and drive package installed

The world's first IE4 synchronous reluctance motor and drive package (SynRM) from ABB has replaced an induction motor-based variable speed drive package at South Staffs Water in the UK, resulting in an additional six percent energy saving.

At Somerford Pumping Station the company needed to replace a 20-year old, 115 kW induction motor used to control a single vertical shaft driven borehole pump which abstracts 2.5 million litres of water each day. The IE2 motor was already using an ABB drive, ACS800, and had therefore maximized the process energy saving opportunities presented by the drive's flux optimization function. The utility was interested in trialling the synchronous reluctance motor to harness its benefits including higher efficiency, greater reliability, lower heat loss, less noise and reduced maintenance costs.

The installation meant removing the existing drive and replacing it with an ABB drive, ACS850, featuring a more powerful core processor that enables operation with the synchronous reluctance motor along with the next generation direct torque control (DTC), which avoids the need for encoders and speed feedback devices.

The results from this SynRM package exceeded South Staffs Water's expectations.

"The biggest benefit, above all others, is the six percent reduction in energy," explains Keith Marshall, Supply Director at South Staffs Water. "While being one of the most efficient companies in the industry, our electricity bill is more than £9 million per year and rising through increases in wholesale energy prices. Pumping water accounts for some 90 percent of this spend as we have one of the highest pumping head of any UK water utility because of the deep boreholes and hilly terrain within our area of supply. So a six percent reduction on one pump in a system that was already very efficient is massive news for us.

"Including the UK government's Enhanced Capital Allowances (ECAs), we estimate the return on investment to be between five to six years. Given that the existing drive and motor were already fairly efficient and therefore squeezing more savings was always going to be difficult, then this is a very acceptable return."

A SynRM rotor has neither a conducting short circuit cage as with the induction motor, nor permanent magnets, nor a field excitation winding. Instead, the magnetic principle of reluctance is utilised. The streamlined rotor structure eliminates rotor cage losses, therefore increasing efficiency and compactness. Achieving standard power and torque levels at a low temperature rise class improves the lifetime of the motor insulation and lengthens the bearing lifetime or greasing intervals.

At South Staffs Water, the SynRM design has resulted in 58 percent reduction in frame temperature compared to the induction motor. "In the summer lots of sites run hot and using SynRM across more sites means we can dramatically reduce the need for forced ventilation," says Marshall. "As the rotor has effectively no losses this lowers the bearing temperature. This means we can either choose to extend the period between greasing or increase the bearing life expectancy."

The SynRM has resulted in a 75 percent reduction in audible noise: down from 78 dBA to 72.3 dBA when running at 1,450 rpm. “While Somerford is remote, the use of SynRM at booster stations close to residential areas is fantastic news for our neighbours and employees,” explains Marshall.

“What is significant is that we chose to trial the SynRM on an application that was already using leading edge drive technology, although it was controlling a 20-year old high efficiency induction motor,” explains Glen Hickman from Sentrige Control, the company responsible for designing the installation and commissioning the application.

“We could have reduced the size of the motor but for the purpose of a like-for-like comparison we opted to retain the same frame size. The additional six percent energy saving is incredible given that the application was already deemed to be extremely energy efficient. If we choose an older motor and drive combination elsewhere on the plant we believe the energy savings could easily reach 10 to 15 percent. We are now looking at applications that are using really old drive technology or where a motor-drive combination is deemed suitable.”

Such is the belief in the potential savings that South Staffs Water has brought forward its Investment Programme to capitalise sooner on the benefits. “This is such a sizable leap forward in technology over traditional induction motors that we are now considering other applications across our sites,” says Marshall. “Suddenly other applications that might have had low priority become easy targets within our Investment Programme.

“We have worked with Glen Hickman for over 15 years and during this time he has introduced many new technologies starting with frequency converters. It is one of the strengths of working with Glen and Sentrige that we remain at the forefront of technological developments. That is essential for our business and ultimately our customers.”

“The SynRM motor is specifically designed to work with variable torque loads being controlled by variable-speed drives,” says Steve Ruddell, Global Marketing Manager, ABB Motors and Generators. “Traditional induction motors are designed for fixed speed operation, which accounts for some 90 percent of the market. For the first time ever we have a motor technology that has been developed, from the outset, to specifically work with the variable-speed demands of pumps and fans.

“In the future I believe that every variable torque pump and fan application that needs a variable-speed should use the SynRM package. Most pump and fan applications are over-dimensioned by some 20 to 40 percent. At low load the efficiency gap between synchronous reluctance and induction motor technologies is at its greatest. There is simply no other combination out there that can achieve this.”

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**Caption:** The world's first IE4 synchronous reluctance motor and drive package from ABB is saving South Staffs Water an additional 6 percent.

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