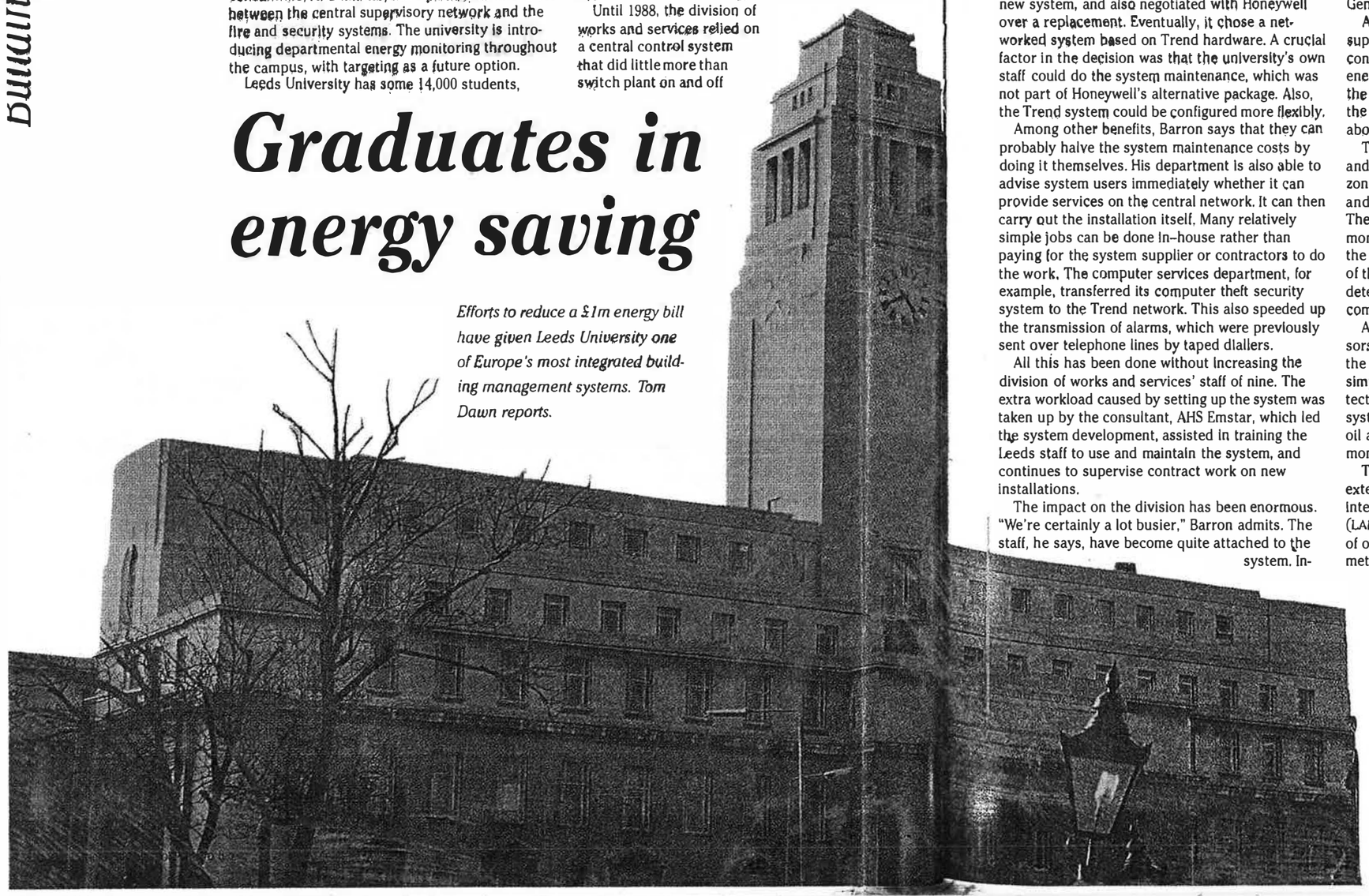
Graduates in energy saving

Efforts to reduce a £1m energy bill have given Leeds University one of Europe's most integrated building management systems. Tom Dawn reports.



Leeds University's building management system (BMS) is emerging as one of the largest and most integrated in Europe. The university has taken over its own system maintenance, for economy and control. The project has cost more than £1m so far, which it has met from savings in the energy budget.

One example of these savings is in the tariff negotiations with the local electricity company, which covered the cost of a major part of the installation, in the Medical & Dental Building.

The 20,000 points already linked to the BMS include heating, ventilating, air handling, fire, security, metering and monitoring equipment. To get this level of integration, the university and its consultants, AHS Emstar, have pioneered interfaces between the central supervisory network and the fire and security systems. The university is introducing departmental energy monitoring throughout the campus, with targeting as a future option.

Leeds University has some 14,000 students, whose numbers are expected to swell to 18,000 by the year 2000. Most of them are based at the central 100 acre site and live in student accommodation on campus. Not surprisingly, the university's energy needs are considerable. It has an electricity bill of more than £1m, and burns 6 million litres of oil and 800,000 therms of gas a year.

This substantial bill provided the motivation for a progressive energy policy. The Medical & Dental Building, which has shared a combined heat and power scheme with the Leeds General Infirmary for 15 years, negotiated hard to cut its electricity tariff and converted plant to burn heavy oil.

Now the introduction of resource centring, where each department is responsible for its own expenditure, has provided the impetus to identify each department with its energy use.

Until 1988, the division of works and services relied on a central control system that did little more than switch plant on and off by a time clock, and had very limited memory and calculation facilities.

"The need for a more sophisticated energy management system was one of the triggers for replacing the existing system," says Michael Barron, mechanical maintenance manager at the division of works and services. "We had reached the situation where we needed either to upgrade our Honeywell Delta system, or put in a new one altogether."

In an installation of this size, an integrated system was the natural choice. Various manufacturers, including Honeywell and Thorn Security, produce complete systems and others such as Satchwell and Trend produce equipment designed to enable integration of different equipment.

The university retained AHS Emstar (then simply Emstar) as consultants to advise it on the choice of new system, and also negotiated with Honeywell over a replacement. Eventually, it chose a networked system based on Trend hardware. A crucial factor in the decision was that the university's own staff could do the system maintenance, which was not part of Honeywell's alternative package. Also, the Trend system could be configured more flexibly.

Among other benefits, Barron says that they can probably halve the system maintenance costs by doing it themselves. His department is also able to advise system users immediately whether it can provide services on the central network. It can then carry out the installation itself. Many relatively simple jobs can be done in-house rather than paying for the system supplier or contractors to do the work. The computer services department, for example, transferred its computer theft security system to the Trend network. This also speeded up the transmission of alarms, which were previously sent over telephone lines by taped diallers.

All this has been done without increasing the division of works and services' staff of nine. The extra workload caused by setting up the system was taken up by the consultant, AHS Emstar, which led the system development, assisted in training the Leeds staff to use and maintain the system, and continues to supervise contract work on new installations.

The impact on the division has been enormous. "We're certainly a lot busier," Barron admits. The staff, he says, have become quite attached to the system. Instrument mechanic, Tony Quigley, readily agrees: "We're really chuffed with this system. It's given us pride in what we're doing". Since taking on the extra responsibility, the division has had to review its work priorities. This has been partly achieved through the benefits of the building management system, and by reviewing the planned preventive maintenance scheme, lengthening the maintenance intervals where possible.

Freed from reliance on a single supplier, the university is able to choose from a variety of manufacturers' equipment. The choice also depends on the willingness of manufacturers to disclose their communications protocols, because of the need to write software interfaces between the proprietary systems and its central network. Equipment interfaced into the central network includes Gent fire alarms and Modern Alarms systems.

At the top level, the BMS has three Trend supervisors based on personal computers. These continuously monitor alarms as well as collate energy information. The Trend supervisors are in the Security Office, the Central Boiler House, and the Medical and Dental Building, which consumes about a quarter of the energy on the campus.

The conversion to a Trend system in the Medical and Dental Building has enabled the university to zone the building, use energy more economically, and monitor the operation of the building services. The security office, which is staffed 24 hours a day, monitors the state of individual fire detectors, and the security system. Its monitor also displays a plan of the campus showing the position and state of gas detectors in the service ducts. The personal computer is backed up with a printer.

At the central boiler house, the Trend supervisors present information diagrammatically about the state of heating and air handling plant, which simplifies remote fault diagnosis. Password protection allows permitted staff to change control system settings from the supervisor PC. Electricity, oil and steam use is analysed with Stark Associates monitoring and targeting software.

The Trend system runs on an internetwork that extends through the length of the campus. To the internetwork are connected 17 local area networks (LANs), which are ring circuits connecting a series of outstations. Some outstations are simply for metering or monitoring alarm systems, others are multi-functional. The advantage of LANs is they form a very secure system and reduce central communications traffic, at low cost. If a network is broken, the system elements are able to operate independently. Several other small networks at off-campus premises are connected to the internetwork by modem over telephone lines.

The LANs connect some 200 outstations around the campus, quite unevenly at the moment. Parts of the campus have many outstations, such as the Medical and Dental Building, which has two LANs

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to itself. Other networks are very lightly used, as the existing services have not yet been replaced. The process of running down the old system while connecting up the new one is evolutionary, but the network structure is in place.

Electricity meters were installed throughout the campus immediately the networks were laid, starting two years ago. Almost every building on campus has its own meter, larger buildings are subdivided. There are 137 electricity meters installed so far, including some at substations as a double check. As a final check, others are connected in tandem with the local electricity company's meters. The Trend outstations monitor and record electricity used at one–hourly intervals (in the case of the local electricity company's meter, at 15–minute intervals). This data is collected twice a day, and analysed by the monitoring and targeting software.

The university is now building up complete information on departmental energy use, and is about to introduce "ghost" accounting for energy. From the new financial year, departments will be told what their electricity use was. In future, it is likely that they will be billed for it. Similarly, the division of works and services plans to install about 100 steam/heat meters on the heating system, work which it has only just begun.

The first security service connected to the network was gas detection. The inquiry into the 1984 Abbeystead disaster, in which 16 people died in a methane gas explosion at a Lancashire water outfall station, was still quite recent. The university had become aware that it had a substantial gas risk because its gas supply ran through several miles of service tunnels underneath the campus. Some 25 gas detectors were clustered around valves and metering points on the gas distribution system.

However, the most radical change in services has been to the university's fire alarm system. The number of fire alarm points has grown to around 3,000. For instance, during the recent refurbishment of the Parkinson Building (a listed building, which includes part of the Brotherton Library), the works and services staff removed 12 break glass systems, and installed 100 new fire alarm detection points. The change also includes the transition from a purely close–contact break glass system, to incorporate heat and smoke detectors, addressable by Gent 3400 fire alarm systems.

The university has installed five Gent 3400 fire alarm systems, and will add more. These are independent systems, but if a fire alarm occurs, the information is displayed both on the addressable control panel and on the security supervisor, showing the location and type of the sensor to assist the fire brigade. "I believe this is the first installation where these systems have been linked. It generated a lot of interest within the fire systems industry," says Peter Hiddleston, AHS Emstar's systems division technical manager, who discovered the task was not so easy as expected.

Although Trend and Gent are both part of Pillar Electric, the complications of the communications protocol made the task of writing the software interface a lengthy one. Ironically, a similar interface, between the Trend system and the university's Modern Alarms 4500 security system, proved much easier to write. The flow of information from the fire and security systems is strictly one–way. There is no question of the Trend supervisors interfering with the integrity of the fire and security systems. "We would like to be able to address the fire alarm system from the Trend supervisors, but we would need to bring the central system up to fire alarm standards of integrity to do so," says Barron.

> *'We're really chuffed with this system. It's given us pride in what we're doing.'*

Tony Quigley

The outstation software has also been modified to direct alarm signals to multiple destinations, up to five or six. For example, it may have to send signals separately both to the printer and the personal computer in the security office, as well as to the other supervisors. "The Gent interface came about because we had Trend and Gent systems going in at the same time. It seemed the most logical step. We have always had a close contact link to security, so we decided to take advantage of the addressable system as well," says Barron.

The BMS is developing at its own pace, at different speeds in different areas. The full potential of integration is being discovered as and when new services are requested and connected to it. "Because the system has distributed intelligence it lends itself to that. It is very flexible," explains Hiddleston. However, one of the options open to distributed intelligence systems, that of autonomous control by the BMS of local heating, ventilating and air conditioning plant in the event of the fire, has yet to be developed at Leeds. The decision making process remains in the control of the human operators.

Michael Barron, Leeds University (left) with Peter Hiddleston, AHS Emstar.

The main system elements are in place, although the system is set to continue growing apace. There is a flush of building and refurbishment work at the university, which promises to keep the division of works and services extremely busy for several years ahead. "There is a lot of work to do, and a lot of money needed to do it," says Barron. It is a fortunate time for his department to have a tight hold on the system costs. □