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BANKING SAVINGS

Reconciling the demands of datacentre cooling with the growing clamour for energy efficiency is a big challenge for building services engineers. **Gareth Holden** explains how his firm, Excalibur Energy, made this possible for a major UK bank, cutting annual carbon emissions by 400 tonnes

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The datacentre sector has a significant incentive to improve the energy efficiency of its server farms and computer rooms.

In July 2014, datacentres joined 50 other energy-intensive industries became eligible for Climate Change Agreements (CCAs), meaning attractive rebates on the Climate Change Levy (CCL) are available, if tough energy efficiency targets are achieved.

Excalibur Energy's experience working for a major UK bank demonstrates that it is possible to improve the performance of existing systems while enhancing resilience – the foremost concern of bank staff when upgrading ICT infrastructure.

The project proved that performance issues can be resolved without resorting to disruptive and costly wholesale plant replacement.

Ejection seat

Typically, datacentres rely either on packaged cold water chillers or computer room air conditioning (CRAC) units, which reject heat from their refrigeration compressors to water-cooled condensers and dry coolers located external to the building. A constant cooling requirement means the equipment needs to operate across a wide range of ambient temperatures. Effective heat rejection is critical to both energy efficiency and resilience.

The requirement for resilience is where all datacentre energy projects start. Indeed, a major hurdle for any scheme is convincing operational staff that any modifications to improve energy efficiency will not affect system integrity. A project that improves both of these will get support from all parties and have a much better chance of progressing.

Electronically commutated (EC) motor driven fan technology has already been used extensively in CRAC units to reduce energy consumption in datacentres. We have pioneered the retrofit of EC axial fans to overcome many inherent problems associated with both dry coolers and chillers.

The renewal of the UK high street bank's datacentre involved replacing 108 AC axial fans fitted to 18 dry coolers with high-efficiency EC fans. The existing coolers were fitted with low-speed units, which limited their performance. Our initial survey showed that dry cooler capacity could be doubled from 400kW to 800kW as a result of the increased airflow from the EC fan. The existing fans were nearing the end of their useful life, so replacing them ticked the resilience box. The project also had to provide an acceptable return on investment.

EC fans represent the latest technology in both motor and blade design – the difference in blade design of the existing AC fans (see Figure 2) and the blade type that come as part of the replacement EC fans (see Figure 1) is a

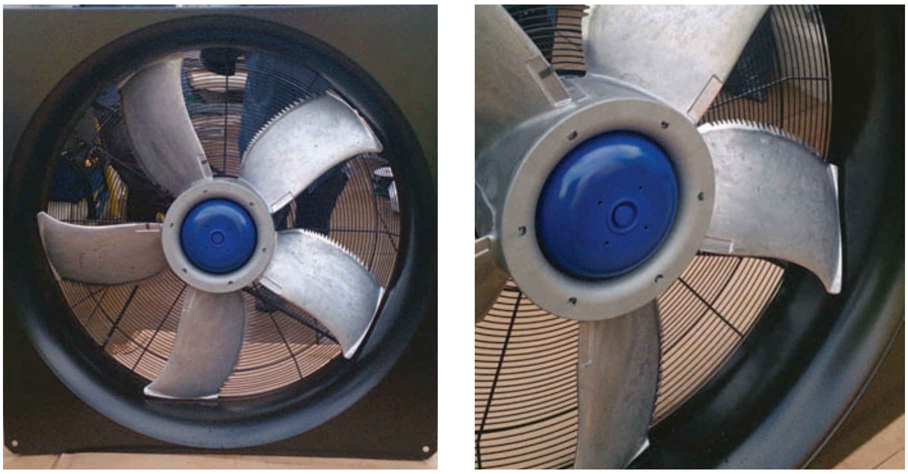

Figure 1: The aerodynamic EC fan has aerofoil-shaped swept blades with winglets, and a serrated trailing edge

major factor in increasing efficiency. This and the lower losses of the permanent magnet EC motor mean that, on this project, for the same absorbed power, the EC fan generated 100% more airflow, while achieving a 79% energy reduction at the same airflow.

Another area not often appreciated as a cause of energy inefficiency is the concept of short circuiting. This is where hot air discharged from the dry cooler or condenser re-enters the heat exchanger. It is often caused by obstructions – such as buildings or louvres – preventing efficient heat rejection, worsened by the poor 'throw' of low-speed fans.

The temperature of air into the dry cooler can be increased by 10K as a result of short circuiting, so that on a 35°C day, the system is effectively operating at 45°C, which exceeds design conditions. The EC fans generate an increased throw that overcomes these high ambient issues, often preventing the need for expensive plant replacement.

On this project, the increased dry cooler capacity meant that for any ambient temperature, a lower water temperature could be maintained. This, in turn, allowed the CRAC unit compressors to be operated at a reduced discharge pressure, increasing refrigeration efficiency and reliability. Typically, for every 3K reduction in condensing temperature, compressor efficiency increases by 9%. Considering that the absorbed power of the compressors is five-times that of the dry cooler fans, it is clear that optimising heat rejection is critical to energy performance.

The existing AC fans were operated using a simple step control, which is perfectly common across the industry. But with a set temperature of 14°C for the majority of the year, all fans operated at 100% because the required temperature could not be achieved.

EC fans – by contrast – allow speed control between 0 and 100%. Using cooling load and water temperature as references, water temperature was optimised to maintain the most efficient fan and compressor energy consumption at all times.

The datacentre remained operational during the eight-week, with no requirement for temporary cooling. We also carried out pre and post-monitoring to validate both the increase in performance and improvement in energy efficiency. This data-led approach was particularly important for building confidence with project champions.

The work has improved the bank's energy efficiency: a cut in carbon emissions of more than 400 tonnes a year is helping to achieve CCA targets, resulting in CCL rebates.

It is also a project that qualifies for 100% tax allowances under the Enhanced Capital Allowance scheme, and one that delivered a return on investment of less than three years. Most importantly, we guaranteed an increase in cooling capacity and more resilience. For the frugal bank manager it's the ideal scenario. CJ

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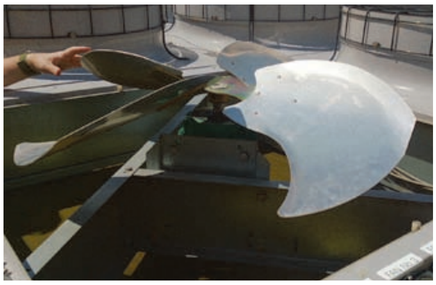

Figure 2: The datacentre's existing AC fans were nearing the end of their useful life