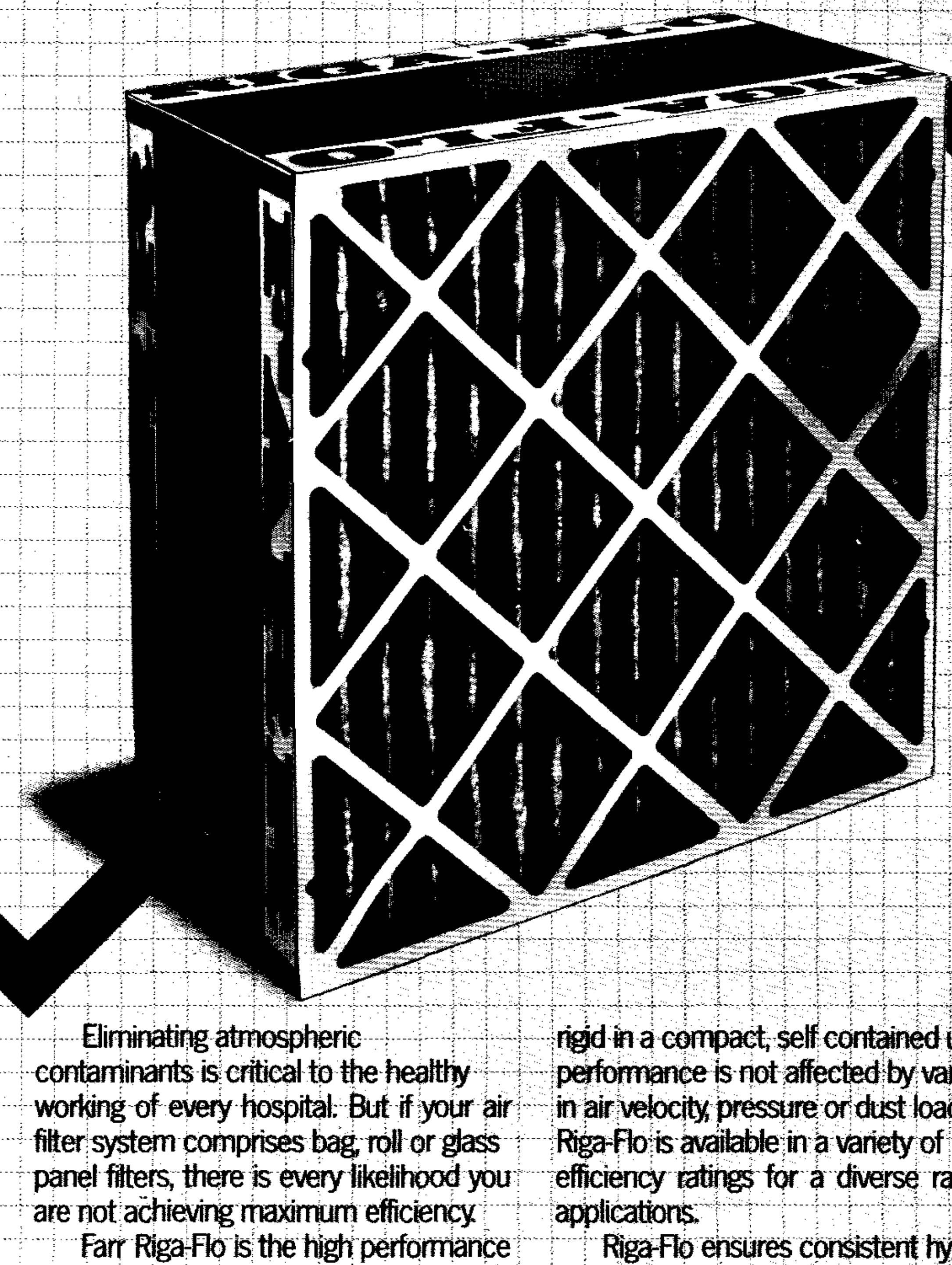
The Journal of The Institute of Hospital Engineering November 1985

HOSPITAL ENGINEERING

- Experience in the use of energy management system
- Cost control for health building projects
- Staincliffe Hospital's new energy centre



HOSPITAL ENGINEERING

The Journal of The Institute of Hospital Engineering

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Front cover: Control room panel system incorporating temperature, heat meter, oxygen trim, draught and smoke monitoring at Staincliffe hospital energy centre. (See feature on page 12).

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Talking Point

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The medical engineering speciality

RICHARD HORTON TEng MIHospE

Slowly but surely over the past two decades, the activity which we know today as Medical Engineering has continued to evolve. A few very far sighted Health Authorities back in the 1960's had the commitment to set up units which were able to deal with not only the medical equipment of the day, but which also laid the foundations of the best of the Medical Engineering Units that we have today. Others clung to the belief that medical equipment could be dealt with by traditional engineering methods and quickly discovered that the expenditure on service contracts and breakdown call-outs called this assumption into question.

Given the benefit of hindsight, it would be enlightening indeed if individual Health Authorities were to correlate the current cost of maintaining medical equipment with the date when each specialist 'in-house' medical engineering unit was established.

Since those early days, much has happened to the speciality, not least of which has been the interest shown by traditional physics departments who felt this was a new role for them in the National Health Service. Irrespective of whether the Medical Engineering specialty has ended up under the Works or Physics umbrella, the Medical Engineers involved continue to move freely from one regime to another, thereby underlining the continuity of the activity itself as distinct from the administrative umbrella.

Qualified service

Very many Medical Engineers are now full members of the Institute of Hospital Engineering and other learned societies and are either Chartered Engineers or registered Technician Engineers. For the most part, the relevant experience and responsibility being attained specifically in the Medical Engineering speciality.

As the volume and complexity of medical equipment has increased, a far more detailed working relationship has been brought about quite inevitably with clinicians, nurses and many other professionals. In many hospitals indeed the Medical Engineer is now an essential member of the health care team, providing not only an equipment repair facility, but also the entire range of activities outlined in H.E.I. 98.

It is perhaps peculiar to the United Kingdom that, as yet, no clearly definable career structure exists for Medical Engineers. The assortment of grades used to pay the specialty includes:- Senior Scientific Officer, Works Officer I, II and III, Medical Physics Technician IV to Principal, Electronic Technician, Craftsman V, Principal Physicists, University Technician grades V and VI. Quite clearly, this rag bag should be rationalised in the interest of all concerned or, beter still, replaced by a comprehensive career structure which accommodates all the staff involved, from trainee Medical Engineer to District Medical Engineer, which will reflect the district based, as distinct from unit based, service which is provided by most Health Authorities.

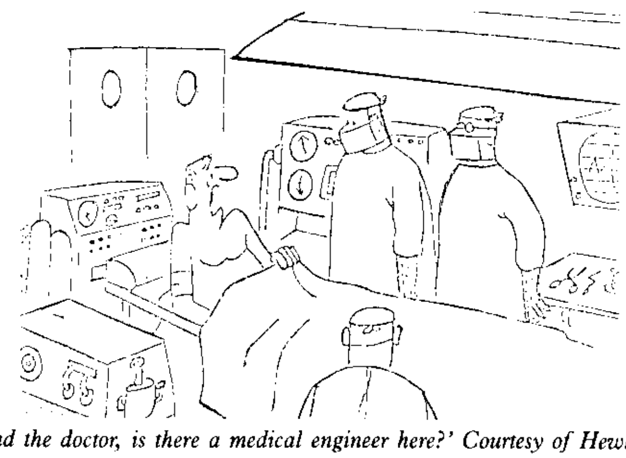
Changing situation

In contrast, specific career grades have long since existed in the E.E.C. countries, the Middle East and North America. I feel sure that it is now only a question of time before Medical Engineers in the United Kingdom are recognised by an appropriate grading structure for the entire profession.

Because the profession has only existed for two decades, we are only just beginning to see Medical Engineering specialists emerge in District Works Officer posts and other senior appointments. This is, of course, not unconnected with the fact that for the first time, in 1985, expenditure upon medical equipment supplies and services has overtaken drugs as the largest single item of N.H.S. expenditure.

If any meaningful attempt is made to ensure value for these vast sums of money, then the expertise of Medical Engineers in the selection, training, evaluation, servicing and management of all such equipment is essential, since none of the other specialities involved have the required expertise.

A time for bold decisions is approaching, not unlike the early days of Medical Engineering, when the speciality should be involved in all decisions regarding medical equipment, which will have far reaching benefits for patients, staff and tax payers alike.



'Never mind the doctor, is there a medical engineer here?' Courtesy of Hewlett Packard.

This paper, here abridged, was first presented to the West of Scotland Branch of the Institute in February 1984, when the author was Senior Engineer at Gartnavel General Hospital, Glasgow. He is now Senior Engineer at the Royal Hospital, Sultanate of Oman.

Experience in the use of an energy management system

R T STATHAM DMS TEng MIHospE MBIM

Introduction

Many papers have been written discussing the benefits which Energy Management Systems have brought to hospitals where they have been installed. In particular, these include financial savings through heating economies and greater plant monitoring availability to the hospital engineering staff.

This paper intends, however, to examine Energy Management Systems from the 'test drive' aspect. It will examine, through the first year's full operation of a typical system, the strengths and limitations, its versatility and its potential for the future.

The paper will also discuss the necessity for training, Health and Safety policy, and inter-departmental liaison, in successfully integrating an Energy Management System into the Hospital structure.

The energy management system at Gartnavel General Hospital

Technical assessment

The system installed at Gartnavel is a Transmitton Micropower 100 Energy Management System. The transmission network utilises a four wire telemetry system for communication between the central station and the 'outstations', located in the hospital's plant rooms. The system layout is illustrated in Figure 1.

The outstations collect data from the various monitor points and send this data through the telemetry system to the central station. They also receive instructions from the central station in order to control the plant connected to the system.

At the central station, the operator can key in instructions and operational parameters, and request reports, using either a visual display unit (VDU) or a teleprinter terminal. A further teleprinter terminal located in the boilerhouse enables shift fitters to monitor plant performance outside normal working hours.

An Intel 'Bubble' memory storage device shares the computer's programmer, as well as parameters and collected data.

Outstation configuration

Each outstation has sixteen control points and sixteen monitor points. The control points each consist of a relay, and a three way switch, which are connected in series with the control circuit concerned. The method of connection to a typical motor starter control circuit is illustrated in Figure 2. It should be noted that, if such a circuit is to be isolated locally in an emergency with the circuit in the 'auto' mode, (e.g., switched through the relay), the 'off' button should be of the mushroom latching off type. The modification to the motor control circuit in no way interferes with the operation of the circuit overload or the smoke detector/break facility.

The monitor points consist of eight digital points and eight analogue points. Digital points may be used to establish, typically, the running status of a piece of plant. Analogue points enable the measurement of temperature, pressure, relative humidity etc., through the hospital. A twisted pair and screen cable connects the oustation analogue terminal points to either a suitable transducer or an interface circuit.

Metering may be carried out using an outstation digital point to count digital pulses transmitted by, for instance, a steam flow meter.

System software and parameters

It would be worthwhile at this stage to re-

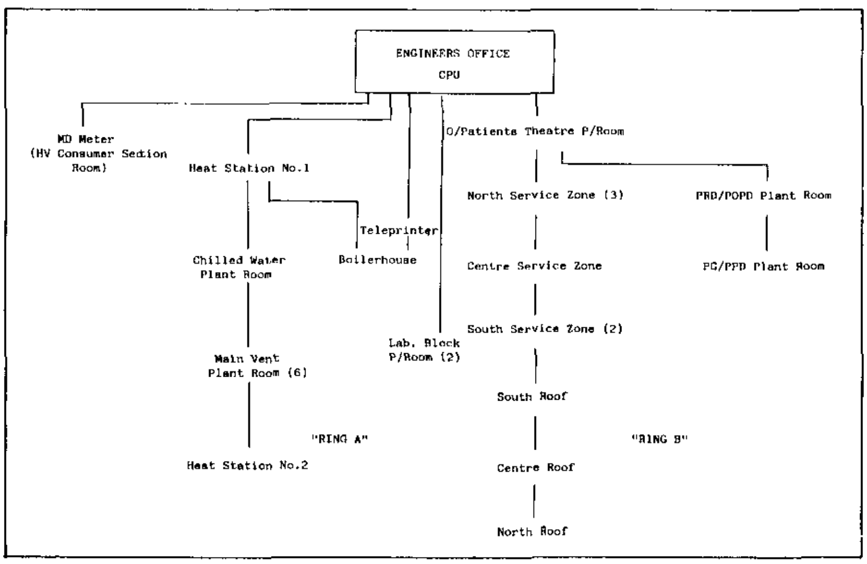


Figure 1. System layout — telemetry runs between CPU and outstations.

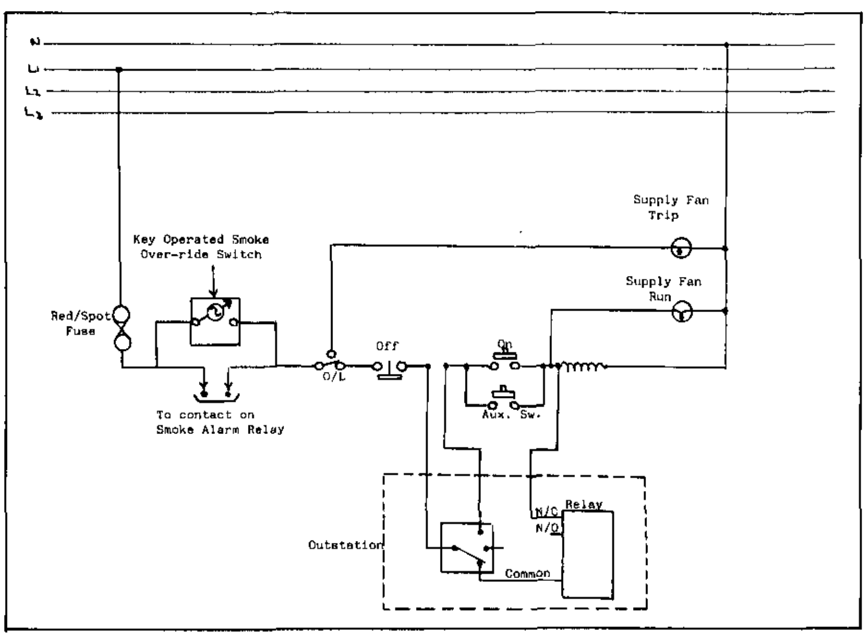


Figure 2. Wiring connections from outstation to motor starter circuit.

mind readers what precisely is meant by 'hardware', 'software', and 'parameters', since the last two items in particular are often misused.

The system hardware consists of the microprocessors and other electronic devices which make up the central processor unit, the interface devices (visual display unit and hard copier), and the outstations. The software is the programme on which the computer runs, its 'behavioural characteristics'. The majority of energy management systems are programmed by the supplier. Only the most sophisticated systems can have their programmes written or modified by the user, and this usually requires several weeks of computer training before it can be attempted.

In the majority of cases the user, having had the software provided, uses this software to write in his own parameters for the various output and monitor points. When parameters are being entered, the procedure is usually carried out on a 'menu' basis, that is, the computer 'asks' the operator for the parameters in a logical sequence.

The parameters thus entered determine the precise nature by which the energy management system monitors conditions and controls the plant. The times at which plant is started and stopped, the temperatures at which heating systems are shut down, and the pressures and temperatures at which printouts and/or alarms are activated, are all determined by the parameters which are entered into the system. Clearly a great deal of care, and groundwork, in entering the parameters is essential if the system is to operate successfully.

Figure 3 illustrates the sequence of setting up the operational parameters on the Micropower 100 System. From the information gathered in Steps 1-6, a site survey sheet can be drawn up (Figure 4).

Day parameters have to be set up, whereby the computer recognises day types by numbers (e.g., weekdays, Sundays, Public Holidays). Other basic information required by the system includes the data on time zones (zone parameters), data for optimum start/stop control on different heating groups (group parameters), and data for maximum demand control (control and segment parameters).

Once all this data has been entered into the system, parameters for the individual monitor and control points can be entered. These points may be allocated a time zone, an optimum start/stop group and maximum demand or cyclic control characteristics, as well as many others, by the parameters thus entered. A typical parameter sheet for all the control and monitor points in one outstation is illustrated in Figure 5.

Controlling the plant

This Chapter examines the way various plant in the hospital is being controlled, and examines such considerations as existing plant control systems, building characteristics, and the savings implications of the control parameters entered into the Energy Management System.

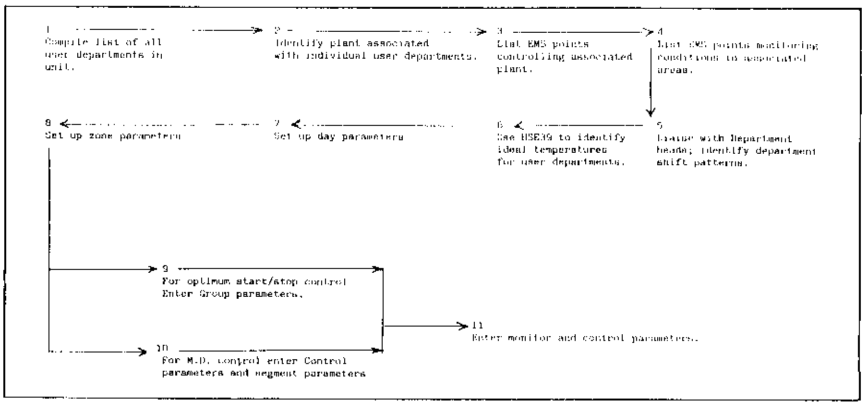


Figure 3. Flow diagram showing procedure for setting up operational parameters.

Ward tower heating

Figure 6 illustrates the heating zones for the ward tower block which rises nine storeys above the ground level. The limitations of the outside temperature compensated heating circuits will quickly be realised, with no allowance for windage and solar gain on the tower.

EMS tempeature sensors are located throughout the tower block, generally in four bed bays, which are less susceptible to solar gain and wind factors than the single bed rooms.

Control of the ward heating pumps is effected through monitoring of these ward conditions. If a zone temperature exceeds the prescribed limit, the EMS will shut down the heating pump for that zone. When the pump is running, the local compensated circuit controls will regulate radiator flow temperatures.

Time of day control

This is possible where departments are not in use twenty four hours per day. This is the case in most of the hospital's podium areas which accommodate the outpatients and diagnostic departments. There are

Figure 5.

OUTSTATION Nº 2A RING Nº 1 ISSUE Nº 1 LOCATION Main Vent P/Room

OUTPUT Nº & REF		SIT	B.T	OFF	EXT	HOL	CUT	PUL	ZON	GRP	COM	CMA	STA	POL	PRI	TYP	BUT	COMMENTS
17																		
18	Theatre 1 Laminar Flow Fan																	
19	FS Zone Fan	[illegible]	[illegible]	10	0S	9	[illegible]	0	4	0	0	NA	NA	0	0	C	0	
20	FF Zone Fan	60	0	0	0	0		0	10	12	0	NA	NA	0	0	T	0	
21	Antifrost Batt.Coil FF Adj																	
22	PMR Zone Fan	0	0	0	0	0	0	0	1	0	0	NA	NA	0	0	T	0	
23	Theatre 1 Ext. Fan	0	0	0	0	0	0	0	10	0	0	NA	NA	0	0	T	0	
24	SSU Extract Fan	60	0	0	0	0	0	0	1	0	0	NA	NA	0	0	T	0	
25	Theatre 1 Fan	60	0	0	0	0	0	0	1	0	51	0S	NA	0	0	T	0	
26																		
27																		
28																		
29																		
30																		
31																		
32																		

DIGITAL MONITOR POINT		MES	LVL	TYP	PCH	ALM	LF	ZON	FOL	WS1	WS2	WS3	WS4	OSP	OFS	FAC	COMMENTS
17	Theatre 1 Airflow	[illegible]															
18	Laminar Airflow Theatre 1	[illegible]		A	60	N	C	10	0	0	0	0	0	0	0	0	
19	FS Zone Airflow	[illegible]		A	660	Y	T	4	0	0	0	0	0	0	0	0	
20	FF Zone Airflow	[illegible]		A	660	Y	T	5	0	0	0	0	0	0	0	0	
21	Primary Filter Press.Switch	[illegible]		A	60	N	C	10	0	0	0	0	0	0	0	0	
22	PMR Zone Airflow	[illegible]		A	60	Y	T	1	0	0	0	0	0	0	0	0	
23	Theatre 1 Extract Airflow	[illegible]		A	60	N	C	10	0	0	0	0	0	0	0	0	
24	SSU Extract Airflow	[illegible]		A	660	Y	T	1	0	0	0	0	0	0	0	0	

ANALOGUE MONITOR POINT		MES	LVL	TYP	PCH	ALM	LF	ZON	FOL	WS1	WS2	WS3	WS4	OSP	OFS	FAC	COMMENTS
25	Theatre 1 Space Temp.	[illegible]		T	0	N	C	10	30	21	21	21	21	21	-15	50	O/P 19L
26	Theatre 1 Lam. Flow Space Temp.	[illegible]		T	0	N	C	10	60	21	21	21	21	21	-20	50	O/P 20
27																	
28	FF Zone Temp.	[illegible]		T	0	N	T	5	30	20	20	20	20	5	-40	50	Controls O/P [illegible]
29	Primary Filter Temp.	[illegible]		T	0	N	C	10	30	10	10	10	10	[illegible]	-20	50	O/P [illegible]
30	PMR Zone Temp.	[illegible]		T	0	N	T	1	30	10	18	18	18	5	-35	50	Controls O/P [illegible]
31	Theatre 1 Lam. Flow L.E.	[illegible]		T	0	N	C	10	90	0	0	0	0	0	0	99	O/P [illegible]
32	Theatre 1 RH	[illegible]		T	0	N	C	10	90	0	0	0	0	0	0	99	O/P [illegible]

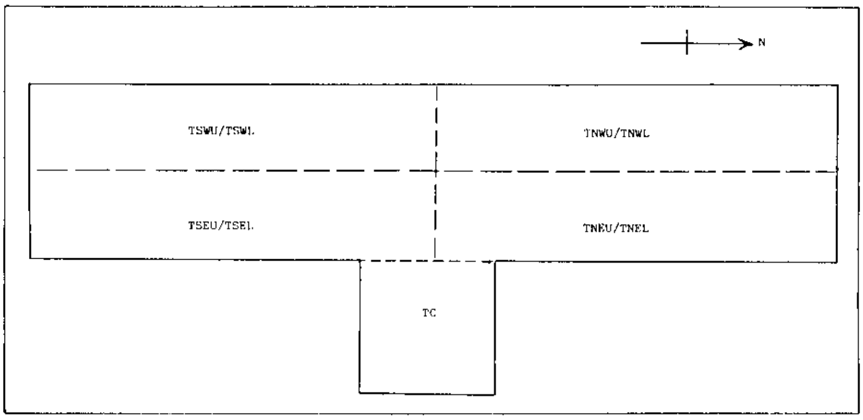


Figure 6. Ward tower heating zones: Gartnavel General Hospital.

Area	Associated plant	Control points	Monitor points	Parameter data
Outpatients Theatre	POPD/S Pump in Service Zone to Heater Batteries on Vent Plant Vent Plant in POPD Plant Room (Ground Floor)	380 — POPD/S Pump 1 381 — POPD/S Pump 2 305 — Fan Low 307 — Ext. Fan 309 — Fan High	(D) 305 — Filter P/Switch (D) 306 — Theatre Relay (A) 313 — Space Temp. (A) 320 — Space R.H.	Shift Times 0730-2100 Mon.-Fri. P.H.'s. not worked except by arrangement. Space Temp. 21°C. T22
Outpatients Department	POPD Pump in Service Zone to serve Vent Plants in PRD/POPD Plant Room	378 — POPD Pump 1 379 — POPD Pump 2 228 — POPD Supply Fan 229 — POPD Extract Fan	(D) 227 — POPD Ext. Airflow (D) 229 — POPD Supply Airflow (D) 225 — Main Filter Press. Sw. (A) 234 — POPD Space Temp. 236 — 1-3	Shift Times 0730-2100 Mon.-Fri. P.H's not worked except by arrangement. Space Temp. 21°C. T22
Outpatients Department	POPD/S Pump in Service Zone to serve rads and Vent Plant for OPT and D/S Vent Plant (Ancillary Rooms) in POPD Plant Room (Grd.flr)	380 — POPD/S Pump 1 381 POPD/S Pump 2 306 — Ancillary Rooms Fan 308 — Ancillary Extract. Fan	(A) 314 — Ancillary Rooms Space Temp.	Shift times 0730-2100 Mon.-Fri. P.H's not worked except by arrangement. Group 13. Space Temp. 21°C T22
Physiotherapy	PPD Pump in Service Zone to serve Rads. & Vent Plant Vent Plant in PG/PPD Plant Room	342 — PPD Pump 241 — PPD Supply Fan 243 — PPD Extract Fan	(D) 242 — PPD Supply Airflow (D) 244 — PPD Extract Airflow (A) 249 — PPD Space Temp. 1-3 251 (A) 252 — PPD — Duct after pre-heat	Shift times 0800-1630 P.H's worked No weekend work Group 3 Space Temp. 21°C T2 6
X-Ray (Radiodiagnostic)	PRD Heating Pump in Service Zone to Heater Battery on Vent Plant Vent Plant in PRD/POPD Plant Room	377 — PRD Pump 227 — PRD Supply Fan 225 — PRD Extract Fan	(D) 226 — PRD Extract Airflow (D) 228 — PRD Supply Airflow (D) 225 — Main Filter Press. Sw. (A) 233 — PRD Duct after preheater (A) 237 — PRD Space Temps. 239 — 1-3	Shift times 0900-1700 Mon.-Fri. 0900-1200 Sat. All P.H's worked except Christmas & New Year. Group 2 Space Temp. 21°C T2 3
Medical Records	PMR Heating Pump in Service Zone to batteries on Vent Plant Vent Plant in Main Vent Plant Room	359 — PMR Pump 22 — PMR Zone Supply Fan 14 — PRM Zone Extract Fan	(D) 2— PMR Extract Airflow (D) 22 — PMR Supply Airflow (A) 30 — PMR Zone Temp.	Shift Times 0900-1700 Mon.-Fri. No P.H's or weekends worked. Group 4 Space Temp. 18°C T2 1
Administration	P.ADM. Heating Pump in Service Zone for radiators only	344 — P.ADM. Pump	(A) 335 — P.ADM. Space Temp. 336 — 1-2	Shift times 0900-1700 Mon.-Fri. No P.H's or weekends worked. Group 5 Working Temp. 18°C T2 1

Figure 4. Site survey sheet — ground floor

advantages over the use of time clocks in this application in that:-

1. Systems can be synchronised to start/stop simultaneously.
2. Frost and low temperature safeguards can be built in.
3. Positive feedback that stop/start operations have taken place, is available.
4. Optimum start/stop programmes are available for groups of heating plant.

Cycling of ventilation fans

Ventilation systems are designed with capacity for extreme conditions, viz., to provide a high level of air changes during hot and humid weather. For most of the year, therefore, the number of air changes can safely be reduced without compromising the comfort levels in user departments. The frequency and duration of cycling should be set up to ensure environmental conditions are not compromised and that excessive wear on plant does not take place.

Maximum demand monitoring/ control

Maximum demand is an integral part of the tariff system for the majority of larger hospital sites, and it is therefore desirable to attempt to incorporate some form of maximum demand control strategy into the Energy Management System. However, it should be decided at the conceptional stage of an energy management system whether the system is to be used to control, or only to monitor, the electrical demand of the hospital. Once the system is installed, the ability of the operator to implement an effective demand strategy depends upon him having a sufficiently large electrical load on EMS control which can be shed instantaneously without adversely affecting user departments. A further consideration is that there may be an opportunity cost in shedding certain loads, viz., having ventilation fans on MD control means that it is not feasible to have them on cyclic control at the same time.

It is therefore desirable to establish the demand profile for the hospital over, say, a typical working week, prior to making the points list and EMS specification. Alternatively, EMS systems which are installed with expansion in mind can be used to record demand profiles over several weeks, and at different times of the year, so that points can be selected in the future for MD control.

The feasibility study carried out at Gartnavel General indicated that it was marginally more beneficial to control the ventilation fans on cyclic control during the winter months, while maximum demand control was the best for this plant in the summer months. The heating load of the ventilation systems has to be taken into account during such a study.

The monitoring potential of the energy management system

The most obvious asset the EMS has in terms of monitoring capability, is being able to monitor and continously record temperatures in user departments. The Energy Manager is able to call up trend logs on the system for any monitor point condition. With this information at his fingertips, the Energy Manager can assess the performance of the existing control circuits on heating and ventilating systems, and the effect of computer control on those systems.

With the trend log facility there is enormous potential for complete plant monitoring by an EMS, particularly where a new, rather than a retrofit, system is being considered. Thus the condition at each stage of the process through an air conditioning system, can be monitored and the individual valves/ controllers performance can be assessed. The flow and return temperatures on heating circuits can be logged so that the total energy used by a zone can be established and assessed in the light of outside conditions at the time. However, individual monitoring points are extremely expensive and there has to be a law of diminishing returns in terms of making a financial case for the number of points in any one system.

The facility to call up run-time reports enables a run-time maintenance schedule to be drawn up as required. If the supply to threatre operating lights is monitored, for instance, the system can print out a warning when the lamps are approaching the end of their useful life, so that replacement can be planned in plenty of time.

Plant monitoring, without direct energy implications, can also improve department efficiency. Pressure switches across panel filters for ventilation systems can send a signal to the system, which in turn will give a print-out, when the pressure differential indicates the requirement for a filter change. Similarly, autoroll filter run-out can also be monitored. Oil pressures and water temperatures on the larger machines can be monitored, so that an alarm print-out will warn if these approach a critical condition. Whereas fire alarm, medical gas monitoring and security systems could also be incorporated in such a system, the cost implications would point to leaving these as stand-alone systems, unless the EMS is being included in the specification for a new building.

The human consideration

This Chapter considers the human and social factors which require to be taken into consideration by the Energy Manager in order to integrate an Energy Management System into the hospital structure. These include:-

1. Health and Safety, I.E.E. Regulations.
2. Staff training.
3. Inter-department liaison.

Health and Safety at Work Act I.E.E. Regulations

Consideration must be given to the ability to stop plant locally in an emergency regardless of the control mode in operation at the time. Adequate warnings should be posted in plant rooms regarding the starting of remotely controlled plant. Existing safety devices in the control circuits such as smoke over-rides and thermal overloads should still remain functional after modification.

Staff training

It is important that members of the engineering staff are trained to be fully conversant with every aspect of the Energy Management System which is relevant to their normal duties. Electricians, for instance, will need to understand the modifications to existing Plant Control Circuits and the switching for different modes of operation. Fitters will need to understand the importance of isolating plant correctly prior to maintenance. The hospital's staff engineers should understand the operation of the system with respect to reports and plant operation, as well as the setting up of operational parameters.

Inter-department liaison

The Energy Manager must take an active interest in other departments in order to implement his energy conservation strategy. This means that he should be prepared to sacrifice time listening to, and following up complaints and queries from other heads of department. The more rigorous control of temperatures will initially be resented where areas have previously been comfortably overheated. The Control of Infection Officer will be interested in situations where the normal supply of ventilation is being interrupted. Once energy savings are being achieved, these should be highlighted at, for instance, Hospital Management Committee meetings, in order that all departments can identify with the success of the system.

Energy savings

Energy savings fall into two categories; fuel oil (3500 secs), and electricity. The table indicates fuel savings achieved between February 1983 and January 1984, in both quantity and cost terms, with 1979-80 as the base year agreed byt he Board's engineering and finance officers.

Electrical savings are calculated on a synthesis basis; that is, the electrical plant on computer control has been monitored using the run-time report facility, and the table following has been drawn up, which compares the new run times with the previous run times.

1. Taking the reduction in electrical consumption (rated motor load) as 69,130.2 KWH per month, and,
2. correcting this figure by a factor of 0.85, which is the average running load as a ratio of the rated load (through load tests), and,
3. taking the unit charge as 2.36 pence per unit (at the top end of Schedule 'A' units):-

Monthly electrical savings attributable to Energy Management System = £(69,130.2 × 0.85 × 0.0236) =
£1,386.75 per month
= £16,641 per annum

Year: 1983/4 Month	Hosp. Degree Days	Fuel Cost £/L	Actual Consumption (litres)	Expected Consumption (litres)	Consumption Difference (litres)	Cumulative Consumption Difference (litres)	Cost Difference (£)	Cumulative Cost Difference (£)	Comments
February	462.5	0.1236	206,794	290,838	84,044	—	10,388		
March	375	0.1236	220,326	254,231	33,905	117,949	4,190	14,578	
April	381.5	0.1216	208,342	256,950	48,608	166,557	5,190	20,488	
May	273	0.1286	183,829	211,559	27,730	194,287	3,566	24,054	
June	178.8	0.1261	165,422	172,149	6,727	201,014	848	24,902	
July	78.75	0.1209	135,477	130,292	−5,185	195,829	−627	24,275	
August	95.25	0.1314	140,801	137,194	−3,607	192,222	−474	23,801	
September	199.38	0.1243	139,535	180,758	41,223	233,445	5,124	28,925	
October	275	0.1243	199,075	212,395	13,320	246,765	1,656	30,581	
November	359	0.1337	230,246	247,538	17,292	264,057	2,312	32,893	*E.M.S. Shut Down for ten days.
December	401	0.1308	201,680	265,109	63,429	327,486	8,297	41,190	
January	525	0.1418	224,527	316,804	92,277	419,763	13,084	54,274	
Total	300.34 (Average)					419,763L		£54,274	

Gartnavel General Hospital — using 1979-80 as base

Overall savings

The overall cost saving on fuel and electricity consumptions are the summation of savings for fuel and electricity inclusive, viz:-

using 1979-80 as base year,

for interval February 1983-January 1984

Fuel cost savings	£54,274
Electrical cost savings	£16,641
Total cost savings	£70,915

Conclusions

The benefits of installing an energy management system into a major hospital unit are apparent from the case thus presented. Apart from the financial benefits, however, the benefits to the engineering departments in the Health Service, in utilisnig energy management systems, are considerable.

From his own experience in the last two years, the author would wholeheartedly recommend, to any colleague who has the opportunity, to take up the challenge of being an energy manager responsible for such a system. One has the opportunity to gain specific experience in the following fields:-

1. Energy Management:- How to monitor present and historic consumption trends.
2. Microprocessor based control systems.
3. Control engineering, with respect to Heating and Ventilation and Air Conditioning.
4. Feasibility studies, including financial analysis of technical projects.
5. Inter-department liaison.
6. Training of staff.

The Building Services/Energy Management Systems are the way to the future in the control and monitoring of building services. Engineers should exploit the new technology available to improve the performance and cost-effectiveness of the service they are providing to the National Health Service.

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NEXT ISSUE

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will be published early January 1986

Plant	KW	Type of Control	Prev. Hrs. Run/Month	New Hrs. Run/Month	Hrs. Run Difference	KHW Difference/ Month
PSC Zone Fan	1.1	T	730	563	167	183.7
PS Supply Fan	5.5	C	730	243	487	2678.5
PS Extract Fan	5.5	C	730	243	487	2678.5
PP Supply Fan	3.0	T	730	730	0	0
PP Extract Fan	3.0	T	730	224	506	1518.0
PMR Supply Fan	5.5	T	730	166	564	3102.0
PMR Extract Fan	5.5	C	730	138	592	3256.0
PK Zone Fan	18.5	T	730	563	167	3089.5
ICU Supply Fan	3.5	T	730	166	564	1974.0
ICU Extract Fan	3.5	T	730	166	564	1974.0
R/R Supply Fan	3.5	T	730	166	564	1974.0
R/R Extract Fan	3.5	T	730	166	564	1974.0
TSC Supply Fan	5.5	T	730	166	564	3102.0
TSC Extract Fan	5.5	T	730	166	564	3102.0
NTS Supply Fan	1.6	C	730	138	592	947.2
NTS Extract Fan	1.6	C	730	138	592	947.2
Lab Supply Fan	3.0	T	730	226	504	1512.0
Lab Extract Fan	3.0	T	730	226	504	1512.0
PRD Supply Fan	7.5	C	730	172	558	4185.0
PRD Extract Fan	7.5	C	730	172	558	4185.0
POPD Supply Fan	12.5	C	730	172	558	6975.0
POPD Extract Fan	12.5	C	730	172	558	6975.0
PG Supply Fan	5.0	C	730	608	122	610.0
PG Extract Fan	5.0	C	730	608	122	610.0
PPD Supply Fan	7.0	C	730	184	546	3822.0
PPD Extract Fan	7.0	C	730	184	546	3822.0
O/P Th.Supply Fan	3.0	T	730	166(332)*	(398)*	1194.0
Anc. Rms. Supply	1.1	C	730	172	558	613.8
Anc. Rms. Extract	1.1	C	730	172	558	613.8

TOTAL 69,130.2 KwH/Mth.

**NOTE — O/P Theatre Supply Fan dropped to slow speed out with normal working hours.*

Electrical savings for plant on E.M.S. control

This paper was first given at the Institute's symposium on hospital developments in December 1984. The author is senior partner of Martin Barnes and Partners, Project Management Consultants.

Cost control for health building projects

MARTIN BARNES BSc(Eng) PhD CEng FICE FCIOB MBCS ACIArb

The principles of controlling cost for health building projects are no different from those for any other construction sphere. However, application of those principles has to be achieved within the constraints imposed by the particular requirements of the health building client, and, in the UK, those of the DHSS expressed in documents such as Capricode, Concode and Cope. In this paper, the principles of cost control and their practical application in health building will be considered and compared with those from the author's experience of project management in the private sector. Many clients in the private sector do not have their management procedures well thought out and set down on paper in documents equivalent to Capricode, Concode and Cope. This is to their detriment as failure to think ahead about management arrangements and to standardise and refine them leaves a big gap and leads to inefficiency. Management arrangements have to be designed just like the fabric of the building and it is the management procedures manual which carries the role of specification and drawings in the design and execution of the management scheme. New developments like the BPF System in the private sector are comparable with those which have a longer history in the public sector.

For our purposes here, cost control can be simply defined. Cost control has been achieved if the finished building costs what it was supposed to or less and works how it was supposed to or better.

Cost control is easiest if everyone in the team, particularly engineers and other designers, are in no doubt that no more money can be found than the amount shown in the original budget. Whatever paperwork is produced, there is no stronger incentive to control costs than the belief that cost has to be controlled and that other things, such as time and performance of the finished building, may have to be sacrificed in order to complete within the allowable funds. This thought is an effective starting point because it establishes the fact that, although paperwork and numbers are important, it is the attitude to control of costs of those who make decisions which has the overriding influence upon whether control will be achieved.

Cost control in the pre-construction stages is all to do with the decisions made during briefing and design. If the cost implications of the alternatives being considered are forecast when each briefing or design decision is taken, control can be secured. If these decisions are made in the absence of cost forecasts or if the forecasts are inaccurate, decisions which are incompatible with achieving the budget will be made and control will not be achieved. There is no escape from this discipline. Cost control will certainly not be achieved if cost checks are carried out after decisions have been made or if cost forecasts are so inaccurate that wrong decisions are made.

Early stages

It follows that cost control is most difficult in the early stages. When the content and form of the proposed health building is least well known and likely cost is a very long term projection relating to work to be carried out in three or four years time, the forecast of costs can be very uncertain. Yet most of the decisions affecting cost are taken at briefing and early design stages. Once these decisions are made the total cost of the scheme is determined within quite narrow limits. This brings out the paradox of contruction project cost control, applicable with particular force to health buildings, that accurate forecasting of costs is most important in the early stages when it is also the most difficult. Lack of recognition of this paradox leads to people postponing the introduction of cost forecasting until it is too late. If the quantity surveyor is heard saying that he cannot make a forecast because the design has not progressed far enough to take off quantities, he must be brought up short. His best forecast is needed now. When the design has progressed further and quantities can be taken off, the decision will have been made for good or ill and his cost forecasts will be ignored.

Due to the uncertainty of cost forecasting, it is essential to keep significant contingencies within the total budget sum and to release them with the very greatest reluctance as the work of briefing and design progresses. There are not enough statistics available in the health sector about the percentage of the budget which should still be regarded as contingency at different stages in the development of the scheme. I suspect that, if such figures were available, we should be surprised by the size of the contingency which ought to be provided. A policy which I recommend strongly is to set very large contingency allowances in the early stages so that the money available to designers is very tight from day 1. When this is done, a fierce struggle begins at day 1 to persuade the project manager to release some of the contingency money — to ease the problem in the services, the foundations or whichever element of the building is on the tightest rein. It is important and helpful that this fierce struggle should take place from day 1 as it ensures that briefers and designers shout about the cost consequences of problems which they have and the decisions that they have to make right from the start. With comfortable budgets, cost consciousness can be left dormant, to be awakened only when it is too late.

Generalisations about professions are

often unhelpful, but it is my experience that a higher proportion of services engineers are cost unconscious than in other professions. The costs of the mechanical services as a proportion of total cost of health buildings is increasing all the time. The necessity for services engineers to be cost conscious is therefore increasing more rapidly. The idea that if it will work it is good enough seems still too prevalent in services design. Until every services design decision is taken with an appropriately accurate forecast of its effect upon initial cost and running cost, there will still be room for improvement.

The architect's role

The system which we now use, encapsulated and very clearly set down in Capricode and Concode, places a lot of responsibility for management of the design team upon the Architect. He is the leader of the design team but he may not be motivated to lead with sufficient strength. Multi-disciplinary practices should mitigate this problem, but it will not be solved until conditions of engagement of design consultants give them a much stronger obligation to think ahead and manage their way around foreseen problems than they now do.

The Architect may not only be the judge and jury if a problem has occurred, he may also be the felon in the dock. For example, suppose some information is supplied late to the contractor and that it is without question the design team's fault. It is the Architect's unfettered responsibility to grant the contractor an extension of time. This creates an obligation for the Client to pay the consequential loss and expense — money which could have bought more building. It also releases the time pressure on the Architect to issue any further outstanding information.

There is really not enough motive implanted in the design team to be alert to cost implications. It seems rather ridiculous that consultants should ever have the right to claim additional fees for seeking the economies which become necessary when it turns out that their own earlier estimates of cost were wrong.

Post-contract cost control must also have the forward looking characteristic required pre-contract. Cost forecasting for variation orders is a goal which few people achieve. Costing after the variation has been ordered is still too common. It is absolutely incompatible with maintaining control of cost. The contingency allowances must still be carefully managed during the post-contract phase.

Cost for health building cannot be effectively controlled if the three criteria of performance, cost and time are all tight. Typically, the Client exerts pressure to obtain the best *performance* for his completed building during the early stages of design, before cost and time targets are set. During the later stages of design and early stages of construction, *cost* control is dominant. This is because the design is virtually complete and the likelihood of finishing late has not yet been realised. Towards the end of construction, *time* control becomes all important as the commitment to a handover date has now been made and the contractor is probably falling behind programme. This progression of the emphasis of control from performance through cost to time is not uncharacteristic. It is damaging to effective management of a project as a whole and often leads to waste of money, wasted time and to sub-standard buildings.

It is impossible to achieve full consistency of control policy, but identifying the relative importance of performance, cost and time at the start and sticking to it substantially reduces the changes of making decisions early on which will be regretted later and decisions at the end which would not have been contemplated at the beginning.

Management contracting

Management contracting has grown as a method of managing construction projects in the private sector in response to some of the ills already discussed. My firm has recently completed a major research project for the DHSS, the task of which was to establish the strengths and weaknesses of management contracting as applied to health buildings. Our conclusions were that management contracting had advantages for health buildings when one or more of the following five factors was present in significant strength.

(a) above average pressure to complete the building early or on time
(b) above average propensity to variation in the Client's requirements
(c) complex phasing of construction
(d) an awkwardly laid out site or one where there was difficult access
(e) a need to reinforce the management resources otherwise available to the project.

We concluded that management contracting was not incompatible with the requirements of public accountability and that, if the management contractor had the necessary experience, his knowledge of buildability should enable the capital cost of schemes to be reduced. We disagreed with the comment in Concode where it is suggested that the management contractor should not have full authority over the appointment of subcontractors. Control and responsibility must go hand in hand and, if the management contractor is to control the activities of subcontractors in the interests of the Client, he must have the major influence over their appointment.

Concode has a brief reference to project management and the use of specialist project managers. Naturally, as the head of a business which is devoted to managing projects, I am pleased to see that Concode recognises our existence. There is an implication in Concode that to use specialist project managers is an additional cost. Certainly it is an additional line in the budget, but unless the value of the project manager's contribution is much greater than his fee, there is really no point in employing him. When cost control of a project is the dominant criterion, any competent project manager would expect to save much more money than he cost.

The author was Mechanical Associate on the Staincliffe project for consulting engineers Donald Smith, Seymour & Rooley. This article, which he wrote with colleagues, was originally published in abridged form in CIBS Journal.

Staincliffe Hospital's new energy centre

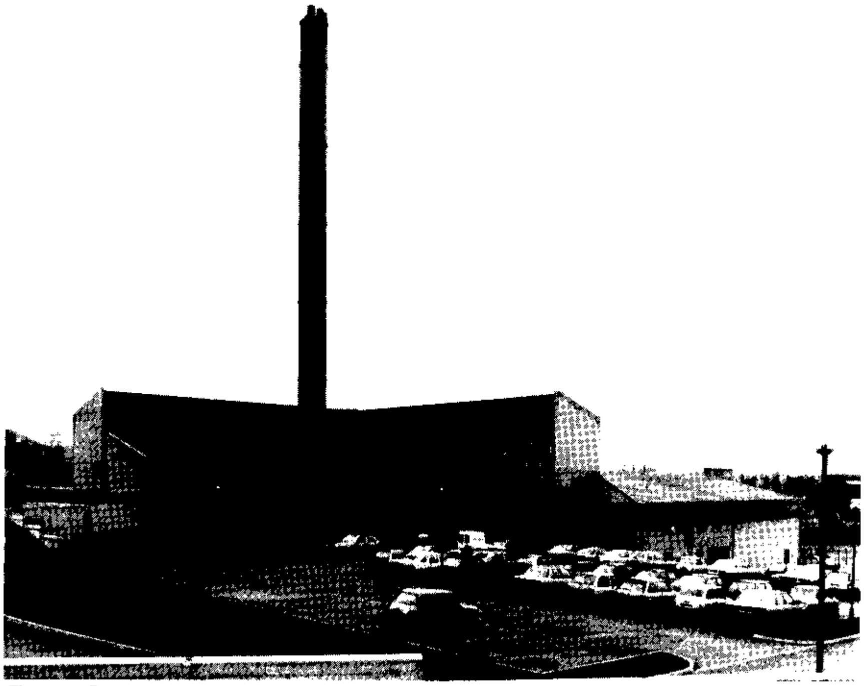
IAN STEWART FCIBSE MASHRAE MIHospE

In December, 1984 the Yorkshire Regional Health Authority took possession of a new Energy Centre and attendant works in Dewsbury's Staincliffe General Hospital. As long ago as 1977 the Dewsbury District had been identified as a high priority for major capital investment in view of its relative deprivation in the context of hospital services. The new Energy Centre represents completion of the first Contract in a redevelopment programme.

The new Energy Centre Building complex is located at the North West corner of the site. It displays substantial construction and careful consideration to detail. Standing in something approaching isolation it should be appreciated that its location was selected to be conveniently placed to the planned load centres. These will comprise a three-storey 'Nucleus' Hospital development with large Service Centre forming most of Contract 2 and the existing accommodation destined for long term retention in the form of the Maternity Unit, the adjacent Nurse Training School and Residencies. The proximity of the Nucleus development as well as some coterminus bungalow housing dictated the mass of the building to contain the noise of the coal-fired boiler plant. Much of the detailing in the brickwork, roofing and eaves will be prepetuated in future construction on the adjacent site.

Coal firing adopted

It was by no means certain that the boilers would be fired with coal and the usual fuel appraisal was carried out by the Consulting Engineers to arrive at the solution adopted. The Health Authority was anxious not to 'over boiler' the scheme nor to end up with massive plant on which maintenance would be cumbersome. Donald Smith, Seymour & Rooley in conjunction with their design team colleagues were briefed to investigate ways and means of reducing energy consumption in the proposed development and thermal modelling was pursued to achieve the optimum solution. The boilers were selected to provide flexibility in use and enable night time summer loads to be accommodated without detriment to plant. The answer was to employ three boilers, two rated at 3300 kW and one at 1800 serving the existing hospital with a further as yet unspecified unit to follow when later load patterns emerge. The three new boilers incorporate chain grate stokers arranged to burn Allerton Bywater Washed Smalls. During the recent difficulties in the coal fields these have been shown to burn fuel from alternative sources quite happily.



Energy Centre Main Car Park and Entrance.

Coal is delivered by tipper lorry into a coal boot off the upper service yard. A dense phase coal delivery piping network comprising 100mm steel piping distributes coal from there to a vertical silo built into the Energy Centre and from there to overboiler hoppers. Fourteen days supply of fuel is stored on site with enough for one shift housed above each boiler. Spare parts have been provided for reinforced bends and sufficient diversion pieces enable coal to be piped direct from the boot to the boiler hopper to allow maintenance to proceed within the silo or in the event of spontaneous combustion.

Under these conditions — which can be detected by carbon monoxid monitors — the coal can be discharged to the upper yard through an emergency line. The silo, boot and hoppers are all lined with high molecular weight polyethylene sheeting to prevent 'hang-ups' or 'rat holing' in the stored fuel stocks. Facilities are also available for agitation of the fuel should this prove necessary. Here was a case of technology overtaking design whereby advice was received from the NCB Fuel Technologists to increase the steepness of the sloping sides of the storage accommodation after they had been cast on site. Bridge breaking equipment has now been specified to cope with if difficulties experienced with fuel flow within the silo or boot. Nor was this the only after-thought: although the ash is conveyed in a dense phase piping system to a storage silo where it can be collected for re-sale, it soon became obvious that for general cleaning and removal of grit, a separate vacuum extraction system would be necessary.

Serious consideration was given towards specifying a fluidised bed coal fired boiler. This would have been the fourth boiler. With ash in the consistency of face powder it was recognised that it would have to be 'last on line' into the ash conveying pipework as the expansion of the conveyed ash in suspension entering the discharge junction from another boiler downstream towards the ash silo would have caused problems. In the end, Boiler No 4 may well repeat the chain grate stoker specification. While the merits of fluidised bed technology are recognised it was felt that development was not complete and that horizontal fire tube boilers may not be the best configuration for fluidised bed firing.

Heat recovery was briefed from the outset, although its scope and complexity has grown over the years. Originally, only the Energy Centre's domestic hot water was to be heated from the products of combustion from two gas-fired incinerators installed in an adjacent part of the Complex. Soon it became obvious that much more could be gained and the new 510 kg/h incinerators work in conjunction with a 1800 kW waste heat boiler.

Although the original primary heating medium was steam this has been superseded by high pressure hot water with a flow temperature of 140°C returning at 90°C. This entailed construction of a new calorifier chamber to serve the old Staincliffe Hospital and many change-overs throughout its undercroft and dispersed buildings. Primary pumps located beneath the firing floor of the Energy Centre ensure the requisite amount of water circulates around the primary loop and through each boiler. Secondary pumps distribute high pressure hot water to the various calorifier chambers and, being of variable speed pattern, all react to load changes. The space beneath the firing floor also houses compressors, water treatment plant, ash crushers and drop chutes and pressurisation equipment. An open mesh floor behind the boilers permits escape of heat from this area.

The space below the firing floor is the result of making the most of the topography of the sloping site. The upper yard, lower yard at which the firing floor level occurs, and the pump level below are a storey height apart and the overall disposition of the levels reflects the 3-storey Nucleus development being concentrated in the Second contract.

After much debate, the decision was taken to select a chimney complex with windshield of Cor-ten steel. The height was determined by wind tunnel testing, but it was with some trepidation that all involved awaited letters to the press commenting on the 'rusty' chimney! In the end no one seemed outraged and the colour is weathering to a not unpleasant appearance minimising maintenance, albeit leaving an initial 'trade-mark' on adjacent roofing via mill-scale deposit.

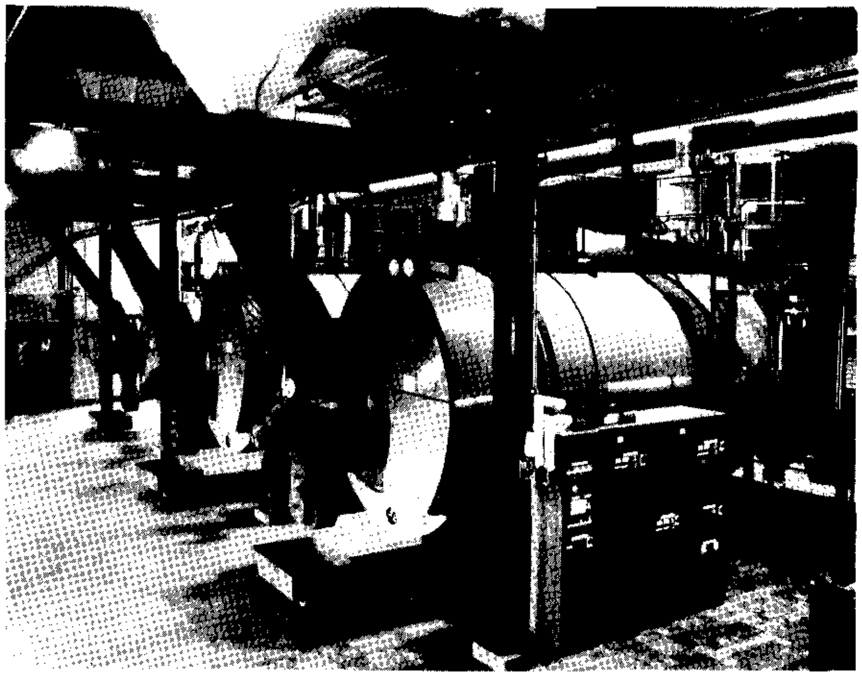
Energy management and control system

Perhaps though, the most innovative feature of the Staincliffe Energy Centre is its Energy Management and Control System with computer installation housed in a special control room with viewing access to the firing floor.

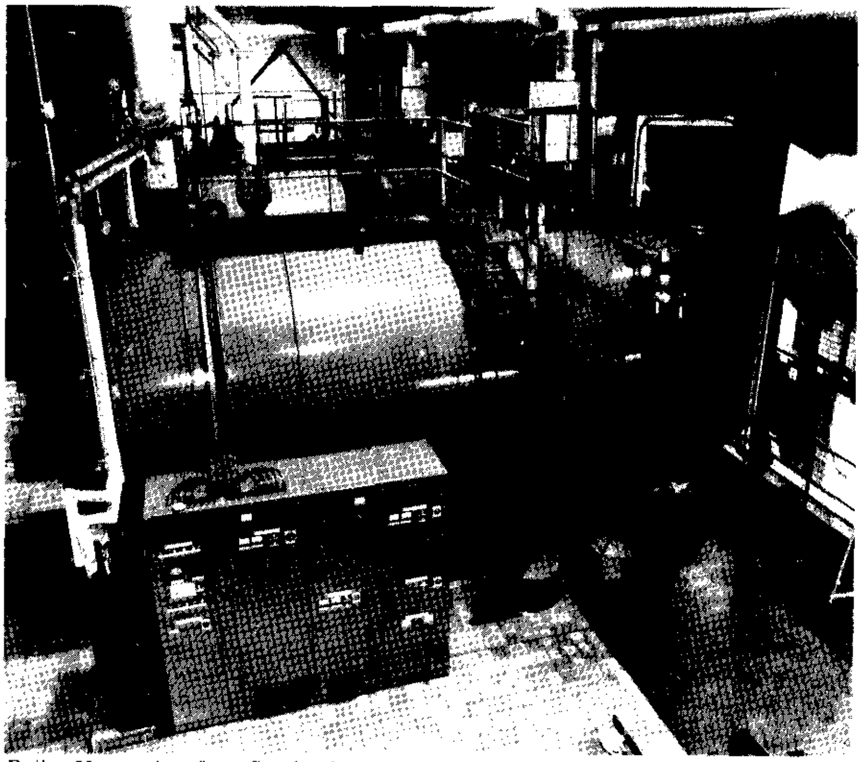
The brief from the Health Authority dictated that the boiler plant forming part of the Energy Centre should be designed for automatic unattended use. This presented some unique problems once coal emerged as the basic raw energy source.

The brief also required that the Consulting Engineers should take cognisance of the latest technology with regard to efficiency and plant utilisation in the running of the complete Energy Centre.

The problems presenting themselves to the control system design were quite formidable without taking account of the constraints already imposed in the brief. Over and above the coal and ash handling problems the incinerator plant emerged with a heat recovery boiler introduced as a preheat on the main ring main heating system. In addition electrical stand-by generation was required for the boiler plant and complete ancillary peripheral equipment to maintain at all times heating to the Hospital's accommodation.



Upper Service Yard with areas of incineration waste heat boiler installation, coal delivery and ash silo.



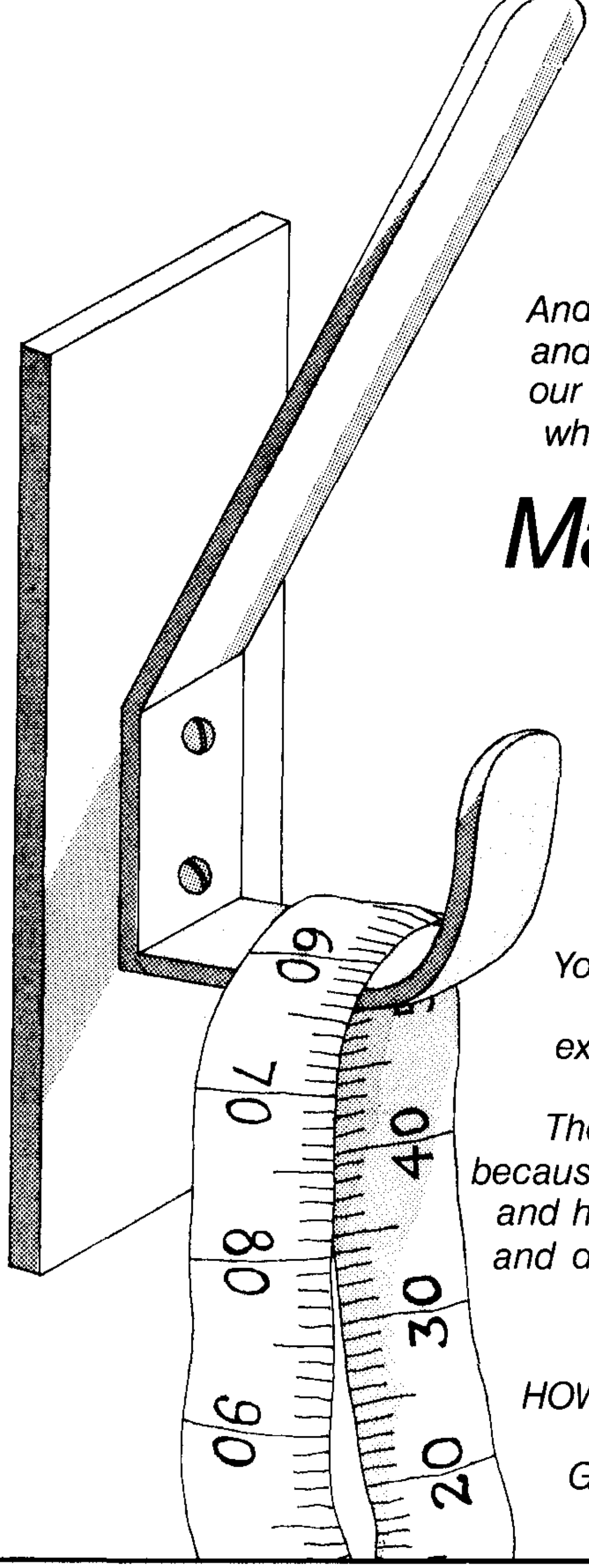
Boiler House view from first level gantry.

As the design developed it became clear that no ordinary control system could cope with the complex monitoring and control requirements of the plant. This became even clearer with the introduction of speed control on all motors associated with the boilers. The F.D. and I.D. fans and stoker motors are invertor controlled to give optimum performance and reduce electrical energy consumption. The primary and secondary pumps have also been fitted with invertor speed control to reduce flow in the primary and secondary systems depending on load requirements.

The Consulting Engineers examined each individual item of plant and how these related to the complete system operation. Each was assessed as to how it would fit into the system operation and what control and/or monitoring functions required to be derived from it.

Having completed this task a specification had to be drawn up particularly concerning the monitoring and control aspect as at that stage of the design the actual manufacturer of the plant items involved was not known.

The instrumentation for the boiler plant and incinerator plant together with primary and secondary heating systems presented in themselves an abundance of information which related to each other. One of the many examples was the overall firing rate of the boiler plant and related



60
70
80
90
40
30
20

speed control of the HPHW pumps.

This requierd the control system to monitor flow and return tempeatures and flow rates from the secondary pumps, calculate the heat required and increase or decrease speed on the secondary pumps to maintain constant differential tempeatures.

This in turn required the primary pumps to be adjusted in accordance with the dictates of the secondary pumps. The control systems also had to try and predict the load profile looking forward half an hour on a sliding scale. If the load on one boiler was insufficient another boiler would be started from kindling condition to maintain temperatures on the secondary circuit bearing in mind that establishing fire bed conditions on a coal boiler from kindling condition takes at least twenty minutes. To make matters even more complex, the control system had to look at the incinerator plant and decide if the incinerator plant was operational and if heat recovery from the waste heat boiler was possible.

Over and above all of the normal operational complex control requirements the control system had to be designed to ensure that if failure of any plant item occurred then set conditions would be implemented to adjust or shut off or start standby plant to maintain heating at all times. This also accommodated the problem of electrical supply failure not only of the Main H.T. network but also low voltage sub-section switchboards feeding essential items of plant. The control requirements for this part alone are quite extensive.

The design solution

Having attempted to provide an overview of the control systems and their complex nature, the design solution was to use equipment which could cope with the multitude of information and organise it into its proper place and then take corrective measures as required.

The solution adopted by the Consulting Engineers was a computer control system using multi-background and foreground configuration so that all tasks could be carried out without interference from one system to another.

The Computers (duty & standby) are installed in a special control room free from dust and dirt and on failure of either one then the other will take over all management functions.

The peripheral equipment associated with the computers comprise an operator terminal and two printers — one for all alarms and the other for logging and reporting purposes.

A colour graphics unit connected to the computers is also provided to give on-line schematic presentation of any system configuration within the Energy Centre. This has proved invaluable in commissioning procedures and indeed in the optimum operation of the Energy Centre and hospital heating and ventilating plants.

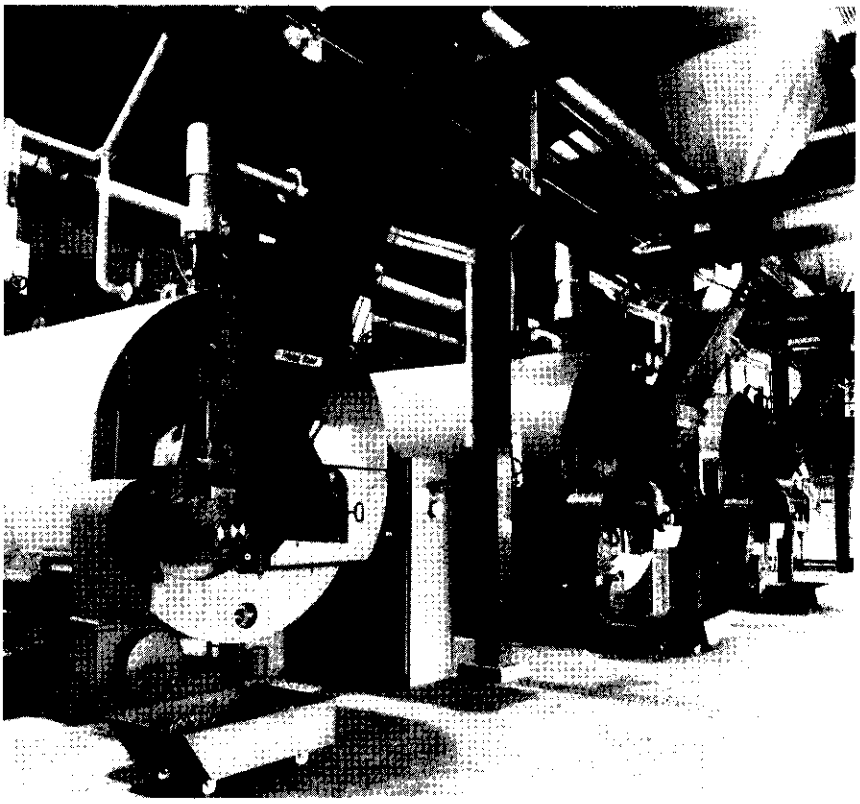
The main computers and perhipheral equipment in the control room is at all times backed up with a U.P.S. system (Uninterruptable Power Supply) so that in the event of power failure the computers can organise start up of generators and subsequent switching of plant items.

The other design problem related to the field equipment associated with the computers and the interface requirements. Space limitations and practical difficulties were major constraints in running all information related to all the field equipment and plant items back to the computers. The design solution was to extend the computer system into the field and multiplex the information to and from the computers to the field and plant items.

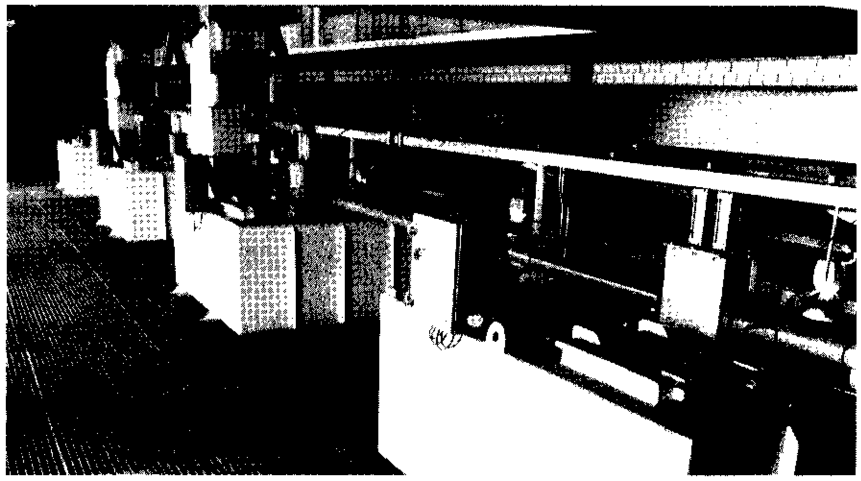
This solution required that F.I.D.'s (field interface devices) should be placed at strategic positions throughout the Energy Centre and indeed into the existing hospital. From these F.I.D.'s all items of plant are connected using conventional wiring. The connections from the computers to the F.I.D.'s using multiplexing can therefore be carried out using transmission cabling — in this case, two twisted pair: a considerable saving in cabling and installation time.

The placing of the F.I.D.'s at the design stage was given very careful consideration. The Consulting Engineers having adopted the use of multiplexing, were concerned that all traffic to and from computers to F.I.D.'s was being carried on a single twisted pair cable — albeit being suitably contained for mechanical protection. This concern centred on failure of the highway transmission cable.

The design solution culminated in the F.I.D.'s themselves incorporating microprocessors compatible with the main computers. All control functions within each F.I.D. are carried out by its own micro-processor and only refer to the main computers for management and executive information. This design solution is known by some as 'distributed intelligence' and this helped to solve three other problems.



Boiler House view from control room viewing panel. (Note — A number of modifications have been carried out and the 'riddle trolleys' are not in use now).



Boiler Coal Day Bunkers above boilers on upper gantry.

First of all it reduced the amount of traffic in the highway transmission system. Secondly, if there were failure of the highway transmission system, then the local F.I.D. and its micro-processor would sense this and organise the plant connected to it into a pre-determined mode for safe operation. The third dealt with the long-term problem of expansion of the system and this renders the system expandable such that any future development of the hospital can be connected to this system for control purposes.

The Consulting Engineer's commission was to draw up a specification for all of the control equipment and software requirements and integrate this with a total design package for the complete Energy Centre.

Design in use

As at August, 1985, all equipment has been installed, tested, commissioned and is running from the computers. The results show that the software is performing satisfactorily but with any system refinements are always desirable. The one benefit from the adoption of computer control is that the refinement can be made without alteration to the installation and hopefully will permit adjustment of equipment and plant items to maintain optimum operation as the state of the art progresses.

The electrical installation

Electricity to the existing site was already supplied at 11kV by the Y.E.B. when planning of this Development started. The system comprised an intake sub-station adjacent to the main site entry with a local transformer controlled by an 11kV fuse switch supplying the old section of the Hospital and an 11kV feeder to a sub-station adjacent to the then new Maternity Block. This sub-station contained a Ring Main Unit supplying a single transformer.

The general design brief was to extend the 11kV system from the Ring Main Unit at the Maternity Block sub-station to sub-stations in the new Development and to take a new 11kV feeder from the intake sub-station to the last of these sub-stations to form a ring. Emergency generators at each sub-station would provide essential supplies in the event of a mains failure to each independent LV network.

Estimation of the mains demand and the physical layout of the Development suggested that at least two sub-stations would be required, one to supply the Energy Centre and (later) Service Centre loads and a second to supply the Clinical Blocks now under construction. Again, the physical arrangement of the facilities resulted in the two sub-stations being virtually back-to-back. It was therefore decided to locate both generators in the Energy Centre, to make them equal in size and to synchronise the two sets. This made the problem of noise easier to cope with, increased the effective short circuit capacity of the standby systems and so imposed less design restraints on the LV networks and provided standby to standby albeit in a limited fashion should a supply failure occur when one set was out of service for maintenance or simply failed to start.

A facility for changeover between mains and emergency supplies is provided at each section board of which there are two in the Energy Centre, five to be provided in the Service Centre and eight in the Clinical Blocks. Voltage sensing is provided at each section board. The changeover unit on each board comprises two mechanically and electrically interlocked motorised MCCB's. The breakers can be manually operated should an operating motor fail and to ease maintenance they are arranged so that either motor operator or MCCB can be changed with the other in service. Manual by-pass facilities allow the mains to be isolated and the emergency supply to be connected to the non-essential section of the board as well as to the essential section. The overall scheme is monitored and controlled by the Energy Management Control System. When the Development is completed it will be possible to test run either set using plant only as load and at the same time still have both sets immediately available in the event of a mains failure. The section boards can be switched in groups in a timed sequence so that high load factors can be applied to the turbo charged engines. The switching sequence can be different for different times of day to suit particular priorities. Should only one set be available, loading is automatically limited to the capacity of that set.

The installation in the Energy Centre at present includes one transformer with integral Ring Main Unit and mains switchboard, one emergency generator set, synchronising board, generator board and two section boards from which all distribution boards and plant switchboards are supplied.

Lighting

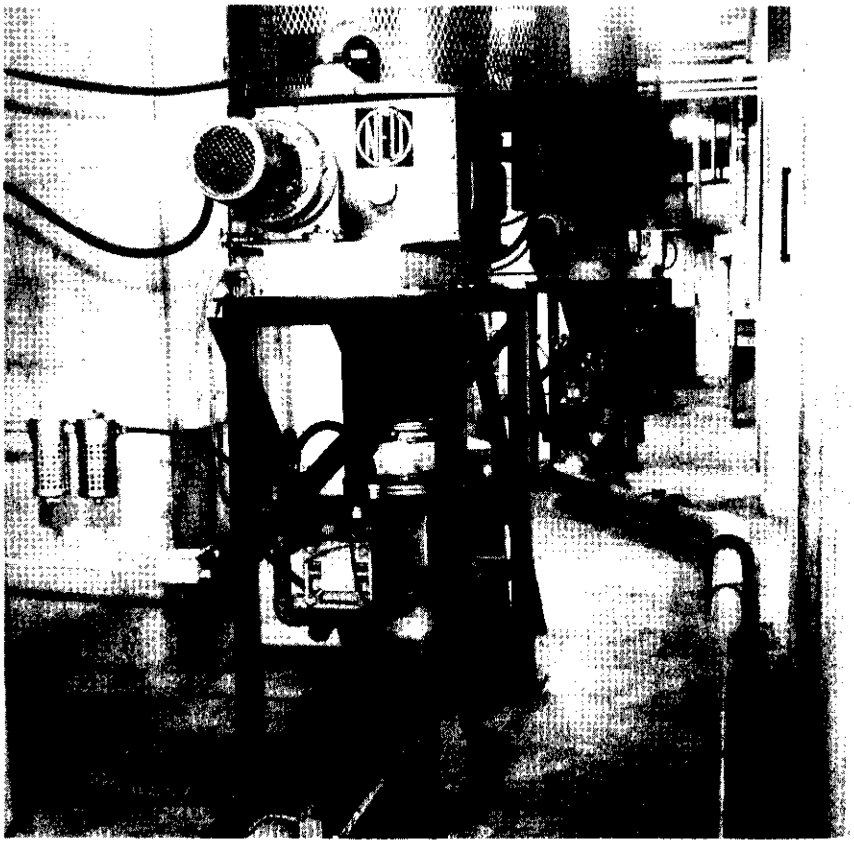
Lighting in the Energy Centre is in the main by means of fluorescent luminaires with high pressure sodium high bay fittings in the boilerhouse. Yard and road lighting is high pressure sodium. Emergency lighting is provided by luminaires supplied from the essential side of the section boards with additional battery operated units in the switchroom.

Lessons learned

Lessons already learned in the operation of the new Energy Centre reflect the very low heat release from the boilers to the Boilerhouse, and the Energy Management & Control Systems ability to provide user information avoiding wasteful use of plant and resources. This has compounded in very low ambient temperatures within the boilerhouse and incinerator complex while the generous provision of the combustion air intake louvres to serve the ultimate development gave cold comfort to the operators inspecting the boiler grates or loading the incinerators during last January.

The African Queen

Did Staincliffe Hospital not have a boilerhouse before? In fact, at one time the hospital did not possess any boiler plant of its own and steam was purchased from the Local Authority whose boiler plant served their accommodation — Beech Towers, bordering the Staincliffe Hospital site. Latterly the Hospital used more of this plant's output than did the Local Authority buildings and eventually the Beech Towers boilerhouse was bought by the Yorkshire Regional Health Authority. It has now been demolished to make way for the Nucleus Hospital Development. The plant has been christened 'The African Queen' (after the famous Humphrey Bogart/Katherine Hepburn film of the same name). The technology and maintenance had much in common with the steamboat. The African Queen is dead, long live..........



Ash crusher, drop tube from boilers and pneumatic ash transfer system to ash silo collection point.

Ministerial visit from — Lady Trumpington, spokesman for health in the House of Lords. Left to right: Lady Trumpington, Mr G. Chester DWO Dewsbury HA, Mr Brian Peacock, Mr S. Lyles Chairman of Dewsbury HA.

Energy Centre Staincliffe District General Hospital, Dewsbury, Yorks.

Client: Yorkshire Regional Health Authority

Building Services Consulting Engineers for the Project were: Donald Smith, Seymour & Rooley, Glasgow in association with the Regional Engineer, Yorkshire Regional Health Authority.

Other members of the design team were: Keppie, Henderson, Architects, Glasgow. Ove Arup & Partners, Civil & Structural Engineers, Manchester.
E.C. Harris & Partners, Quantity Surveyors, Leeds.

The main contractor was Shepherd Construction Ltd., Leeds.

Nominated sub-contractors were Young, Austen & Young Ltd., Manchester. (Mechanical Services.)
Landis & Gyr Ltd., (Energy management & control systems) London, Crown House Engineering Ltd., Sheffield. (Electrical Services.)

The total value of the contract was: £3,300,000

With engineering content:
£1,050,000 Mechanical services
£ 455,000 Controls
£ 315,000 Electrical services
£ 52,000 Chimney complex

The above figures include conversion and linking up the existing hospital to the new facilities, and include fluctuations in cost.

Principal Suppliers of Equipment
Boiler plant: NEI International Combustion Ltd.
Coil & ash handling equipment: Neu Engineering Ltd.
Primary & secondary pumps: Holden and Brooke Ltd.
Pressurisation units: Warmac Ltd.
Compressor plant: Atlas Copco Ltd.
Water treatment: Feed Water Treatment Services Ltd.
Incinerators: Evans Universal Ltd.
Waste heat boiler: NEI International Combustion Ltd.
Chimney: F E Beaumont Ltd.
Acoustic louvres: Sound Attenuators.
Standby generators: Dale Electric Ltd.
Transformers: G E C Ltd.
Switchgear: Howarth Switchgear Ltd.
Computers: D E C Datasystems.

Product News

Communications study

The international Ewbank Preece Consulting Group has recently completed a comprehensive study of the applications of digital PABXs and data communication within the National Health Service for the NHS Computer Policy Committee. The three month study involved detailed examination of two areas (one metropolitan and one semi-rural); and Ewbank Preece engineers visited and interviewed NHS staff to assess communications requirements, existing facilities and systems, and potential future developments.

The project is a preliminary stage in building a NHS communications strategy; and Ewbank Preece's report, which is currently being considered by the NHS Centre for Information Technology, sets out guidelines and recommendations for short and long term communications and management strategies at all levels within the National Health service.

Further details from: Ewbank Preece Ltd. Tel: (0273) 724533.

Safety signs reminder

Britain's employers are reminded that they have until the end of this year to bring their safety signs up to date to meet the requirements of the Safety Signs Regulations 1980.

Health & Safety Executive main offices are in London, Sheffield and Liverpool — tel: 01-229 3456; 0742 78141; and 051-951 4318 respectively.

Large industrial water softeners

A new range of economic reliable Ion-exchange plants has been developed by Feedwater Treatment Services.

Feedwater have recently completed installation of Quadoex Units at two major London hotels. Both hotel projects included bulk storage tanks, salt saturators and involved cutting out and removal of out-dated plant, without interrupting flow of soft water to hotel services.

Contracts for engineered plant are currently under way for two large hospitals. The company undertakes design, engineering specifications, supply, manufacturing, installation and routine maintenance.

It is interesting to note that the company recently won an award of merit in the British Telecom joint Chamber of Commerce Business Efficiency Scheme.

Further information from: Feedwater Treatment Services, Tarran Estate, Moreton, Wirral L46 4TP. Tel: 051-606 0808.

Computerisation for smaller hospitals

Computerisation of manual systems for non-medical records in smaller hospital units can be achieved inexpensively and without need for specialist computer staff by using a 'fuzzy access' system available from Infospec Computers.

At three West Yorkshire hospitals — Dewsbury General, Batley General and Staincliffe General — with a total of 750 beds, Infospec are in the final stages of a four year £70,000 programme, interlinking the units to a master index. Staff at the three hospitals will be able to access information of some 300,000 entries, many of which are duplicated due to changes of addrss or name changes on marriage.

Further information from Infospec Computers Limited, Leeds Bridge House, Leeds Bridge, Leeds, West Yorkshire. Tel: (0532) 441678.

Monitoring medical gases

Ohmeda has introduced a range of new Medipoint medical gas alarms, which is a versatile centralised system using computerised technology to monitor both source equipment and local gas pressure conditions.

There is a local alarm panel monitoring up to four gas services for both high and low pressure conditions.

Further details from: Ohmeda, Telford Crescent, Staveley, Derbyshire S43 3PF. Tel: 0246 474242.

THERMOSCOPIC MEANS IT'S COMPLETELY SAFE FOR HER TO GO UNDER THE WATER.

Our unique thermoscopic mixing valve allows her to step under the shower safe in the knowledge that the water temperature will be just right.

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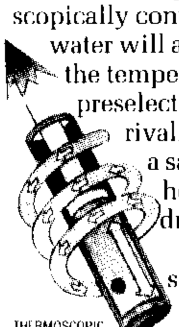

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The system is a great help for patients and nurses alike, but also allows significant savings on water, fuel, and maintenance costs. In addition, we also provide full technical support and advice, so whatever the project you can specify thermoscopic technology in complete confidence, knowing that it will satisfy all your most stringent performance requirements.

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News

The Industrial Water Society

'Microbiological Control of Water Systems within Commerce and Industry', including Legionnaires' Disease, is the subject of a one-day conference staged by The Industrial Water Society, on 6th March at the Institution of Civil Engineers, London. Six papers will be given including maintenance, design, monitoring and control.

Further details from The Industrial Water Society, One Tolson's Mill, Lichfield Street, Fazeley, Tamworth, Staffs. B78 3QB. Tel: 0827 289558.

Power Europa '86

June 3rd to 5th, 1986, Rhein-Main, Wiesbaden, West Germany

TCM Expositions have pleasure in announcing Power Europa '86, the power supply and Conversion exhibition/conference totally dedicated to the power supply and alternative power sources industry. Power Europa '86 will provide a much needed forum, recognising that every item of electronic equipment ever produced requires some form of power supply and will satisfy the needs of major manufacturers and agents. The selection committee are already evaluating papers for the conference and would be interested in receiving contributions from engineers in the industry who feel they have constructive comments to make about power supply technology and the application of power supplies in commercial and insutrial equipment.

For further details contact: TCM Expositions Limited, Exchange House, 33 Station Road, Liphook, Hampshire GU30 7DN. Tel: (0428) 724660.

£1 Billion investment

John Patten, Parliamentary Secretary for Health, today confirmed that the Government has now committed over £1 billion to the building of major new hospital schemes and other NHS capital projects. He said: "We ae now seeing the renewal and rebuilding of a lot of the infrastructure of the NHS. The fact is that we are running a major programme of capital development and modernisation in English hospitals." The record shows that:

- A total of 158 hospital schemes costing more than £2 million each — and together costing over £1 billion — are being planned, designed and constructed at present.
- This year alone three major hospital schemes costing over £5 million each have already been completed:
  - Queen Elizabeth Hospital, Gateshead (Total cost — £8m)
  - Northern General Hospital, Sheffield (Total cost — £8m)
  - St George's Hospital, South London (Total cost — £14m)
- Another two major developments should be completed by the end of the year:
  - Lewisham District General Hospital, South East London (Estimated cost £8m)
  - Homerton District General Hospital, North East London (Estimated cost — £18m)

'These schemes will provide a total of 864 new beds, 12 operating theatres, 7 x-ray departments, 4 outpatient departments and a medical school. They are complemented by a great number of smaller schemes, rebuildings and upgradings of our hospitals.'

Power UK '86

March 4th-6th, 1986, Kensington Exhibition Centre London

Once again the voice of the Power Supply Industry, the influential Power Supply Manufacturers Association (PSMA) will be sponsoring and playing host to the UK's only dedicated exhibition/conference in the specialised field of Power Supply and alternative Power Sources. Power UK '86 provides a unique oportunity to discuss specific requirements with manufacturers and examine all competing products.

For further details contact: TCM Expositions Limited, Exchange House, 33 Station Road, Liphook, Hampshire GU30 7DN. Tel: (0428) 724660.

Environmental Engineers' handbook

The 2nd Edition of the Handbook of the Society of Environmental Engineers has just been published. In addition to providing a comprehensive listing of the products and services offered by the Society's Members, the 232-page publication also contains a wealth of interesting and valuable information for wokers in the environmental engineering and associated fields. This includes basic informatio such as constants and conversion factors, coupled with glossaires of, for example, frequency analysis, infrasound and acoustical terms together with terminology used in such areas as computing, radioactivity, and vibration.

It is published by the Society of Environmental Engineers, Owles Hall, Buntingford, Hertfordshire SG9 9PL. Tel: 0763 71209. Price £8.00.

The Institution of Structural Engineers

A Manual for the design of reinforced concrete building structures has been written by, and for, practising designers and thus reflects the logical sequence of operations that a designer follows. It covers the majority of reinforced concrete buildings, but with the deliberate exclusion of some items. The recommendations given in the Manual fall within the wider range of options in BS 8110. The Manual offers practical guidance on how to design safe, robust and durable structures. The initial design section isd a novel feature and the guidance given will make a positive contribution to design practice. The Manual is priced at £5 a copy (including postage and packing) for IStructE/ICE members and £7 for other. Copies should be ordered from The Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1X 8BH.

British Standards Institution

Arc welding

BSI has published a new Part 3 to the welding standards. BS 4870 *Approval testing of welding procedures* Part 3 *Arc welding of tube to tube-plate joints in metallic materials.* This lists the items to be recorded in a procedure test and gives details of those changes that would entail re-approval of a procedure. BS 4871 *Approval testing of welders working to approved welding procedures* Part 3 *Arc welding of tube to tube-plate joints in metallic materials.* This is closely linked with the requirements of BS 4870: Part 3, particularly with regard to the information to be given to the welder and the extent of approval. *Copies of BS 4870: Part 3 and BS 4871: Part 3 may be obtained from the Sales Department, British Standards Institution, Linford Wood, Milton Keynes MK14 6LE. Price; £12.20 each (£6.10 each to BSI subscribing members).*

Cavity wall foam insulation standards revised

BSI has published revisions of both British Standards relating to the manufacture and installation of UF foams for the thermal insulation of approved types of buildings. The new publications are BS 5617 *Urea-formaldehyde (UF) foam systems suitable for thermal insulation of cavity walls with masonry or concrete inner and outer leaves* and BS 5618 *Code of practice for thermal insulation of cavity walls (with masonry or concrete inner and outer leaves) by filling with urea-formaldehyde (UF foam systems),* which supersede the respective 1978 editions, now withdrawn.

Copies of BS 5617 and BS 5618 may be obtained from the Sales Department, British Standards Institution, Linford Wood, Milton Keynes MK14 6LE. Price: BS 5617 £16.50 (£6.60 to BSI subscribing members), BS 5618 £35.50 (£14.20 to BSI subscribing members).

Ultrasonic therapy equipment

BSI has published a further new Section in the series of British Standards designated BS 5724 *Medical electrical equipment.* This latest publication is Part 2 *Safety requirements* Section 2.5 *Specification for safety or ultrasonic therapy equipment,* which is identical with IEC Publication 601-2-5.

Copies of BS 5724: Part 2: Section 2.5 may be obtained from the Sales Department, British Standards Institution, Linford Wood, Milton Keynes MK14 6LE. Price: £31.00 (£12.40 to BSI subscribing members).

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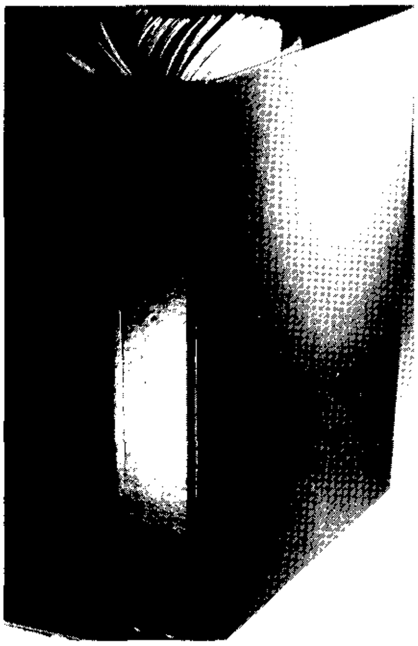

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3 Wycliffe Street, Leicester LE1 5LR62 England

Ohmeda Medical Engineering is a fully integrated business unit within BOC Health Care and the market leader in the specialised contracting business of installing and maintaining medical gas pipeline systems for hospitals, clinics and laboratories.

Applications are invited for the following vacancies based at our Sunbury on Thames office.

Contract Engineer

We are looking for an experienced Engineer with a contracting background to be responsible for installation projects and the scheduling and control of materials and labour on site in order to ensure timely and profitable completion of installation contracts.

We are a specialised Company, therefore full training in design and installation techniques will be given.

The appointment will interest Engineers in the contracting industry aged between 25 and 35, and qualified to HNC level with a full knowledge of JCT conditions of contract.

Success in the position could lead to further opportunities in the UK or overseas.

Quantity Surveyor

In order to aid our continued business growth, we have created an opportunity for a qualified Quantity Surveyor aged 28 plus, who is experienced in either the medical or engineering field and who wishes to join a professional and ambitious business.

For both positions, benefits include an attractive remuneration package, Company car, contributory pension scheme and 25 days annual holiday. Re-location help will be considered where necessary.

Initially, please write with a full CV including salary details to: **Alec Luhaste, Ohmeda Medical Engineering, Telford Crescent, Staveley, Chesterfield S43 3PF.**

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Institute News

The Engineering Council

Britain's engineers hold the key to the country's future, said the Prime Minister, the Rt Hon Margaret Thatcher, when she addressed the first Engineering Assembly in September. The two day conference was organised by The Engineering Council and attended by delegates representing 300,000 engineers from all over the country. She told the delegates that she was at the conference to demonstrate the Government's commitment to engineering in Britain and said 'the success of engineering is the key to our future prosperity.'

New appointment

John Richards has been appointed executive director of The Portland Hospital for Women and Children by American

continued on page 24

LETTERS TO THE EDITOR

I read with interest the article by J H Postans on Ethylene Oxide Sterilisation (July/August 1985 issue) and would appreciate the privilege of commenting upon a point made in the article.

In the section entitled 'the working environment', it is stated the ethylene oxide will stratify within its storage cylinders at the temperatures below 15°C if a carrier gas mixture is utilised. This gave immediate cause for concern. In my Authority we have operated successfully with a such a system, for the past 10 years, where our gas cylinders are kept in an external; unheated manifold room and temperatures are frequently below 15°C. We have over the years employed two gas mixes, initially 90% Co2, 10% ETO, presently 88% Halocarbon 12, 12% ETO.

I have consulted B.O.C. Special Gases who have informed me that in both cases the gases are completely homogeneous in liquid form within the storage cylinders and no fractional distillation takes place owing to the vapour pressure of the carrier gas. Furthermore, due to the construction of the cylinder whereby a tube runs internally to the bottom of the cylinder, the mixture is removed from the cylinder in the liquid state.

In these systems the mixture is not vapourised until it reaches the steriliser and hence there is no danger of sub-cooling at the cylinder from the latent heat of vapourisation.

It is our experience in Newcastle that ehtylene oxide/carrier gas mixtures can be supplied from remote location without the need to maintain cylinders and pipework constantly in excess of 15° or 20°C as stated in the report.

K C Clark
A.D.W.O. (Specialist Engineering Services)
Newcastle Health Authority

THE INSTITUTE OF HOSPITAL ENGINEERING ONE DAY SYMPOSIUM

'THE CHOICE IN SELECTING CONSTRUCTION AND MAINTENANCE CONTRACTS'

Thursday 5th December 1985
at The Institute of Marine Engineers
Mark Lane, London EC3

In Hospital Engineering we use contracts for a variety of purposes. These can be conveniently classified into (1) Construction, (2) Maintenance and Operations and (3) Purchase.

The JCT form of contract is commonly used for new construction, for a variety of reasons. However, there are other forms of contract which may be used and are more appropriate in certain circumstances. There are also different varieties of Operations and Maintenance contracts.

This Symposium illustrates the various different types of contracts available to hospital engineers and illustrates the strengths and weaknesses of the different forms.

PROGRAMME

10.00	Coffee
10.30	OFFICIAL OPENING by and Chairman for the day: JOHN BOLTON ESQ CB, LLB(Hons) Lond, CEng, FICE, FIMechE, Hon FCIBSE (Past President), FInstE, FCIArb, Hon FIPHE, Hon FIHospE, FRSA. Chief Works Officer and Director General of Works, Department of Health and Social Security.
10.40	REVIEW OF THE FIELD Speaker: B. W. EAST ESQ CBE, FRIBA, Regional Works Officer, North East Thames Regional Health Authority.
11.20	MANAGEMENT CONTRACTING Speaker: SIMON DANDO ESQ, Bovis Limited. Speaker: M. K. DAVIS ESQ MA(Cantab), Committee of Associations of Specialist Engineering Contractors, Drake and Scull Engineering Ltd.
12.00	JOINT VENTURE/TURNKEY PROJECTS Speaker: T. T. BARTON ESQ MA, CEng, MICE, John Mowlem & Co Plc Speaker: R. E. O'DONNELL ESQ, FRICS, Committee of Associations of Specialist Engineering Contractors, Haden Young Ltd.
12.40	Lunch
14.00	CONTRACTS FOR MAINTENANCE AND OPERATIONS Speaker: W. NICHOLAS ESQ, DipArch, ARIBA, District Works Officer, Peterborough Health Authority.
14.40	PROFESSIONAL VIEW OF ALTERNATIVE FORMS OF CONTRACT Speaker: Dr MARTIN BARNES BSc (Eng), PhD, CEng, FICE, FCIOB, MBCS, ACIArb, Martin Barnes and Partners. Speaker: P. A. TYLER ESQ FINucE, MASHRAE, MRSH, FIHospE, Austen Associates.
16.00	OPEN FORUM
16.30	Close

NB: Please note that tickets are available ONLY from the Institute of Hospital Engineering, (Tel: Portsmouth (0705) 823186).
To: The Secretary, The Institute of Hospital Engineering, 20 Landport Terrace, Southsea, PO1 2RG.

Please send me...........ticket(s) for the ONE DAY SYMPOSIUM entitled 'The Choice in Selecting Construction and Maintenance Contracts' to be held on Thursday 5th December 1985.

I enclose £....................to cover the cost.

Ticket to include morning coffee, lunch and VAT.
Member: £46.00. Non Member: £51.75
No fees will be returned for cancellations (in writing please) received after midday on Thursday 28th November 1985.
VAT Registration No. 339 3963 20

NAME (in capitals please) ....

ADDRESS..

....

Position ....Non member (please tick)...........

Medical International. He has been assistant hospital director of AMI's Harley Street clinic since 1981. Before joining AMI Mr Richards was district engineer for the North East district of the former Kensington, Chelsea and Westminster area health authority.

Health & Safety Executive

Proposals to introduce a new two-part examination procedure for local exhaust ventilating plant are published today by the Health and Safety Executive. In an important discussion document, the Executive details the background to existing requirements for the examination and testing of such equipment and the reasons for the proposed toughening of procedures, as well as providing detailed guidance as to how the new system might operate. Comments on these proposed changes and the guidance for competent persons would be welcomed by the Executive and should be submitted by 2 December this year to Mrs D Sixsmith, HSE, McLaren Building, 2 Masshouse Circus, Queensway, Birmingham B4 7NP. Copies of the discussion document, A Guide to the Examination and Testing of Local Exhaust Ventilating Plant from HMSO or booksellers, price £4.50. ISBN 0 11 8838342.

Further details from HSE Press Office, Regina House, 259-269 Old Marylebone Road, London NW1 5RR.

Building Research Establishment

New BRE Information sheet

The features, attributes and limitations of available building management systems and the factors affecting their suitability for particular types of application are examined from the point of view of the specifier/user in Building Research Establishment Information Paper IP 6/85, 'Selection of building management systems' by A B Birtles. *Copies of BRE Information Papers are available from the Publications Sales Office, Building Research Establishment, Garston, Watford WD23 7JR, price 75p each (post free, but minmum order £2).*

NEXT ISSUE

December '85/ January '86 International

will be published early January 1986

FORTHCOMING BRANCH MEETINGS

West of Scotland Branch: *Hon Sec: R. W. Gardner, 12 Middlehouse Court, Carluke, Lanarkshire. TN Glasgow (041) 204 2755 ext 2710.*

November 28th 'Mains Communication for Monitoring and Control' by Mr G. Walsh, Burgess Control. The Board Room, Glasgow Royal Maternity Hospital.

Southern Branch: *Hon Sec: A. J. Styles, 11 Rufford Close, Boyatt Wood, Eastleigh, Hants. SO5 4RU. TN Southampton (0703) 777222 ext 4109*

November 14th Visit to IBA Crawley Court, Nr Winchester.

East Midlands Branch: *Hon Sec: E. A. Hall, E. G. Phillips Son and Partners, 26 Annesley Grove, Nottingham. TN Nottingham (0602) 475783*

November 6th Coffee 5.30. 'Magnetic Resonance Imaging — A Presentation on Principles and Application' by Prof B. Worthington. Lecture Theatre, MR1 Suite, Queens Medical Centre.

North West Branch: *Hon Sec: B. Duncan, 21 Farm Lane, Worsley, Manchester M28 4PU. TN Manchester (061) 236 9456 ext 284*

November 19th Visit to the CIS Building, Manchester.

December 5th Paper by Nu-Aire Contracts Ltd, Smoke Vent Division, St Marys Hospital, Manchester.

Welsh Branch: *Hon Sec: M. J. Back, 10 Nant-y-Felin, EFail Isaf, Nr Pontypridd CF38 1YY. TN Cardiff (0222) 499921 ext 163.*

November 5th 2pm A second visit to the Control Tower at Rousse Airport.

Please contact the local Branch Secretary if you wish to attend any of the above meetings.

ATTENDANCE AT BRANCH MEETINGS

Members who intend attending any particular branch meetings are urged to complete this return slip and send it in to the relevant Branch Honorary Secretary so that anticipated numbers of each meeting are known in advance.

To: The Hon. Secretary, ______________________ Branch

I would like to attend the meeting on ______________________

Name: ______________________

Tel. No: ______________________

Health & Safety Executive

Manual handling problems

A review of current knowledge on many aspects of manual handling and lifting is published today by the HSE. The book will provide a valuable source of information for a wide audience including those with managerial, supervisory, technical and medical interest in manual handling and especially in the problem of back pain associated with lifting. *Copies of Manual Handling and Lifting — An Information and Literature Review are available from HMSO or booksellers, price £5.50, ISBN 0 11 883778 8.*

New guide

A guide to the Classification, Packaging and Labelling of Dangerous Substances Regulations 1984 is published by the HSE. The new regulations, which are designed to increase health and safety protection for both workers and the general public by requiring dangerous substances including preparations and other mixtures to be adequately packaged and suitably labelled, come into full effect on 1 January 1986, or for smaller packages, on 1 January 1987.

A guide to the Classification, Packaging and Labelling of Dangerous Substances Regulations 1984, (HSR 22), HM Stationery Office, price £5.00. ISBN 0 11 883794 X.

Occupational exposure limits

A new listing of agreed occupational exposure limits for workers has been published by the HSE. This new publication is the first annual revision of EH40; and contains a number of revisions and additions to the text as well as to the lists of Control and Recommended Limits. *Copies of Guidance Note EH40/85 Occupational Exposure limits 1985 can be obtained from HM Stationery Office or booksellers, price £3.25 (ISBN 0 11 883516 5).*

Safety signs reminder

Britain's employers are reminded that they have until the end of this year to bring their safety signs up to date to meet the requirements of the Safety Signs Regulations 1980. HSE has published a free leaflet giving brief details of the types of sign, the style, size and colours dictated by the Regulations and giving varoius examples. Copies of *Do Your Signs Comply* available free from local HSE offices or direct from the Public Enquiry Points at HSE main offices in London, Sheffield and Liverpool — telephone numbers 01-229 3456; 0742 78141; and 051-951 4318 respectively.