CTTC - TEGA Article

by Paul Hanbury

The ECM Fan Array

The Electronically Commutated Motor, or ECM, has infiltrated the small fan market. The technology gained ground several decades ago, mostly with small scale process applications and residential air conditions. More recently the ECM fan has made a huge impact with fan powered boxes. Currently they're being used on fan coil units; air cooled condensers, evaporator coils, bio-safety cabinets, and a host of other small fan applications. Although limited to low pressure air systems (~ 4.0" w.c.), there have been recent improvements in the technology that suggest the ECM can do more, even central air handling systems. With this technology an air delivery systems can be optimized with incredible turn down efficiencies and flow control between central and terminal fans.

The benefits of the ECM fan versus the more traditional permanent split capacitor (PSC) induction motor is that the ECM is powered by direct current (DC) electricity with electronic commutation systems, rather than mechanical commutators and brushes. While AC current is connected to the ECM motor, it has an internal rectifier that converts AC current to DC power. The current-to-torque and frequency-to-speed relationships of an ECM are linear, and therefore extremely more efficient at part loads. This is even more apparent when you include the drive losses on three phase motors.

There is an array of ECM fans at the University of Massachusetts Medical School (UMMS) South Street facility that serve a 7,400 square foot data center. Each array consists of (12) 7.5 HP ECMs, with backwards curved fans, that can deliver 83,000 CFM at 2.5" w.c. The two arrays combined can deliver a total of 166,000 CFM, which is enough air to cool the maximum design data center heat load of 1.2 MW (SA=75F to RA=100F). The air distribution system is a plenum design that allows for a low pressure drop at maximum design flow (T.S.P < 2.0"). The 24" raised floor is maintained at a constant positive pressure of 0.05" by an array of static pressure sensors under the floor that modulate the discharge of the ECM arrays. The turndown of the ECM array is so good that perforated tiles are only added with new IS equipment, unutilized floor space is left all solid tile. Each added perforated tile delivers the design air flow. Rack mounted temperature sensors let the facility staff know if more tiles (or even grates) are needed. The supply air flow closely matches the IS equipment air flow, saving tremendous amount of fan power. What's more, the air flow system can seamlessly grow with data center load without compromising on efficiency.

The ECM fan is directly controlled by the Building Management System (BMS); a single fan on the array can be modulated, start, stop, measure air flow, pressure drop, and power draw. The ECM array provides not only an energy efficient central fan, but provides redundancy with easy to replace multiple fans. The motors also have a longer life cycle and take up less space than traditional fans. A potential candidate for an ECM array in a large building central air handling systems could be a dedicated outdoor air system (DOAS) with the primary air distribution sized for low pressure drop, and ECM fan powered terminal units as well. A facility with such a system, combined with a robust BMS, would be capable of turning down the central air system to closely match only what the terminal units need for primary air; even if it's just one terminal unit calling. The manufacturer of the ECM fans at UMMS; http://www.ebmpapst.us/