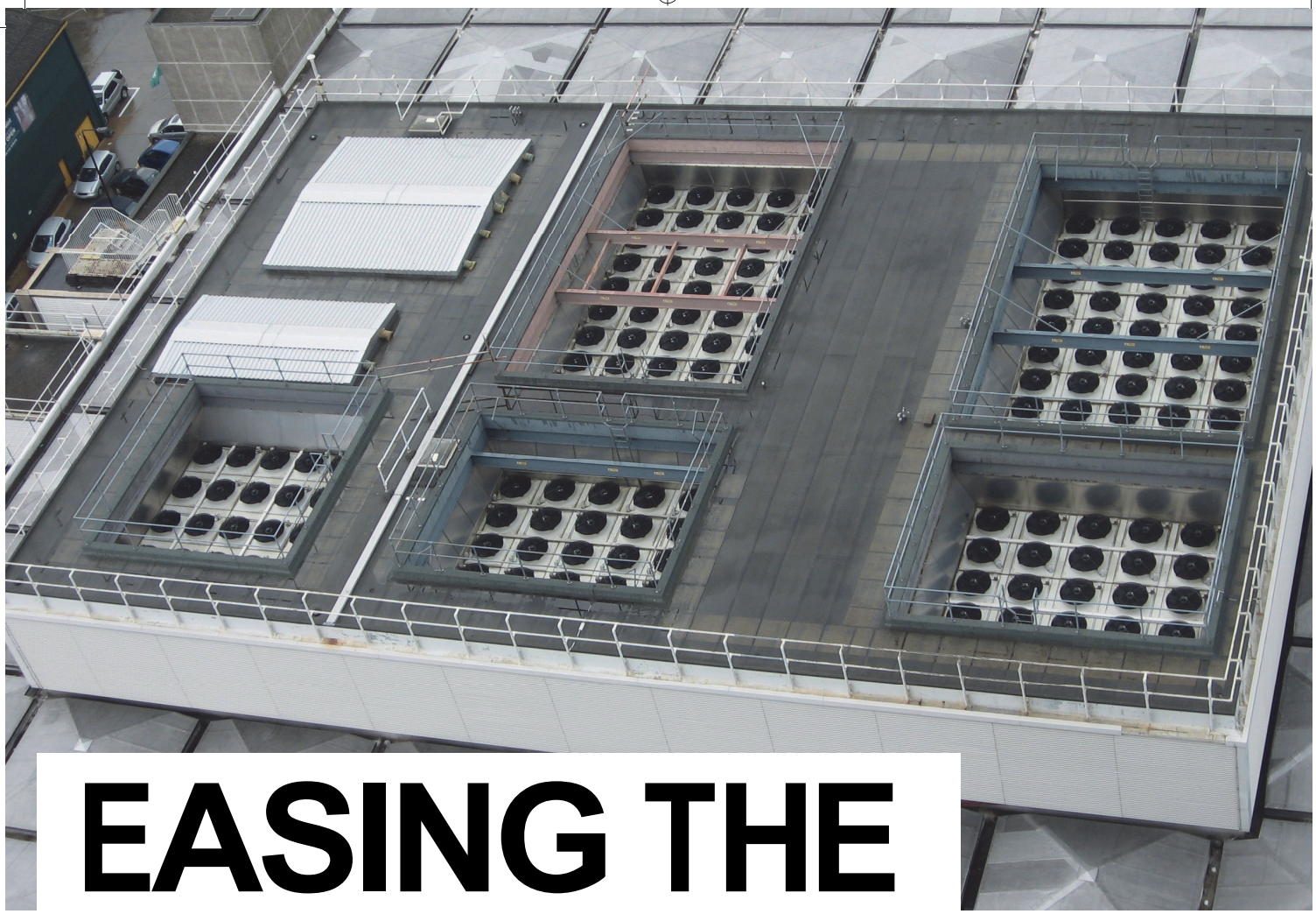

EASING THE PRESSURE

The installation of liquid pressure amplification on two chillers has cut electrical consumption by 38% on a pilot data centre project for a High Street Bank. Gareth Holden reports

Data centre server room

Data centres offer a unique challenge to energy management; a constant year round heat load means that cooling represents a significant energy cost. The critical nature of the building means that a very conservative approach to design and modification is adopted.

Excalibur Energy was approached to investigate the potential to reduce the energy consumption of these chillers. Its study showed that there was potential to reduce electrical consumption by nearly 40%.

Excalibur proposed the installation of liquid pressure amplification (LPA) along with the chiller manufacturer's recommendation of replacing existing condenser fans with more efficient Electronically Commutated (EC) fans.

Data centre technical staff had to be persuaded that modification of their chillers would not effect the resilience of their building. A presentation demonstrated that no single point of failure would be introduced as a result of the modifications.

Further confidence was gained by undertaking condition monitoring of each refrigeration circuit using the Climacheck analyser to ensure the chillers were in good working order prior to works commencing.

Improved refrigeration efficiency is achieved by reducing compressor discharge pressure; this is commonly referred to as 'floating head pressure'. Reducing discharge pressure positively affects efficiency in two ways: absorbed power is reduced while cooling capacity is increased.

LPA allows the minimum discharge pressure to be reduced well below what would normally be achievable, with improvements in efficiency of 25% to 35% achievable.

Patented in the US, LPA allows a chiller to be recommissioned for efficient floating head

pressure operation. An LPA pump is located in a fabricated manifold in the drain from the condenser; this pumps liquid refrigerant to the expansion valve, maintaining a flow of good-quality liquid refrigerant at the expansion valve during low head pressure operation.

With the condenser fans adjusted for low head pressure operation, it is important that accurate fan control is maintained whether by inverter control of existing fans or, as in this case, by replacing the existing alternating current (AC) fans with EC fans, which can be speed controlled.

Typical head pressure control is achieved by cycling condenser fans on and off to maintain the desired pressure. This is not accurate enough for low head pressure operation. Inverter or EC fan control allows all condenser fans to be operated and their speed modulated to provide precise control of pressure; the correct control allows discharge pressure to be continually optimised against ambient temperature and cooling demand.

If these operating parameters were maintained without the installation of LPA, a condition commonly referred to as 'over condensing' is experienced. This is where discharge pressure has been reduced to a level where liquid refrigerant starts to evaporate before it reaches the expansion valve, leading to reduced capacity and efficiency.

Installation of LPA requires the recovery of refrigerant and the fabrication of a manifold on the discharge side of the condenser. Bypass pipework ensures that in the event of a pump fault (generally as a result of a loss of refrigerant), the chiller will continue to operate. This fault signal will increase head pressure to ensure that over condensing does not occur.

The LPA control will generate a fault condition when 5% to 10% of refrigerant has been lost, and so provides an early warning that the chiller should be tested for leaks.

Data centre chillers

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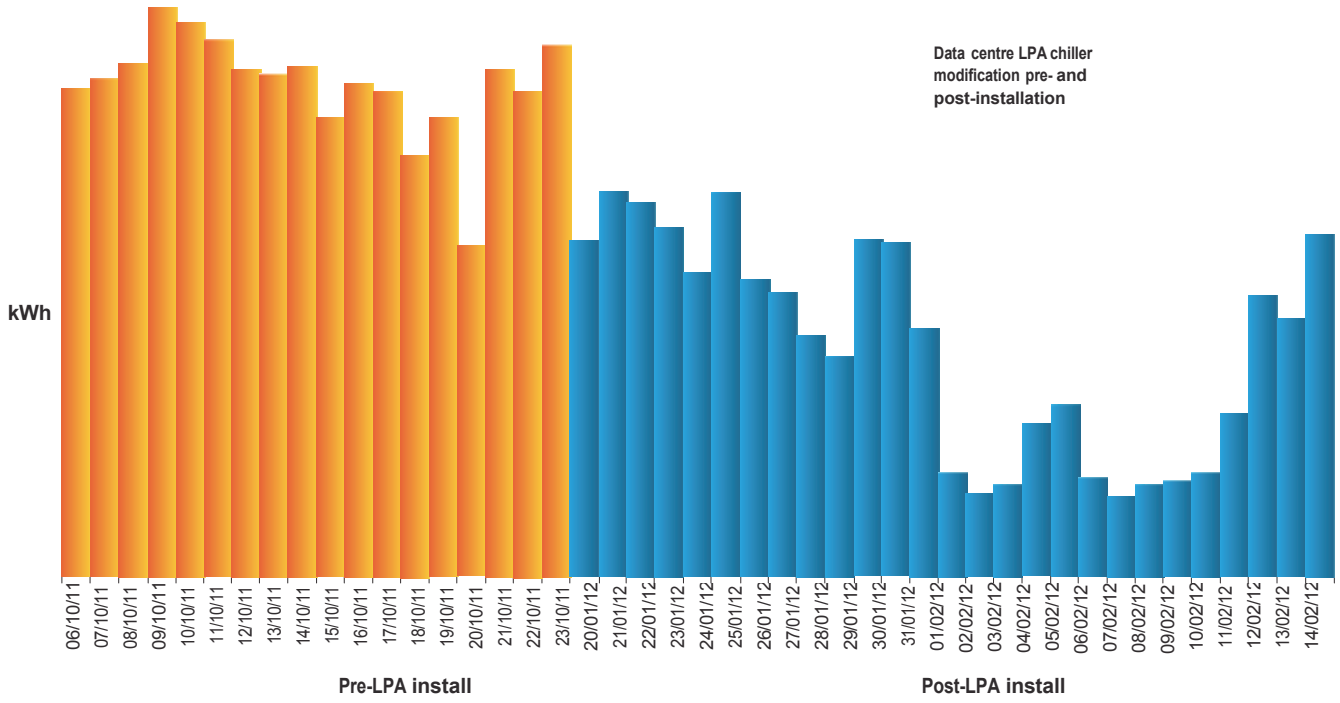

Data centre LPA chiller modification pre- and post-installation

Two 700kw, two-circuit chillers operating on R407c were selected for a pilot installation, these chillers incorporate free cooling coils, which would also show an increase in capacity as a result of floating head pressure operation.

The energy consumption and cooling capacity of these chillers was monitored for a period prior to installation works being undertaken to provide a baseline for efficiency.

Following the installation of LPA and EC condenser fans, the chillers were commissioned for floating head pressure operation and the monitoring repeated.

The results over the period of monitoring showed a reduction in absorbed power of 38% (see graph, p47), which represents an annual reduction in electrical consumption of 325,000 kwh and 177 tonnes of CO^2 for a single chiller.

The monitoring also demonstrated the effect that the increased airflow generated by the EC fans was having. Prior to modification, the chillers were able to entirely satisfy demand in free cooling mode when external air temperatures fell below 1°C; following the modifications, cooling demand could be satisfied when air temperatures fell below 4°C, thus ensuring a further reduction in chiller energy consumption. **CJ**

• *More details at www.excaliburenergy.co.uk*

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