Continuous Optimisation of Imperial College London's Laboratories

Imperial College London

As one of Britain's premier science and technology universities, a large proportion of Imperial College's Estate is laboratories and related facilities. This means that its Carbon Management Plan target of a 20% reduction in CO_2 emissions from 2008 levels by 2014 can only be met if laboratory energy consumption is significantly reduced. This is now being achieved through a Continuous Optimisation (ConCom – also known as continuous commissioning) programme, which involves detailed examination of individual buildings to identify opportunities for safe improvement. The examination involves identifying the original design specifications; analysing the current occupation strategy and area by area use; identifying the service strategies which are actually needed to meet current requirements; and developing proposals for operational changes and cost-effective investment to meet these requirements in safe but more energy efficient ways. As the examples show, this typically involves measures such as air change volume adjustments; changing AHU temperature and time set-backs; introducing more efficient plant; adjusting pump delivery to meet flow demands; improving filter efficiencies; and introducing occupancy controls such as CO_2 sensors and user switches.

Flowers Building Night Setback

A ConCom analysis of the Flowers Building identified that the main air handling services were operating 24/7 at levels considerably above the original design. Environmental conditions and operational dependencies were discussed with users and revealed that considerable areas of the building were not being used at night, creating an opportunity for setback. As part of their re-commissioning, the four AHUs were fitted with motorised dampers and controls. This allowed the air change rate between, initially, 22.00-07.00 and subsequently 18.00-07.00, to be reduced from 13 to 6 air changes per hour. The daytime air supply pressure was also reduced from 400 to 300 pascals. The changes have reduced the building's annual energy costs by £48,159 and carbon emissions by 315 tonnes, with a payback within 12 months.

Chemistry Building

Key Points

- 1. ConCom provides a strategic approach to managing the energy consumption in buildings.
- 2. Research demands controlled environments heavily reliant upon plant/infrastructure not natural ventilation.
- 3. When new facilities are handed over, operational parameters are delivered as designed, but use and occupancy changes with academic practice and carbon is often wasted.
- 4. ConCom optimises the environmental conditions in laboratories, while maintaining safe working environments, by working with academics to reduce:
  - air volumes delivered
  - temperatures
  - operational time of plant & services
  - filter efficiency
  - energy costs & consumption

S-Lab Case X – Imperial's Continuous Optimisation

Air Change Rationalisation

Many Imperial laboratories have between 10-14 air changes per hour (AC/H), which is double the CIBSE guidance of 6 and even further from the Labs 21 aspiration of 3-4. The ConCom programme involves measuring current air change rates, working closely with users to understand building operation and system performance, and then making gradual adjustments to fan motor speeds and cooling and heating set points. In the Sir Alexander Fleming (SAF) Building this led to reductions from 13.8 to 10.1, 11.7 to 10.8 and 10.9 to 8.0 in the three zones within the building (each served by a separate AHU). This resulted in an annual saving of £31,450 in energy costs, and 274 tonnes of CO_2 emissions. Further savings are anticipated by reducing AHUs further and by linking the BMS to live weather data.

Filter Optimisation

AHU fan motor speeds – and therefore energy consumption - are partially related to the air flow resistance of filters, which varies by condition (i.e. clogging) and type. High efficiency filters are less prone to clogging, but can be more expensive to buy. The ConCom Programme has, with Carbon Trust support, conducted trials to identify and evaluate filter improvement options. One measure identified – replacing standard G4 panels with 30/30 pleated panels – has already been implemented in the SAF Building, giving an annual energy cost saving of £2,492, with a 42 month payback. Further savings of £13,820 are anticipated by applying it in other buildings. Three other simple but high impact measures identified in the pilot were improving filters and changing regime for AHUs under 15 kW (with potential annual energy cost savings of £24,373 when applied in all buildings), and changing panel filters (£10,396) and bag filters (£6,273). Other measures identified with positive paybacks were replacing pad filters with 30/30 pleated panels, replacing HEPA H13 filters with H10, and replacing S Flo (WU) and Opakfil (rigid) with panel-less Hi Flo Bags.

Sir Alexander Fleming Building

Views

"Our continuous optimisation programme is underpinned by large scale investment in metering – which we've spent over £1million on in 2009-11 – and Britain's largest TREND Building management System. These enable us to understand consumption patterns and identify improvement opportunities, and to monitor the performance of pilot exercises and improvement actions. However, our actions will only be effective if we have the support of building users, who help us to ensure that there's no risk to research, teaching or safety. To help maintain and build this support, we are currently making energy costs and carbon emissions data for individual buildings available through a 'Carbon Desktop' on the Intranet."

Kevin Cope, Head of Building Operations, Imperial College

Further Information – www.goodcampus.org. The case is based on a EAUC Suste-Tech workshop presentation – see www.eauc.org.uk/greening_ict_with_jisc. Version 1.0 August 2011.

Disclaimer – Every effort has been made to ensure accuracy, but readers should verify all data.