HOSPITAL ENGINEERING

September 1978

International Federation Issue

The Journal of the Institute of Hospital Engineering

I.F.H.E.

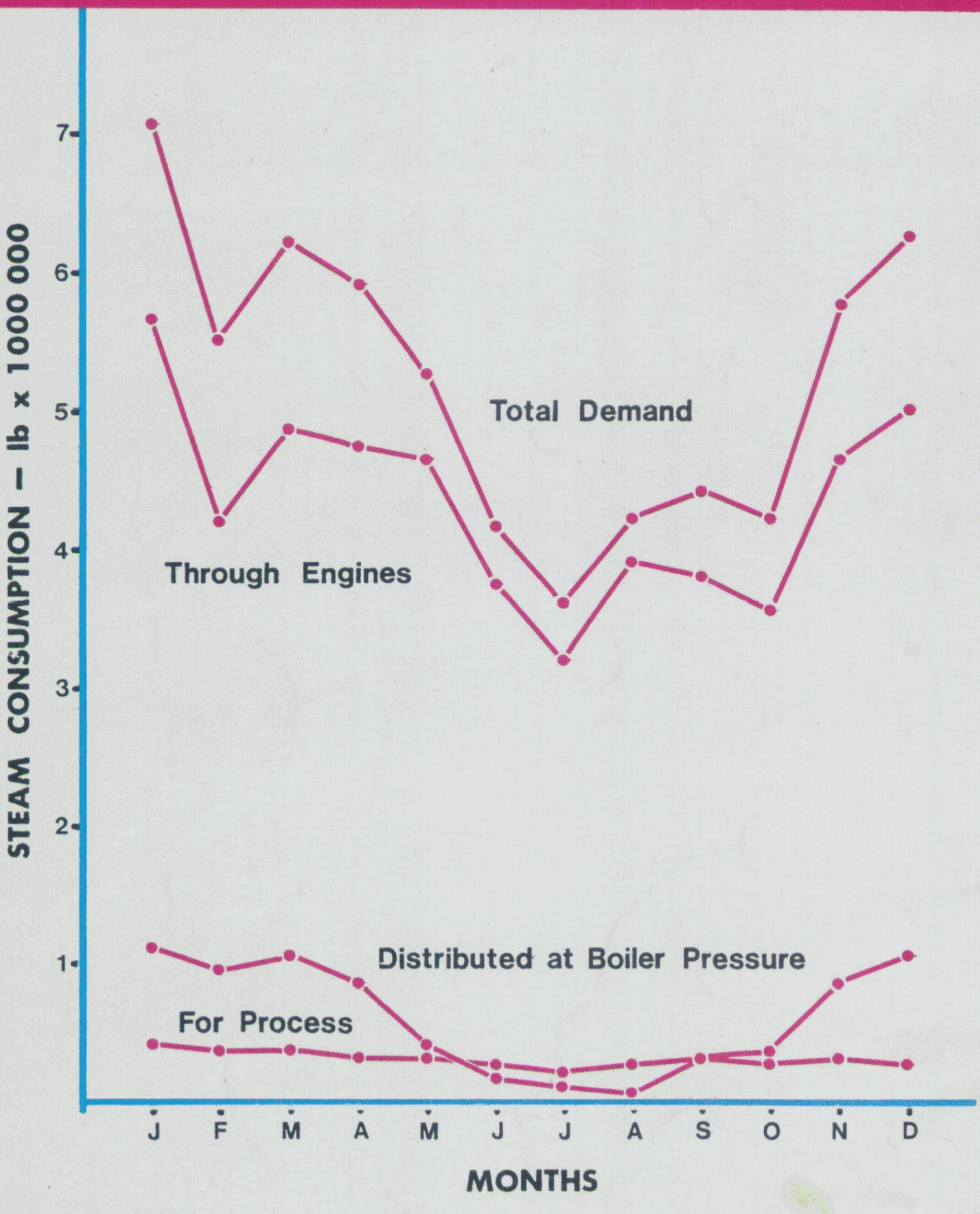

Fig. 13 Hospital Steam Consumptions

Site Generation - Operational Experience

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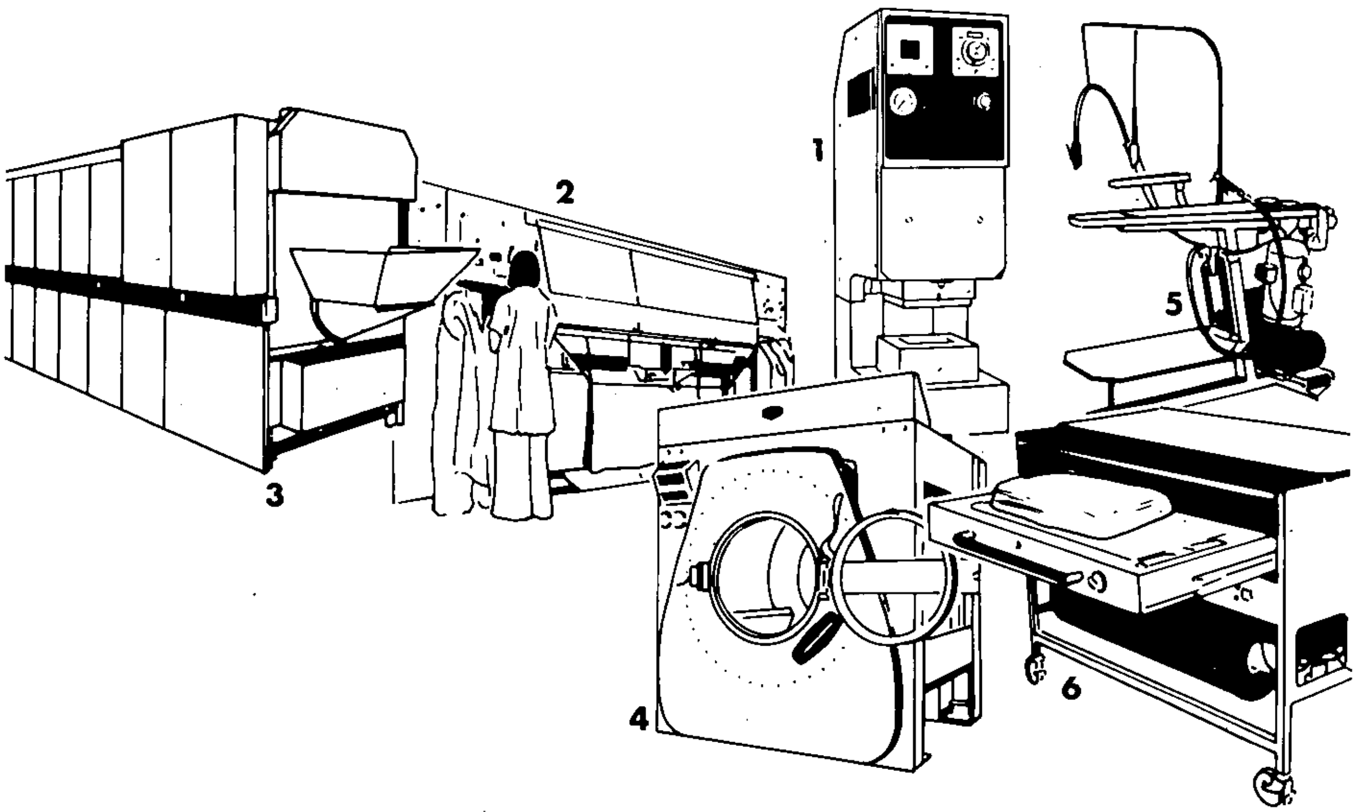

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HOSPITAL ENGINEERING

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The Journal of the Institute of Hospital Engineering

International Federation Issue No. 27

September 1978

Contents

Institute News

Major step for Institute CEI affiliation

Institute affiliates to CEI

It has been announced that The Institute of Hospital Engineering has been admitted as an Affiliate of the CEI.

Council of the Institute is sure that members will welcome this as a further significant step in the affairs of the Institute.

The Supplemental Charter of CEI has been recently sealed and delivered and in due course it will be incumbent upon the newly-constituted Board to prescribe the constitutions and terms of reference of the new Committees and so we must await clarification in these and other respects.

Further information on developments will be published as it becomes available.

Autumn One-Day Symposium

Safety – Management Implications

The next One-day Symposium held by the Institute will be on November 1 and will be devoted to the subject of 'Safety Representatives and Committees — Management Implications'.

Will members please note that production difficulties have prevented preparation of the usual leaflet (incorporating ticket request) for distribution with this issue of the Journal. Accordingly, the full programme is given below.

The Symposium will be held at The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, on Wednesday, November 1, 1978.

The Regulations on Safety Representatives and Safety Committees (SI 1977 No 500) are operative from October 1, 1978. This Symposium is intended to give managers, hospital designers and those responsible for maintaining the estate in the NHS, an opportunity to examine the implications of these Regulations and other aspects of the Health and Safety at Work Act, 1974.

Programme

10.00 Coffee

10.25 Official opening by J. R. Harrison Esq CBE CEng(Fellow), President, The Institute of Hospital Engineering
Chairman for the day:
J. D. McLean BSc FIOB FRSA
Industrialist, Master Builder, Member of Wolverhampton AHA

10.30 **Technique of Safety Inspections**
Speaker: R. Mackmurdo, Editor of Industrial Relations Briefing

11.30 **Is Safety Negotiable?**
Speaker: George Redman, a NUPE Research Officer

12.30 Lunch

14.00 **The Work of the Health and Safety Executive as it Relates to Hospitals**
Speaker: R. J. Atkins, HM Senior Principal Inspector of Factories, Health and Safety Executive

15.00 **Open Forum**

16.00 Closure

Tickets (price £12, includes Lunch and Morning Coffee) are obtainable ONLY from The Secretary, The Institute of Hospital Enginering, 20 Landport Terrace, Southsea, PO1 2RG.

Institute 1979 Annual Conference

The 35th Annual Conference of The Institute of Hospital Engineering will be held at the Spider's Web Hotel, Watford By-Pass, near London from Wednesday, May 9 to Friday, May 11.

The Conference Dinner Dance will be held on the evening of Thursday, May 10, and will be attended by distinguished guests.

As is usual, a separate Ladies' programme will be arranged.

Full information on the Conference itself and the associated activities and forms for Conference registrations and hotel reservations will be distributed to members and others early in January.

Jim Winning's 12 months in Kuwait

A series of 12-month secondments to Kuwait have been made to advance the collaborative arrangements between the Wessex Health Service and the Gulf State.

Regional Works Officer, Mr James Winning, leaves later this year with other specialists to advise on technical aspects of developing Kuwait Health Service.

Mr. Winning, although looking forward to the year abroad, said that he expected the work of bringing a new technical organisation into existence to be 'demanding'.

William Runcie retires

Mr William Runcie, District Engineer for the South Grampian District, has retired after thirty years in the Health Service. He is a former Council Member of the Institute.

After his apprenticeship Mr Runcie served in the Merchant Navy and later the Royal Navy before joining the

Health Service in 1948 as Resident Engineer at Woodend General Hospital, Aberdeen.

In 1957 he was made Group Engineer of the former Aberdeen General Hospitals Board of Management and later held the same post with the former Foresterhill and Associated Hospitals Group. He became District Engineer on NHS reorganisation.

Mr J. Rowell

Mr Rowell, a member of the Southern Branch of the IHE for a considerable number of years has died, aged 79. He was a highly respected member who always endeavoured to attend very regularly to Southern Branch matters, and served to remind the more vociferous of its members that difficult times had been experienced over the years.

In his early years he was a member of the Royal Flying Corps, who had a reunion recently, as an aircraft fitter. The RFC along with the Royal Naval Reserves formed what is now the RAF. At the reunion he was honoured as being one of the oldest living members and wined and dined in a style befitting a VIP. He has said since then that he had received general invitations to join Air Force reunions, but due to his increasing years and failing health had had to decline them.

Mr Rowell lived in Hartley Wintney since his retirement and had been an engineer at Winchfield Hospital from 1930, retiring in about 1964.

Fr O'Riordan

We regret to hear of the death of Fr O'Riordan, a member of the Institute. His sudden death while on holiday at his brother's house in Dundalk came as a great shock.

J. O'Mahony, BE, Technical Services Officer of the Southern Health Board of Ireland was a colleague and writes that Fr O'Riordan 'served his engineering apprenticeship with Messrs Lunham, a meat processing company in Cork in the 1940s and later became a priest in the missionary congregation of the Holy Ghost Fathers (CSSp). He worked for 17 years in Nigeria mostly in the Onitsha area, two years in New York, two years in San Francisco and five years in Calgary, Alberta, Canada.

His work in Africa included building and installation of services in schools, churches, hospitals, clinics and dispensaries. His experience in these matters was wide ranged. His work at all times was effective and carried out in good humour.

He is gone to his heavenly reward for much, including his engineering services in three continents. His relatives and many friends are grieved at his passing'.

Conferences & Exhibitions

Environmental Engineering Today

A symposium and exhibition on 'Environmental Engineering Today' is to be held at the Wembley Conference Centre, London from May 9-11, 1979. It is sponsored by the Society of Environmental Engineers to mark its 20th Anniversary year.

Subjects to be discussed are in six groups as follows: (i) Vibration, Shock and Noise; (ii) Fatigue in Adverse Environments; (iii) Materials and Contamination Control; (iv) Climatic Testing; (v) Packaging; (vi) Reliability and Durability.

Further information from the Conference Secretary, SEECO 79, Owles Hall, Buntingford, Hertfordshire, England. Tel Royston (0763) 71209.

Second Reliability Conference

The Institute of Quality Assurance and the National Centre of Systems Reliability are holding their Second National Reliability Conference, 'Reliability — The Key to Survival', at the Metropole Hotel, National Exhibition Centre, Birmingham from March 28-30, 1979.

Details from The Secretary, The Institute of Quality Assurance, 54 Princes Gate, Exhibition Road, London SW7 2PG.

SAME Meeting

A seminar on the 'Control and Measurement of Pollution in Operating Theatres' will be held on October 14, 1978 at The Institute of Psychiatry, Kings College Hospital, London SE5 9RS. It will be in the form of an open forum for manufacturers, hospital engineers and users. Further details from: Professor L. Strunin, Anæsthetic Department, Kings College Hospital, Denmark Hill, London SE5 9RS.

Symposium on Designing for Safety/Security

A One-day Symposium has been organised by the Building Construction Forum in association with the British Security Industry Association and the British Fire Protection Systems Association to take place at the Institution of Civil Engineers, Great George Street, London SW1 on November 21, 1978.

The organisers feel that the whole problem of public safety must now be re-examined in order to hold a balance between easy means for the public to escape and the protection of legitimate occupants of buildings from assault, theft and terrorist activities. Further, sophisticated means of fire extinction can themselves lead to danger to occupants.

The Symposium will bring together experts in different fields, and marks a major step forward in the evolution of a new philosophy of security and safety in a world troubled by increasing technological hazards and human violence.

The cost (including lunch, morning coffee and afternoon tea) is £25 including VAT. Application forms from the Conference Office, The Institution of Civil Engineers, 1-7 Great George Street, London SW1 (Tel 01-839 3611).

Water Treatment and Pollution Control – Joint Exhibition

The Effluent and Water Treatment Exhibition and Convention 1978 with the Environmental Pollution Control Exhibition 1978 will be held jointly at the National Exhibition Centre, Birmingham, Hall No 2 from November 13 to 18, 1978. The Convention venue, on November 15 and 16, will be in the Albany Suite, The Albany Hotel, Birmingham.

Branch News

East Anglian Branch

The July meeting of the Branch was held at St Nicholas Hospital, Great Yarmouth. Mr J. Hersey of Midland Electrical Manufacturing Ltd., gave a talk on his company and its products, tracing the history of electrical switchgear from 1908 to the present time and giving his views on possible future developments.

A film was shown which gave an insight into manufacturing techniques employed followed by a lively discussion on miniature circuit breakers.

London Branch

Practical Energy Conservation

A London Branch meeting was held on June 27 under the Chairmanship of Mr W. Askew, Branch Vice-Chairman.

The first speaker, Mr Bowen, Marketing Manager, Cooling Products Division, Dunham-Bush Ltd, began by supporting the principle of energy conservation, not only in order to reduce material costs and capital plant expenditure, but to safeguard and prolong the effective life of the world's limited natural resources until new forms of energy have been found. He suggested that one method of energy saving was in the recovery of heat rejection from essential refrigeration or air conditioning equipment. A typical example for heat recovery was the water chiller where the heat rejected through the condenser water is normally discharged to the atmosphere via a cooling tower. By installing a double bundle condenser to provide an additional separate closed water circuit, it would then become practical to collect this very useful energy source in the form of hot water.

The rotary helical screw compressor also provided a capacity control stability from 100% to 10% of full load without the need for hot gas by-pass, and operating over a wide range of condensing temperatures. These machines were ideally suitable for really large duty requirements ranging from 100 to 750 Tons Refrigeration to take advantage of the lower power requirements during the cooling season, and to provide maximum heat recovery water temperatures during the heating season. The elimination of complicated controls with minimum maintenance were inherent characterstics. A very important feature of the screw compressor was its quietness of operation.

For smaller duty requirements single bundle condensers with reciprocating compressors were also effectively being used for heat recovery systems. But the efficiency of these smaller units was restricted by their unloading characteristics and have to be carefully designed to achieve their design duty performances. When considering duty requirements and BHP performances, experience had shown a condenser leaving water temperature between 105° to 110°F to be the most economical.

A significant energy saving feature Mr Bowen suggested would result from a 20% window area reduction of building surfaces with subsequent major energy savings on heat losses from the perimeter of building structures.

The second speaker, Mr Graver, Manager, Heating Department, Spirax-Sarco Ltd, began by describing the basic properties of steam and the fundamental principles of effective steam raising. Boiler manufacturers' recommendations regarding pressures and temperatures should always be followed and by installing separators after the boiler crown valve the quality of steam would be considerably improved by the removal of wet steam. The presence of air in steam reduces its working temperature and subsequently its resultant efficiency, and it is therefore essential to install sufficient traps incorporating an integral air vent. The siting of the traps is also critical and an air vent at the terminal end of each branch main will materially assist warm-up performances.

It would be desirable to size steam distribution pipework on a pressure drop basis with drain taps positioned at 100ft intervals. To protect expensive plant equipment from costly maintenance, strainers should be fitted before each control and pressure reducing valve. The importance of installing the correct steam trap was stressed, *viz* mechanical, thermostatic, thermodynamic and their relative functions. The mechanical traps included the ball float and the inverted bucket traps which found applications where the steam density and hot condensate were different. Thermostatic traps differentiated between steam and condensate temperatures through a thermostatic element and valve, whilst thermodynamic traps operated on velocity. Most traps should be located near the drain connection, otherwise steam locking may occur. Exceptions are the various thermostatic traps where it is important to have an unlagged pipe between the drain point and trap to allow the condensate to lose some of its sensible heat.

Energy conservation could be achieved also by condensate recovery by the installation of a heating calorifier, a flash vessel or a heat exchanger, and insulation of steam and condensate pipework was another factor. It was emphasised that steam escaping through a ⅛in orifice at 90 psig could waste 1,000 gallons of oil per year based on a forty-hour week.

Regarding his earlier comment referring to something for nothing, Mr Bowen stated that it was related to the amount of reject heat available which was equivalent to the evaporator duty and the motor heat, and the heat of compression which was an additional bonus of some 25% in the reject circuit above that used in the evaporator. Asked how the Hall Thermotank monoscrew and the conventional Dunham-Bush twin rotary screw compared, Mr Bowen replied that no machine life comparison figures were at present available, but was of the opinion that the monoscrew had more operating parts.

On the subject of steam quality, Mr Graver stated that whilst it was possible to achieve excellent results in the laboratory, site conditions were very different and one could only hope to achieve acceptable levels of purity. There was discussion regarding the use of water as a secondary refrigerant in the coils. Mr Bowen explained that although there were advantages in using water in that leakage only caused damage, in the case of the direct expansion system although the refrigerant had no real toxic effect, the loss of a large gas charge could be rather expensive. Where comparatively short runs existed with only basic duty control requirements, the direct expansion scheme would be more competitive than secondary refrigerant (chilled water) schemes.

A recent Government announcement providing financial grants covering 25% of the costs for replacing or modernising boilers, insulating premises and improving or changing combined heat and power systems to save energy should be of interest to many members.

A. M. GOWER

Letters to the Editor

Is PPM adequate?

Dear Sir,

Press comments on the recent Hospital Electricians' work-to-rule have tended to give the public the impression that without constant attendance by these skilled men a considerable amount of plant and equipment will quickly break down, and subsequently have to be taken out of service.

The point of this letter is in no way an attempt to become involved in an unfortunate dispute situation, but simply to raise the question of whether or not planned preventive maintenance systems currently used in the Service have proved adequate to requirements over the past few years. Or, indeed, are such systems being carried out in the manner that was originally intended?

Yours faithfully,
R. G. SMITH

Solar heating – another view

Dear Sir,

I found Mr J. R. Fielding's article on *Solar Energy for the Boiler House* in your April edition extremely interesting. The use of solar energy in commercial and industrial fields has been much talked about recently but very few articles have discussed the subject and summarised the analysis of costs in the way Mr Fielding has done. However, whilst Mr Fielding's drawings and details of the steam raising boiler plant are indeed admirable I feel that perhaps the research work on the solar heating aspect of this project could have been carried out in a little more depth, especially when coming to such dramatic conclusions. In the same way that different types of boilers are used for differing applications there are several distinct types of solar collectors, each one suiting different applications.

The glazed and insulated type of collector as described by Mr. Fielding may be suitable for heating small quantities of hot water, such as a domestic hot water system, but may be totally unsuited and hence, not at all cost effective, for a 'pre-heat system'. When designing a solar preheat system it is fundamental to determine which type of collector is most suitable, ie whether your requirements are for low, medium or high temperature water and if the volume of water required is large or small. For such a system as described by Mr Fielding the application is low temperature with a large volume and therefore perhaps a more suitable type of collector would be the unglazed polypropylene type. This type of collector can prove to be much more cost effective in this type of application compared to the glazed and insulated construction of panel. Mainly because of its construction the cost per unit area is less than other types of collectors whilst remaining equally as efficient during the summer months from April to September and supplying some useful energy during the Spring and Autumn months.

From detailed studies carried out by Robinsons Developments Limited on particular steam raising plants for hospitals and the private sector of industry, we have found that solar heating can be extremely cost effective. Indeed on several proposed installations a 'pay back' period of five to six years has been indicated. This figure is somewhat at variance with Mr. Fielding's pay back period of 37 years using the glazed and insulated collector.

Yours faithfully,
R. HILEY
Project Engineer,
Robinson's Developments Ltd.

An article by Mr Hiley putting forward alternative proposals will appear in our next issue. — Ed.

Sorry!

Dear Sir,

I would refer to the article of mine, 'Site Generation for Hospitals — The Concept', published in the August, 1978 (Vol 32 No 6) issue of the Journal. Whilst I must congratulate you on the layout and reproduction of the diagrams unfortunately there has been a transposition of the table titles on Page 22.

These are the Present Value Tables for the Diesel and Steam Driven Generators and it appears that Table No 1 which shows the heading Diesel Driven Generators should read Steam Driven Generators and vice versa, as you will see from the original papers there has been a transposition of the two sub-titles.

I would be obliged if you could print a correction as soon as possible as the present headings make nonsense of the case presented.

Yours faithfully,
RAYMOND KENSETT

Book Reviews

Building Energy Code–Part 1 Guidance towards energy conserving design of buildings and services

Available from the CIBS Publications Department, 49 Cadogan Square, London SW1X 0JB. Price: £3.50 (Members £2.50).

The CIBS make it clear that this is the first part of a comprehensive Building Energy Code now being prepared and to be published in four parts:

1. Guidance towards Energy Conserving Design of Building and Services;
2. Energy Design Targets for Buildings and Services Designers;
3. Guidance towards Energy Conserving Operation of Buildings and Services;
4. Energy Conservation Targets for Building and Service Operations.

I must admit that in the capacity as a Librarian (Honorary), I think I would have preferred to have read the four parts contained as one volume, however, one would accept that this Part 1 will be of considerable importance to those primarily involved in design and therefore should be released now.

The code states that no part of the building and its services can be considered in isolation — all are interrelated one with the other. The site, the shape, the structure, the conditions. It would therefore follow that a wise investment to those engaged in Health Service Engineering is to ensure obtaining, on publication, copies 1 to 4.

I particularly like the format, layout and illustrations of this Code, much in keeping with the former IHVE Guides A, B and C.

I would emphasise that this Code No. 1 is not a text book. It is for use and reference by those who are sufficiently knowledgeable in design to appreciate the relative importance of the various factors involved.

R. G. SMITH
Honorary Librarian

Medical Gases Their Properties and Uses

William J. Grant BSc FRIC MIChemE FPRI. Published by: HM&M Publishers Limited, Milton Road, Aylesbury, Buckinghamshire. Price: £4.00 (not shown on cover).

The Author of this highly professional book is now Consultant to BOC International Ltd, having formerly been their Chemical Engineer. One may well expect, therefore, the contents made up by ten Chapters of 200 pages to be extremely descriptive and informative.

Each chapter deals in considerable detail not only with the various gases in use, but also the vapours of substances normally existing as liquids or even as solids.

It is most encouraging to note that the Author is well aware of the surprisingly large number of people involved directly or indirectly with medical gases, and who from time to time need to apply their knowledge of gas characteristics.

Chapter ten, *Review and Future Trends*, I found exciting in regard to the search for improved anæsthetics. Existing inhalation means might become outmoded in two ways, either better ones or some other procedure. The search for the ideal inhalation anæsthetic with all its unqualified virtues will continue. However, in the Author's view, it may not be too pessimistic to anticipate that no such ideal substance will ever be found. Perhaps a new discovery in the field of anæsthetic drugs for injection may bring a large shift in the balance of the methods used.

This book brings together in concise form a body of technical information about medical gases which until now has tended to be dispersed among a voluminous literature not readily accessible to those who need information quickly.

I would recommend that this book should hold a place on the shelves of those interested in this important subject.

R. G. SMITH
Honorary Librarian

I.F.H.E.

International Federation News

International Congress in Lisbon a great success

The 5th International Congress of Hospital Engineering was held in Lisbon, Portugal, from May 28 to June 2, 1978. This bi-annual event, now firmly established in the cycle of international gatherings designed to promote understanding and learning in those sciences and technologies which relate to health care and human welfare, was no less successful than the previous occasions in Paris, Athens, London and Rome.

Each occasion has gathered increasing recognition throughout the world for the work done by the International Federation of Hospital Engineering to develop those technologies contributing directly to the design, construction, maintenance and operation of health care buildings and patient environment and the beneficial interface between medical practice and engineering science.

The Gulbenkian Foundation building in Lisbon, with its support facilities, created an excellent atmosphere as the venue for the Congress. The Portugese Government, its Ministers and Officers together with the Organising Committee of the IFHE are to be congratulated on their efforts to ensure success of the Congress.

It is understood that during the Lisbon Congress the Council of the International Federation made a significant decision to enter the field of formal training and education in those specialist subject areas of hospital engineering which are of common interest and demand throughout the world. This is an important development which will be reported in detail in future issues of *Hospital Engineering*.

The Congress was attended by more than 1,000 delegates from thirty countries and this in itself is a measure of its success and increasing recognition given to the work of the International Federation. However, the value of renewed acquaintance, establishment of new contacts and cross-fertilisation of ideas and concepts among such a multi-national gathering is immeasureable.

The 6th International Congress of Hospital Engineering will be held during 1980 in the USA, probably in the Washington or Baltimore area. Our good wishes go to those who will be responsible for the formidable task of organising the event and particularly to the President and Vice-President of the International Federation of Hospital Engineering, Messrs Eduardo Cætano (Portugal) and Vinson Oviatt (USA) who will head the Organising Committee.

Our thanks and appreciation also go to the immediate Past President, Monsieur Jacques Ponthieux of France for his valuable work in the development of the IFHE during his years of office.

President's Opening Address

Eduardo Cætano (Portugal)

We would like to greet and welcome all participants and those accompanying them who have come from all over the world to Lisbon to take part in the work of the 5th International Congress of Hospital Engineering.

We thank the speakers for their papers. Their active contribution is of great value to our Congress.

We are grateful to the Calouste Gulbenkian Foundation for allowing us to use its fine premises.

We would like to thank the information media (press, radio and TV) for covering the 5th International

Congress, and all those others who have given us their valuable co-operation.

On behalf of the Organising Committee, I do thank you all.

I am very pleased to announce that with us are about 800 persons from thirty countries attending the Congress. So far, our friends have come from the following countries:

Australia, Austria, Barbados, Belgium, Brazil, Canada, Denmark, Egypt, Finland, France, The Federal Republic of Germany, Greece, Holland, India, Iran, Ireland (Eire), Israel, Italy, Mozambique, New Zealand, Nigeria, Pakistan, Portugal, South Africa, Spain, Switzerland, United Kingdom, USA and Yugoslavia.

According to our records, still more are expected, including some from countries not referred to above. We regret the absence of our colleagues from the Eastern countries of Europe. We believe that a comparison and discussion of hospital engineering technologies would be of help to all of us.

We tried and contacted their embassies in Lisbon several times. Some answered regretting that no representative would come. Let us hope that at future Hospital Engineering Congresses, these colleagues of ours will join us to our mutual benefit.

In order to strengthen our ties with other technical and scientific international organisations in the field of health, and especially that of hospital engineering, we have sent out several invitations to this Congress. The president of the International Hospital Federation, for example, could not come, as he would have wished, because the date of our Congress coincides with that of the IHF Study Tour in the USA.

After Rome, London, Athens and Paris, and before the USA, where the 6th International Congress of Hospital Engineering will be held, we meet now in Lisbon to talk with one another, exchanging our ideas, so that we become technically more up-to-date and humanly richer.

To our old ties of friendship and comradeship, new ties are being formed which increase our great family: that of those who work in hospital engineering.

It is undeniable that the importance of hospital engineering has been increasing continuously both in absolute and in relative terms. Every day new equipment is produced to help save lives and reduce human suffering. In a future not too far off, the health world will be full of new and unpredictable technical innovations. Then it will be difficult to establish the frontier between bio-medical engineer and the bio-engineering doctor. And here we are, those who work in hospital or health engineering. Let us start now to prepare to face this challenge and succeed.

We, technicians of hospital engineering, always have to move within three basic parameters: the technical, the economical and the human. The last is the most important because everything we do in our field has implications upon it. That's why we agree with Dr Rene Sand's ideals of balancing technical progress with human progress. Otherwise Man will suffer. And so, following this line of thought, we believe it does not mean much that this or that hospital is 'the best in the world', or that it is the most technically sophisticated hospital, if the costs are unbearably high or if patients do not feel at ease. For hospital engineering workers, what we really mean is that the solution should be technically the most appropriate and that it should be bearable economically and, above all, humanely adequate.

The subjects of the seven working sessions cover practically all fields of hospital engineering. Specifically, they deal with:

— Hospital planning and programming
— Modern hospital construction
— Industry and hospital equipment
— Hospital engineering services
— Safety and comfort
— Hospital maintenance
— Hospital engineers inside the hospital. Hospital engineer training.

As you will note, there are papers of great significance, interest and importance. We want you to take an active part in discussions. Your comments will be most valuable. Either your agreement or disagreement, both your doubts and explanations, all will be welcome and all will be useful, because here we are among colleagues and friends and our objectives are common: to improve hospital (health) engineering and to save patients' lives.

Some selected papers will be published in the international issues of *Hospital Engineering*, the journal of the IFHE, the growth and dissemination of which we must promote on behalf of our Federation.

We hope you will have a good and fruitful time and a pleasant stay. We will be very happy to help you whenever you need and hope you will go away with a pleasant memory of Portugal.

We want the 5th Congress to be the fifth ring in the chain of fraternity that unites us, strengthening the friendship among ourselves who, representing different peoples of one sole Mankind, have a common aim: to help save lives and vanquish human suffering.

International Seminar for Senior Hospital Engineers

England, September 1979

The International Federation of Hospital Engineers has endorsed a proposal by the President, Eduardo Cætano, that a seminar should be held in the intervening years between conferences. The Institute is greatly honoured to have been invited to organise the first of these international seminars.

In liaison with the Engineering Division at the Department of Health and Social Security the inaugural seminar is being organised for August 28 to September 14, 1979. The venue will be the Hospital Engineering Centre, Falfield (near Bristol), England. The Centre offers not only accommodation and lecture facilities but excellent demonstration and teaching aids.

The seminar is being planned for senior graduate engineers who may be employed by State or National Government to plan or co-ordinate health service facilities, or who are responsible for the management of services in health care facilities. The theme will be the application of appropriate technology to health care facilities. No longer is one design solution immediately applicable universally. The seminar will define the problems and discuss various systems which will help to solve the problems. Delegates will be offered various techniques and methodology which will enable them to undertake their responsibilities for meeting the health care needs more effectively.

The main speakers and tutors will have considerable expertise in the field of planning and design of health care facilities. Delegates will have the opportunity of presenting contributions. There will be several visits which will demonstrate the UK's application of appropriate technology. Full details and programme will be available soon.

International Federation Members 1978

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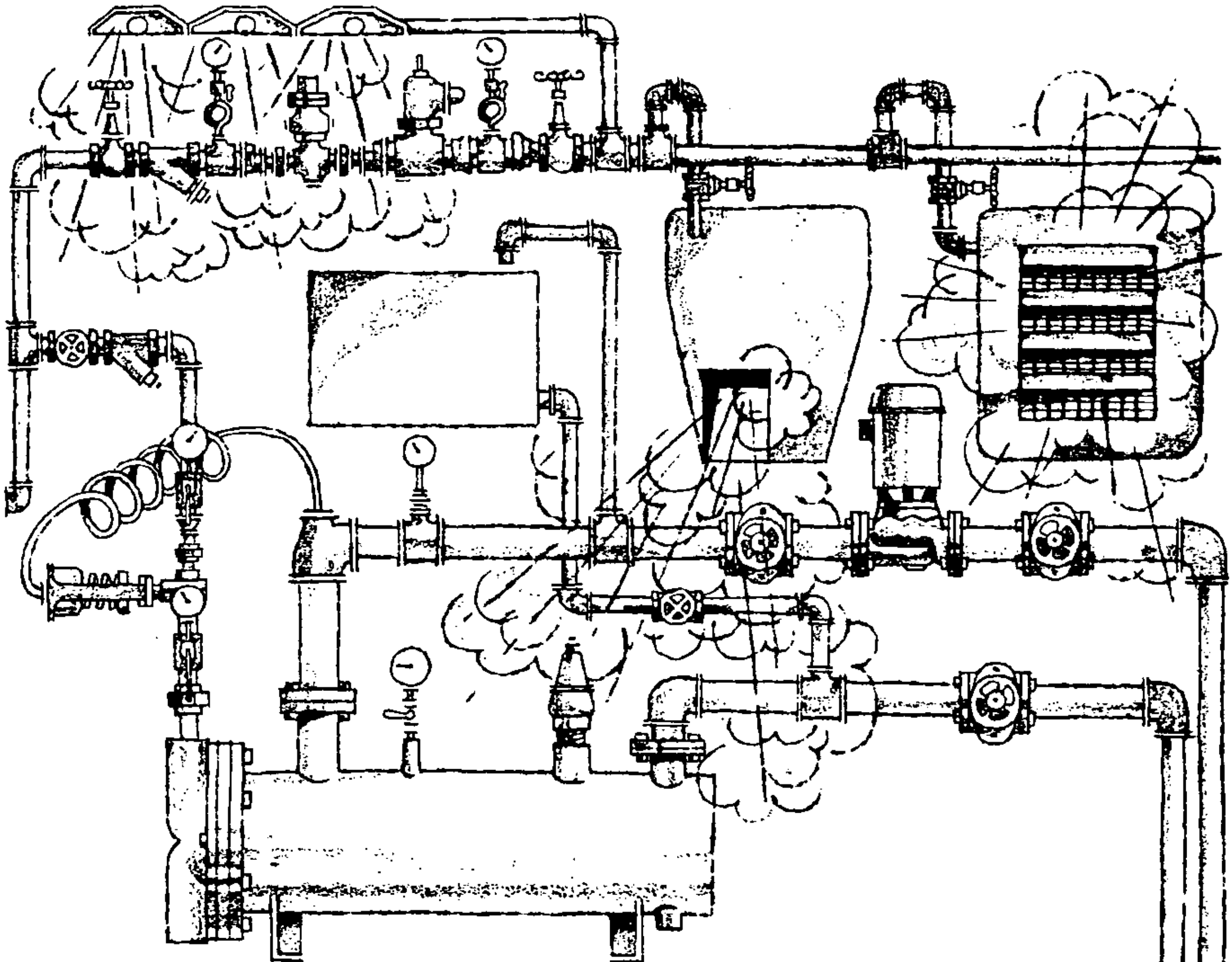

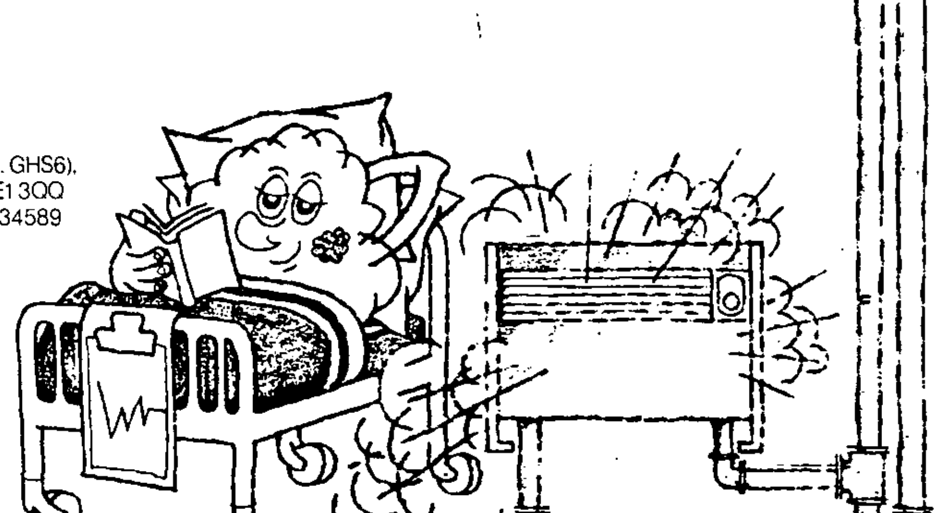

Hospitals in Holland

The following brief description of the Dutch health care system, 83% privately owned, but non-profit making is supplied by Mr Jan de Vries MIHosp, 1977 Northcroft Silver Medal winner.

Health care institutions in the Netherlands number around 801: 243 hospitals, 212 psychiatric institutions, 303 nursing homes and 43 other institutions (medical children's homes, children's day homes and institutions for sensorially handicapped). There are 170,000 beds and 200,000 employees in all hospitals*, which is more than 4% of the active population — only slightly less than in the field of education and twice as many, for example, as in the chemical industry. Total costs of the Dutch hospitals amount to 11 billion guilders. (All figures mentioned refer to 1976.)

The Netherlands are the most densely populated country in the world. There are about 14 million people living in an area of 13,000 square miles, ie over 1,000 persons to the square mile. About 70% of the Dutch population is insured against the costs of illness under a sickness fund scheme. This insurance is compulsory for all persons with an income below a certain level and it is revised every year. The majority of the remaining 30% carry voluntary insurance with a private health insurance company.

Dutch hospitals are non-profit making institutions, even though most of them are privately owned (about 83%). Hospital fees are established on the basis of costs. The Central Institute on Hospital Fees, recognised by law, sets guidelines for the establishment of fees and every hospital is required to submit any increase to the central institute for approval. The board of managers of the central institute is composed of 11 representatives of health care institutions, 11 representatives of the 'sick funds' and private health care insurance companies, one representative of the provinces and four independent members.

The average length of stay per patient in a general hospital has dropped from 18.5 days in 1967 to 14.6 in 1976. This is mainly due to a more extensive use of out-patient services. The number of admissions per bed increased from 18.8 to 21.3 per year.

Legislation is being developed with a view to the regulation of national health planning: bills on health care facilities and health care tariffs have been introduced to parliament. Construction of hospitals without the permission of the Minister of Public Health is forbidden. The Commission on Hospital Facilities, which was established under the Act on Hospital Facilities, advises the minister on the execution of the act and the effectiveness of hospital facilities.

Since 1967 all Dutch hospitals have been organised into the Nationale Ziekenhuisraad (National Hospital Council), formerly a foundation which was converted into an association in 1871. The Nationale Ziekenhuisraad finds its origin in the continuous and progressing co-operation of the nine former hospital organisations. The scientific research activities of the various organisations also have now been grouped together and enlarged into one single institution, the Nationaal Ziekenhuisinstituut (National Hospital Instiute), maintained by The Nationale Ziekenhuisraad. The work of the association and of the institute is financed by contributions from the hospitals, based on the period of treatment.

Nationale Ziekenhuisraad (NZR)

The Nationale Ziekenhuisraad is the association of all Dutch hospitals. Members of the NZR are divided into three sections:

— general hospitals, including special hospitals;

— psychiatric institutions which comprise both psychiatric hospitals and institutions for the mentally defective;

— nursing homes.

The objective of the NZR is to develop a national hospital policy that should, while recognising the denominational values within hospitals, be directed towards an efficient organisation and functioning, and within this objective to further the interests of its members.

The office of the NZR contains the secretariats of the association and the sections, together with specialised staff departments for economic, legal, social and nursing affairs, training and public relations. The office deals with the preparation, assistance and execution of the work of the association and the sections. Some important tasks are:

— representing hospital organisations in discussions with the government, parliament and with national organisations in the area of health care. The NZR is also permanently represented in the Commission on Hospital Facilities, the Central Council on Public Health, the Central Institute on Hospital Fees and the Sick Fund Council and is in regular communication, for example, with home nursing organisations, organisations of homes for old people, of medical doctors and nursing personnel.

— providing information and advice to the members. The office sends to hospitals a continuous stream of information about recent developments in the area of legislations, financial regulations, salaries, training, etc. This is done by means of the periodical *Het Ziekenhuis* (The Hospital), appearing twice monthly, circulars, and personal contact. The office receives daily requests from individual hospitals for advice in various areas.

— acting as central employers' organisation. The NZR is establishing a policy on labour relations specially designed for hospitals. On January 1, 1977, a collective agreement for hospital personnel came into force.

— furnishing information. The NZR keeps the media regularly informed and also tries to keep the hospitals informed about existing opinions and criticism on hospitals. The periodical *Het Ziekenhuis* is sent both to hospitals and to numerous addresses within and beyond the health care field.

— representing the Dutch hospitals in international contacts. The NZR participates in the work of the hospital commission in the European Community as well as in the work of the International Hospital Federation.

The management of the NZR consists of 16 persons, all of whom are appointed by an assembly of the members: an independent chairman and 15 members are appointed by means of a binding nomination by the sections (five members per section).

*The word 'hospital' in the text is used for any institution belonging to one of these categories. The figures regarding beds, employees and costs are exclusive of the 'other institutions'.

The sections have their own executive bodies. The section chairmen are also nominated as members of the executive body of the association and act as vice-chairmen in the executive body.

In 1972, a start was made on the development of organisation by province. Now provincial contact groups of the NZR act as liaison between the hospitals in the area and the national organisation.

Nationaal Ziekenhuisinstituut (NZI)
The foundation National Ziekenhuisinstituut (National Hospital Institute), established in 1968, is the institute for scientific research and development of the Dutch hospitals. The NZI is engaged in finding solutions to basic problems in this field, carrying out research projects and providing information, advice and assistance. It also collects objective and reliable data on which individual hospitals, managing organisations and the government can base their policies.

The NZI may accept requests from all health care institutions and organisations. These comprise the Nationale Ziekenhuisraad (National Hospital Council) and its members, the Koninklijke Nederlandsche Maatschappij tot Bevordering der Geneeskunst (Royal Dutch Company for the Promotion of Medicine), more specifically the Landelijke Specialisten Vereniging (National Association of Medical Specialists) and the Centraal College voor de Erkenning en Registratie van Medische Specialisten (Central College for the Recognition and Registration of Medical Specialists), insurers of cost of illness and others.

By its own regulations the institute must be objective and independent in its research activities. The NZI is autonomous in the choice of research projects. Their selection, however, is closely related to the needs of health care institutions and health care workers who consult closely with the NZI. The working programme is aimed at practical problems — when a research project is started, those who have requested the project are asked for advice as to methods of study and publication of results.

In the NZI a great number of specific qualities are brought together. The institute has 11 sections for 11 different branches of activity, viz. automatic data processing, architecture and technique, documentation, economy, medical hospitology, education, organisation, nursing and information research. They work separately on specialised fields as well as jointly on common projects. For select activities consultants from outside the institute are sought. When a project is being carried out groups of workers from health care institutions may be asked to follow the proceedings.

The NZI use different channels to propagate information and research results. The institute makes reports, compiles information leaflets, writes articles and organises congresses and information days. The documentation section keeps up special literature on the vast range of subjects relating to the health care organisation and makes it accessible to those who are interested. The institute also maintains a documentation file on hospital supplies.

The NZI maintains regular contacts with sister-organisations abroad, exchanging programmes and research outcomes.

The executive body of the NZI consists of nine members who are appointed by the management of the NZR. Five members are appointed from the NZR management and the other four, including the chairman, from persons outside the NZR. The controller of NZI activities is a managing director.

Ziekenhuiscentrum
The Nationaal Ziekenhuisinstituut and the office of the Nationale Ziekenhuisraad are both located in the Ziekenhuiscentrum (Hospital Centre), Oudlaan 4 in Utrecht, tel. 030-739911, Address: PO Box 9696, 3506 GR Utrecht. The Ziekenhuiscentrum is about 1.5 miles from the Central Station in Utrecht, and thirty miles from Schiphol airport (Amsterdam). There is direct bus service between Schiphol and Utrecht.

Conferences and meetings
The centre has facilities for both conferences and meetings. On the ground floor there is a lecture hall which can seat up to 100 people, and a room for 25 people. There are five other rooms for smaller meetings of ± 16 people.

Library
The NZI library contains 4,500 books, primarily in the area of health care. It subscribes to more than 180 Dutch and foreign magazines. The library is open from 9.00 am until 12.30 pm and 1.30 pm until 5.00 pm, admission free.

A Pommie in Australia

B A HERMON CEng MICE FIMechE FCIBS FIHospE

Basil Hermon, the Regional Works Officer of the South West Thames RHA, recently took a holiday in Australia where he went on a busman's sight-seeing tour of hospitals with members of the Victoria Branch of the Australian IHE.

It was my very good fortune to be able to have nearly six weeks' holiday visiting my wife Moya's relatives and friends in Melbourne and other parts of Victoria in February/March this year. It was also fortunate that I served for some six years on the Council of the International Federation of Hospital Engineering (IFHE) and therefore I knew the benefits which have derived from IFHE since it was formed in 1970.

Before leaving for Australia I informed Harvey Roberts, one of the two Australian representatives on the Council of IFHE, of my intended visit, and suggested that it would add to the pleasure of my holiday if I could meet him and exchange a few views. As a result, Harvey Roberts contacted me within 24 hours of our arrival in Melbourne and that was the beginning of a wonderful association with the Victoria Branch of the Australian Institute of Hospital Engineers.

My introduction to hospital engineering in Australia came when Harvey collected me from my temporary residence and took me to the Royal Children's Hospital in Melbourne for a discussion with himself and Len Irwin, the Chief Engineer there. The Royal Children's Hospital is a comparatively new building opened in 1964 by Her Majesty The Queen who is the patron of the Hospital. The Royal Children's Hospital is so highly regarded by the people of Melbourne that its annual appeal brought in A$1.4m in 1977 and A$1.5m whilst I was there.

My discussion with Harvey and Len ranged over a comparison of expenditure, management techniques and methods of financing our respective health services. We continued our discussions over a long lunch, very pleasantly provided at the Carlton Football Club. Whilst we mainly exchanged views about the advantages and disadvantages of a proposal to establish a South East Asian Secretariat of IFHE, we also took time out to try to get a Pommie to understand why Victorians get so worked up over Australian Rules football. Unfortunately for me the football season did not commence until the Saturday after I left for home; on reflection perhaps it was not a bad thing, because a Pommie who made friends across the length and breadth of Melbourne would find it difficult to know whether he should favour Carlton, Collingwood, Fitzroy, South Melbourne or Hawthorn.

It was also our good fortune that the Victoria Branch of the Australian Institute of Hospital Engineering, under the chairmanship of John Cherry, Chief Engineer of the Western General Hospital, Footscray, were to hold their annual summer conference on the weekend of March 11/12. The conference was held at Beechworth, some 200 miles north of Melbourne, and the members of the Branch kindly invited Moya and me to join them. Harvey Roberts collected us in Melbourne at the crack of dawn on the Saturday and drove us through the bush and above average Pommie temperatures to get us to this old gold mining town, where the two largest buildings would be the prison and the hospital which has seen some development in recent times.

At the Mayday Hills Hospital we were welcomed by Douglas Craig, the Hospital Manager and Noel Commins, a most enthusiastic Hospital Engineer. The ladies were taken in a mini-bus, in temperatures of around 37°C, to see the sights of Beechworth whilst the men enjoyed the air-conditioned accommodation provided in the new psychiatric assessment unit, not yet in use, and listened to an address by the Deputy Shire Engineer on the services provided in Beechworth by the Shire. The formal business of the Branch followed, and it was interesting to compare this with the way in which a Branch of the British Institute conducts its business through a committee rather than at a meeting of the members, because the number of members in Victoria is considerably less than in the average branch of the British Institute.

Following a tour of the new kitchen with its cook-chill-reconstitute system dealing with 6,000 meals per day, I was invited to give a brief description of the structure of the British health service with particular reference to the way in which the building and engineering management is organised.

Having received outstanding hospitality from the hospital staff, including lunch and tea, the delegates travelled about fifty miles north to cross into New South Wales to enjoy dinner and entertainment at the Corowa gold club and back again to Beechworth. On conclusion of the conference on Sunday, we returned through the historic Ned Kelly and gold mining country to Melbourne.

Later, whilst spending a few days in Bendigo, another old gold mining town, Harvey Roberts again met me and conducted me round the Bendigo Home and Hospital for the Aged, where Reg Thorne is Chief Engineer, and the Bendigo Psychiatric Centre where I met Keith Coddington, the hospital engineer.

A holiday in Australia is attractive but it is even more enjoyable if you can meet people and make friends as we did. We learned a great deal and I would recommend to any hospital engineer going abroad that he should use the International Federation of Hospital Engineering to make contact in this way — they have only to write to the Secretary of their own Institute or contact one of their country's representatives on the Council of IFHE.

Finally, I would like to put on record our grateful thanks to all the engineers and their wives whom we met in Victoria for the wonderful way in which we were received.

The Inspection of Hospitals and Health Services

—the Approach of the Health and Safety Executive

HM Inspectors of Factories of the Health and Safety Executive have, hitherto, restricted their visits to hospitals to the inspection of those parts covered by the Factories Act or OSRP Act, and to reactive visits to investigate complaints, accidents, or by request.

A programme of basic inspections of hospitals defined below is to be initiated by HMFI and the purpose of this article is to describe the way in which this will be undertaken.

The term 'hospital' in the context of this paper includes all premises staffed by employees of the Area or Regional Health Authorities (or, in Scotland, Boards) other than those that are purely offices, and so will include nursing homes, Health Centres, Blood Transfusion Centres, Ambulance Stations etc. In the private sector it will apply to similar types of premises. General medical and dental practice and similar acivities are not included in this programme but are subject to inspection by the same group of inspectors. For the time being they will continue to be inspected under the terms of the first paragraph above.

The Organisation of HM Factory Inspectorate

HMFI has an organisation based on 21 Areas covering England, Wales and Scotland, each under an Area Director or Senior Area Director. The work of inspection in each area is divided on an industry basis between a number of industry groups, each under a Principal Inspector. Each Area Director has, in addition, responsibility for the co-ordination nationally of the inspection of one industry or group of activities. The co-ordination of the inspection of hospitals is undertaken by the National Industry Group for Health Services and this is the responsibility of the Area Director for South West England whose address is: Mr J. Rudd, Health and Safety Executive, Inter City House, Mitchell Lane, Bristol BS1 6AN. Tel: 0272 290681.

Technical support is given to the inspectors of each Area by one of seven Field Consultant Groups, and these Groups are structured so that environmental testing and specialist support on engineering, chemical and microbiological advice can be provided. Specialist support on occupational medical problems is provided by the Employment Medical Advisory Service which is also arranged on a geographical basis. The Employment Medical Advisers and Employment Nursing Advisers will not undertake a role of primary inspection of hospitals. Technical support is also provided by Headquarters specialists and there are also specialist laboratory and research services.

The Inspection Programme

It is intended that eventually the inspection of hospitals will be fitted into the overall inspection programme covering all types of premises, but until then a special programme of inspection of hospitals and health services will be adopted. Each area of the HSE will aim to undertake the basic inspection of some 20% of its hospitals each year with the intention of completing the first round by the end of 1982. In preparing the initial area programme the aim will not be to visit a statistically random sample but to cover as wide a range of types of premises as possible, having regard to their size, function and geographical distribution, and covering both old and new premises. Hospitals in each Area Health Authority will be included and, if possible, at least one hospital in each District. Private sector establishments will also be included in the programme on a similar basis.

The Method of Inspection

Inspectors appreciate that the inspection of this area of employment, much of which has not previously been subject to occupational safety and health legislation, will involve many new problems: in particular, the importance that will be attached to the best interests of the patient, and the complexity of the hospital organisation. They also appreciate that the hospital involves a range of hazards affecting the health and safety of employed persons not normally encountered elsewhere. Inspectors will do all they can to carry out their duties in a way which takes full account of the particular problems which are encountered in hospitals.

Before arrangements are made for the basic inspection of any hospital in the public sector, a visit will be paid to the AHA (or where appropriate to the RHA) to explain the purpose and arrangements for inspection and to discuss the safety policy of the authority. Inspectors will also take the opportunity to inform themselves of the organisational structure and disposition of responsibilities in the Area. This visit will normally be to the Administrator, but there may be occasions when particular issues need to be discussed with the Chairman of the Authority.

The first aim of the inspection will be to ensure that each Authority has an adequate health and safety policy and that it has set up a management organisation to implement that policy. This should include the appointment of a senior member of management responsible to the Authority for co-ordinating the implementation of the policy and monitoring the Authority's performance. The approach will be analogous to that followed in other areas of employment, but it is particularly important to bear in mind that the health as well as the safety of employed persons must be fully covered in the policy.

The safety policy statement, in addition to dealing with matters common to other premises such as the safety of mechanical and steam plant, electrical and fire precautions, should cover the policy for the control of hazards of particular significance in the health service field such as the control of infection, the arrangements for the control of hazards of radiation. There should be an effective system for identifying, recording, investigating and monitoring accidents and cases of occupational disease or other ill-health. The policy statement should cover the arrangements for accident prevention and occupational health and it should describe any specialist safety and occupational health services available. It should contain precautions in connection with such matters as the handling of animals where these are used for laboratory work. It should deal with the control of dangerous drugs and of toxic materials used in laboratories and should cover the hazards in the storage and use of flammable liquids and gases. It should also cover procedures for protection of employees against violence.

The discussion with the AHA will cover the mechanics of the visits to the hospitals and identify the officers to be contacted. The Area Administrator will be asked to provide details of the arrangements for employee representation through trade unions, staff and professional associations and of the safety representatives (when appointed). He will be asked to keep the Inspector informed of developments in these arrangements.

In deciding whether to inspect with or without having given prior notice to the management, the Inspector will take account not only of the needs of effective inspection in the particular circumstances of the case, but also the need not to cause disruption which may adversely affect patients. He will, as in the case of other premises, be guided by considerations such as the purpose of his visit, the part of the premises to be inspected, the need to see one or more particular people in order to make the visit effective, and his previous dealings with the premises in question.

It is the intention of the HSC that employees in hospitals shall receive no less degree of protection against risk of injury or danger to health than they would receive in other areas of employment. The Inspectorate recognises, however, that financial and staff resources will not always be available to remedy immediately all the matters identified by the Inspector as requiring attention. As in the case of other employers the Inspector will be prepared to discuss priorities with management with a view to phasing less urgent matters. The Inspector will aim to agree any programme with management — 'management' meaning the individual hospital or the AHA. He will also discuss it with the trade union and professional organisations concerned. (In circumstances where agreement is not possible see the next but one paragraph below for the procedure which will be followed). All matters of significance and any agreed programme of implementation will be confirmed in writing.

Staff Side Organisation

Inspectors will establish contact with safety representatives when appointed and in the interim with shop stewards and other employee representatives. However, in view of the complexity of the staff organisation, Inspectors will seek to establish central points of contact for the disclosure of information under the terms of Section 28(8) of the HSW Act.

Standards and Precautions to be applied by Inspectors

Inspectors will be familiar with many of the processes, hazards, plant and equipment found in hospitals and will apply to them similar standards as in other premises. Parts II and IV of the Pilot Study Report refer to the principal standards which already exist for the main areas of hospital activity. Where the DHSS has issued technical guidance this will not be challenged at Area level. If Inspectors consider that this guidance is unsatisfactory either generally or in particular circumstances, they will refer the matter to the National Industry Group which will if necessary take it up centrally with DHSS or other appropriate body. Where remedial measures are not covered by any national standard it will be for the AHA to decide whether the implications of complying with an Inspector's request should be referred through the normal channels, ultimately to the Health Departments. It is intended that all standards of technical guidance given by DHSS to hospitals affecting health, safety and welfare of employed persons might finally be reviewed by the Health and Safety Executive and discussed with DHSS and the Scottish Home and Health Department, so that the standards can be agreed and recognised.

Clinical Laboratories

The Howie Report embodies a draft Code of Practice for the prevention of infection in clinical laboratories. This Code of Practice is at present being discussed at national level by representatives of the HSE and DHSS in order to determine the ways in which the recommendations will be met and the time within which the various requirements will be implemented. Further advice on standards of enforcement in clinical laboratories will be given to Inspectors following the outcome of these discussions.

Radiation Hazards

In most premises the National Radiological Protection Board will undertake surveys which will be arranged by the Inspector to whom its report will be sent. The Inspector will discuss the procedural systems for radiation protection with the Authority's Radiation Protection Adviser as part of his inspection. Surveys will not normally be undertaken when patients are under treatment without agreement of those concerned. Officers of the NRPB will survey all fixed and mobile equipment used for diagnosis or radiotherapy and protective structures. They will investigate procedures and protective and monitoring equipment, but will not normally enter wards or operating theatres. They will survey laboratories and places where unsealed materials are manipulated or dispensed and investigate procedures there. They will check records and dose rates.

Fire Precautions

The general fire precautions in hospital premises (other than process risks) are covered by the Fire Precautions Act 1971 (in England and Wales) and the responsibility for enforcement of this Act for the public sector lies with HM Inspectorate of Fire Services (Home Office and Scottish Home and Health Department). HSE Inspectors will not seek to examine the fire protection arrangements, the fire precautions or fire aspects of the structure of the building. If, however, fire matters causing serious concern come to their attention they will be brought to the notice of management and employees' representatives and the Assistant Inspector of Fire Services informed accordingly. Matters concerning premises in the private sector will be referred to the Fire Authority for the area instead of the Assistant Inspector of Fire Services.

Inspection and the Patient

HSW Act 1974 S.3 concerns the responsibility of the employer towards persons not in his employment who may be exposed to risks to their health and safety as a result of his work activity. It is primarily intended to cover the incidental effect of work activities on members of the public. In the particular case of Health Services the whole purpose of the work activity is to foster the health of the patient and it is not clear how far Section 3 applies to his treatment. Inspectors will initially take the line that they will not concern themselves with the professional or nursing care of patients except as far as it may be necessary to do so when dealing with certain systems of work or the fitness of plant and equipment.

Enforcement

In England and Wales Regional and Area Health Authorities are regarded as Crown bodies and they are therefore exempt from prosecution and the enforcement notice procedures provided for in the HSW Act. The Health and Safety Commission have asked Ministers to change this but in the meantime have instructed the Executive to implement a 'Crown notice of procedure'. This means that in circumstances which would normally lead to the issue of a prohibition or improvement notice except for the immunity of the Crown, Inspectors will issue a 'Crown enforcement notice' and will give a copy to the employees or their representatives, in accordance with Section 28(8) of the HSW Act. If a Crown employer fails to comply, the matter will be taken up at appropriately higher levels in both the department concerned and the Executive.

The HSE have been advised that in Scotland, Area and Regional Health Boards are not Crown employers and the position is at present under review.

Private employers will be subject to the normal enforcement procedures provided for in the HSW Act.

There is no legal bar to the prosecution of employees of Health Authorities and Health Boards but the undertaking given to the Staff Side of the National Whitley Council of the Civil Service will be applied to them.

'The HSE had no intention whatsoever of prosecuting an individual civil servant in substitution for his department.

The HSE would only prosecute an individual civil servant in circumstances in which they would prosecute an individual employed person outside the Civil Service, for example, where there was wilful or reckless disregard for health or safety requirements and a consequential contravention of Sections 7 or 8 of the Health and Safety at Work Act. There was no question of prosecuting individuals for honest mistakes, or because of defects in management organisation'.

This paper was presented at the 1978 Annual Conference of the Institute of Hospital Engineering, held in Cardiff from April 26-28. It complements R. G. Kensett's article in our last issue, Conservation Through Site Generation — The Concept.

Conservation Through Site Generation Operational Experience

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Steam for Power

There is nothing new about utilising back pressure steam engines or turbines as generator prime movers and then using the exhaust steam for process work or heating. The arrangement is well known in industry.

In general the industrial application is consequent to a high demand for process steam at low pressure. Steam can be produced economically at a higher pressure and expanded through engines or turbines driving alternators which consistently run at or near their maximum power output.

In recent years the industrial use of the back pressure reciprocating engine has diminished. This is due primarily to the attraction of the steam turbine as a prime mover for generation at the power outputs (above 500 kVA) associated with industrial application.

It is also true to say that there is nothing particularly new about the application of back pressure engines for electrical generation in hospitals. There are many examples throughout the country. What then is new or different about the concept described here?

The essential principle is that the amount of electrical power generated is made entirely dependent on the variable demand for exhaust steam. During the normal running of the generator in parallel with the public electricity supply, the quantity of steam entering the engine is governed by back pressure control, which modulates to maintain the desired pressure in the exhaust steam supply.

The electrical power generated is therefore dependent on the demand for low pressure exhaust steam which contributes towards meeting the total electrical demand of the hospital. One could say that the electrical power is produced as a by-product of the demand for exhaust steam with the engine acting as a substitute for a pressure reducing valve.

It was the late Sir Oliver Lyle who described the reducing valve from a thermodynamic point of view as an invention of the devil. He described it as degrading good heat and dissipating good power potential, and suggested that its use is an admission of defeat. Unfortunately, it is not always practical to meet Sir Oliver's maxim. Reducing valves are, of course, often essential. There are, however, sound thermodynamic reasons to support the use of an engine instead of a reducing valve in the context described here, where it is warranted by the pressure drop and the low pressure steam quantity required.

A large hospital will, in any case, require an emergency stand-by generating capability and it should be appreciated that on failure of the public electricity supply the back pressure control of the engine — alternator set output is automatically disconnected. The steam supply to the engine can then be such to enable generation at any power up to the maximum output of the generator. If simultaneously the electrical demand of the hospital is reduced to an essential load at or below the full output of the generator then no interruption of supply is suffered by essential users. The steam required by the engine to meet the essential electrical load is normally in excess of that required by the normal low pressure steam demand and is likely to be at or near the full load consumption of the engine. The excess steam is blown into the atmosphere by low pressure relief valve.

It is appropriate to examine within the energy conservation context the principles embodied in this type of combined power and heating plant. The most efficient national grid condensing power station converts only approximately 30% of the heat content of its fuel into electrical energy. In contrast, the combination of power production with steam used for heating or process has an ideal efficiency of 100%, and in practice it is possible to make effective use of up to 80% of the heat content in the fuel. Does it follow, however, that such a combination can be utilised in a hospital to generate electricity for the same or less cost per kWh than that purchased from the public supply?

Theory and Design

The operation of this type of generation at a hospital cannot be fairly assessed without some appreciation of the constrictions encountered at the design stage. It will become clear that the site generation cannot be considered in isolation within the design context. Opportunities to maximise the output of site-generated electricity as a by-product of the heat energy demand of the hospital must be recognised to achieve optimum energy and cost savings.

Back Pressure

The steam back pressure is the first parameter to be settled when considering the installation of back pressure plant.

There are obvious advantages for power production in having a high steam pressure at the inlet to the engine and it is clear that the pressure drop across the engine is also relevant. The greater power gain can, however, be obtained by reducing the exhaust steam pressure.

The area of a theoretical pressure — volume diagram (ideal indicator diagram) shows the ideal power output available from an engine. *Figure 1* illustrates the respective theoretical gains in power output that can be expected from increasing the inlet pressure and reducing the back pressure. The gain in power output obtained by a reduction in back pressure is considerably greater than that obtained by the same increase in inlet pressure. The increase in pressure drop across the engine will be the same in each case.

Clearly the back pressure should be as low as possible but compatible with the use to be made of the exhaust steam.

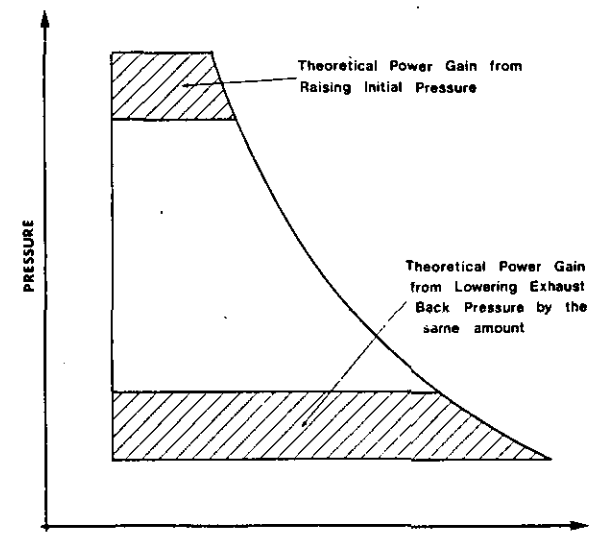


Fig. 1 Theoretical Pressure-Volume Diagram (Ideal Indicator Diagram) for Ideal or Rankine Cycle

Steam Consumption

A linear law exists between the rate of steam consumption and the power developed by an engine which is throttle governed. Steam Engineers will recognise *figure 2* as a Willans Line (named after P. W. Willans' discovery). The thermodynamic proof of this relationship is both elegant and interesting.

At no load the engine will have a fixed steam consumption which is due to its working against a back pressure. This amount of steam is required to meet the losses arising from warming the engine, overcoming mechanical friction and effectively moving the piston against the back pressure.

When the engine is on load the steam consumption is made up of two parts: the fixed consumption and the *quantity of steam which actually does useful work* and which is directly proportional to the power output.

If the steam consumption per unit of output is calculated then the relationship shown in *figure 3* is derived. The engine becomes increasingly extravagant in steam consumption as the power output falls.

The no load or fixed steam consumption will, in general, increase both in engine size and a rise in the back pressure maintained at the exhaust. It is of considerable significance when a decision has to be made on the size of engine to be employed.

Figure 4 illustrates a typical comparison between the

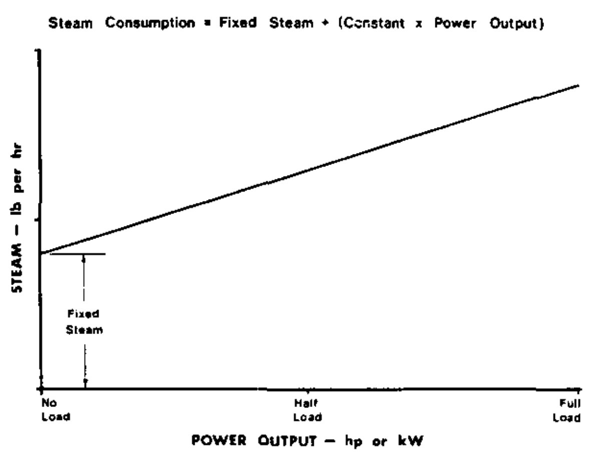


Fig. 2 Typical Steam Consumption – Power Output Relationship for Throttle Governed Back - Pressure Steam Engine

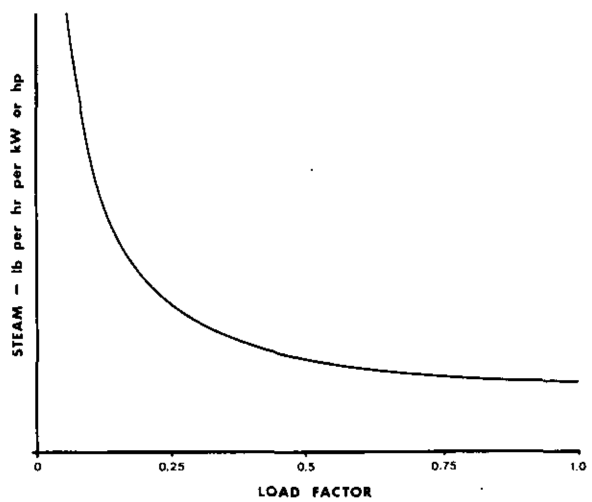


Fig. 3 Typical Steam Consumption per Unit Output for Throttle Governed Back-Pressure Steam Engine

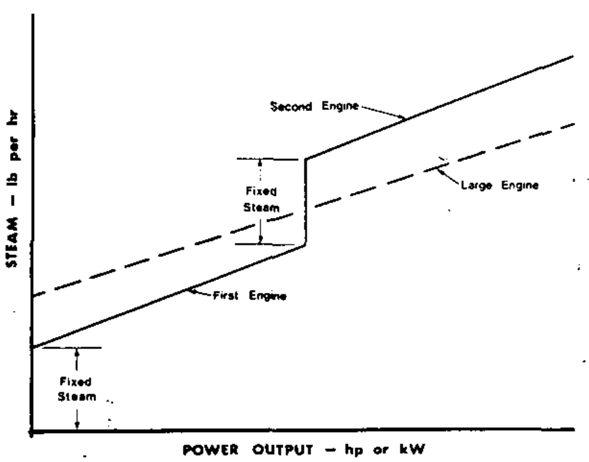


Fig. 4 Typical Steam Consumption – Power Output for Two Engines

steam consumption of a single large engine and the consumptions of two smaller engines — a relevant comparison when considering whether to run two engines on part load, or one engine on full load.

Use of Low Pressure Steam

The choice of back pressure maintained in the exhaust steam supply from the engine will be greatly influenced by the use made of the exhaust steam. The items of plant utilising exhaust steam will have output rates corresponding to the pressure of the steam supplied which will place a limit on how low the back pressure can be.

A further consideration is the loss inherent in the distribution of exhaust steam. There is, therefore, a need for the exhaust steam to be used as near as possible to the engine. This suggests a central services complex housing the boiler plant, steam engine — alternator sets, all calorifier plant and any other major items of plant using exhaust steam.

With such an arrangement the pressure drop due to distribution loss is considerably reduced so that the back pressure maintained at the engine can be lower. The effect of small increases in back pressure should not be underestimated, as the power output from a given steam flow will be significantly lowered.

The demand for low pressure exhaust steam is the predominant factor in determining the power that can be generated at a given back pressure. There is a clear incentive to use exhaust steam as a heat source in preference to steam at higher pressures wherever this is practical throughout the hospital. This, in theory, enables the largest size of engine–alternator set to be used consistent with running near full load.

However, it is not realistic to expect a constant demand for exhaust steam since the change in seasonal heating demand alone will give rise to variations. The back pressure control of the steam output to the engine ensures that the engine–alternator set will work at varying output corresponding to the variations in exhaust steam demand.

The maximum and minimum levels of the annual profile of exhaust steam demand will be of particular relevance in determining the optimum size of engine–alternator set. The crucial concern is that the minimum exhaust steam demand exceeds the no load consumption of the engine by as great a margin as possible.

The greatest economy in steam consumption will be obtained when the engine is working as near as possible to full load. The ideal annual profile of exhaust steam demand will therefore have the smallest possible variation between maximum and minimum levels.

Where the hospital has an air-conditioning cooling load the drop in Summer heating demand can be mitigated to some extent by the use of absorption refrigeration utilising exhaust steam.

Electricity Stand-by Supply

Stand-by generating capacity is built into the system. On failure of the public electricity supply a transition is necessary from in-parallel running to meeting the essential demand of the hospital without any appreciable break in supply to essential users.

If the normal exhaust steam demand warrants the size of engine–alternator set which has a maximum output greater than the desired essential electrical load capacity then there is no problem. Rarely will this be the case. The desirable essential load capacity will frequently require a size of engine-alternator set that is not compatible with that required in terms of steam consumption during normal in-parallel running. Clearly in such a case the selection of engine–alternator size is a matter of compromise.

The problem arises in the main from the need to provide a continuous supply to essential users and there is, in general, an incentive to restrict the capacity of the essential circuits to that which will enable the hospital to carry out essential functions when running on stand-by emergency supply.

The unit of generating plant running in parallel with the public supply is normally duplicated for the purpose of maintenance down time. The alternative unit is available on stand-by when not undergoing maintenance, and after an appropriate run-up time the site generating capacity can be doubled. During prolonged or planned supply interruptions, a substantial proportion of the total hospital demand can be met if judicial shedding of less essential load is carried out. During full load running of the plant, and with the back-pressure control in abeyance, excess exhaust steam will be blown to atmosphere through dump valves. This loss of heat is costly but must be considered secondary to meeting the essential demand of the hospital. To incur additional cost in using the alternative engine to meet a greater proportion of the normal hospital demand must be a matter of decision. It should be emphasised that the alternative engine is regarded primarily as a substitute during maintenance down time.

In order to meet the contingency of the steam driven alternator tripping on overload during a failure of the public supply, a diesel generator of sufficient output to supply the boiler house is essential for maintaining a steam raising ability. Such a generator can be of comparatively small output.

There is a clear need for adequate response of the boiler plant to the sudden increase in steam demand that will arise from the engine–alternator set going to near full load on failure of the public supply. The choice of boiler plant and type of firing must reflect the particular requirements of site generation by steam engines. The number and size of boilers is also pertinent.

Thermodynamics and Costing

It has been said earlier that the electrical power produced can be described as a by-product of the demand for exhaust steam. This is not strictly true since it implies that the power is available free. The engine will extract heat energy from the steam so that, whatever the condition initially, the exhaust steam will contain less heat than the steam supplied to the engine. Power from the engine has, therefore, cost this amount of heat.

The effect of back pressure on steam consumption is confirmed. The higher the pressure at which the steam is exhausted, the greater will be the amount of steam that has to be supplied for a given power output, since the engine will demand a fixed quantity of heat for conversion into power. An increase in exhaust pressure will effect a proportional reduction in the thermal efficiency of the engine although the exhaust steam will consequently contain more heat.

The combined power and heating arrangement is such that the thermal efficiency of the engine is almost insignificant provided the heat contained in the exhaust is used and external losses such as leaks, radiation and friction are kept to a minimum. Nevertheless a back pressure engine needs to be kept in an efficient state so that as much power as possible is produced from a given exhaust steam demand.

Adiabatic Heat Drop

The theoretical work expected from a perfect engine is calculated using that useful thermodynamic concept known as entropy. The energy extract from the steam by a perfect engine is known by Steam Engineers as the adiabatic heat drop. A better description would be ideal or isentropic heat drop since the expansion is assumed to take place at constant entropy.

The dryness fraction of the exhaust steam is calculated by assuming that the entropy remains constant during expansion.

Entropy before expansion $= \phi_1 =$ Dry saturated steam
Entropy after expansion $= \phi_2 =$ Liquid entropy + q (entropy of evaporation)
For constant entropy $\phi_1 = \phi_2$

The dryness fraction of the exhaust steam q is obtained from this equation.

Total Heat (Enthalpy) of steam entering engine $= H_1$ Dry saturated steam

Total Heat in exhaust steam (after expansion) $= H_2 = h + (q \times L)$

Where h = Sensible heat of water
q = Dryness Fraction of the exhaust steam
L = Latent Heat of evaporation.

The Adiabatic Heat Drop is given by $H_1 - H_2$

It is interesting to compare this theory with that for the pressure reducing valve where entropy is increased, the total heat remains constant and the steam is drier after expansion.

Real Heat Drop and Efficiency Ratio

Hitherto the emphasis has been on a perfect engine. Reality is far different. In a real engine only part of the theoretically available heat drop is actually turned into useful work.

The engine will have an efficiency ratio which is a measure of its ability to make use of the theoretical heat drop and which is defined as the actual heat drop divided by the adiabatic heat drop expected had the engine been perfect. This is not to be confused with thermal efficiency which is defined as the heat energy converted into work divided by the heat energy in the steam.

What, then, is accountable for this loss in use of theoretically available heat drop? The losses in the engine will consist of external losses such as external steam leakages, heat radiation and friction losses. These external lose are irrecoverable and contrast with internal losses such as valve leakages, piston leakages and internal expansion (wire drawing) losses which, although a loss to power generation, are recoverable within the power-heating arrangement. The internal losses simply increase the heat in the exhaust steam which, in consequence, will be drier than that expected by calculation from a perfect engine.

The actual heat drop will therefore consist of the energy turned into useful power plus all external losses of energy. Whereas in the ideal engine the expansion was regarded as isentropic in reality it is polytropic and much more complex.

Costing

A recognition of the difference between the ideal and actual heat drop is essential if the heat energy consumption correctly attributable to power generation is to be used in calculating the cost per kWh generated.

The proportion of steam cost attributable to power generation is given by:

$$\frac{\text{Actual Heat Drop}}{\text{Total Heat of Steam Entering Engine}}$$

The cost per kWh generated is given by:

$$\text{Cost of Steam} \times \frac{\text{Steam Consumption}}{\text{kWh generated}} \times \frac{\text{Actual Heat Drop}}{\text{Total Heat of Steam entering engine}}$$

The accurate metering of the steam consumption of a reciprocating engine is notoriously difficult if not impossible due to the pulsations encountered. In general, steam meter readings need to be regarded with some caution since the accuracy can be affected by a number of factors not the least of which is the variation in pressure at the point of measurement. A reasonably accurate measurement of steam consumption is nevertheless essential to the costing of power generated.

Obtaining the actual heat drop is dependent on getting a reliable measurement of exhaust steam quality. Since the exhaust steam is likely to be wet the measurement of dryness fraction by calorimetry will be difficult and of doubtful value. The actual heat drop relates to a particular load condition for the engine.

The variation in load conditions inherent in back pressure control signifies that the actual measurement of the steam condition becomes less important unless extensive research is contemplated. What is required is a realistic assessment of the heat drop which is representative of loading conditions encountered during the cost period under consideration. It is nevertheless important to comprehend the thermodynamics so that the validity of any assumption made is clearly understood.

Case Study

A case study has been chosen to illustrate the practical effects of the factors looked at theoretically and to examine the magnitude of benefits arising from a particular application of this type of site generation.

The Hospital

The hospital is an acute District General of approximately 450 beds. Construction was completed in the mid-Sixties with a later phase completed in the early Seventies. Clearly the design was undertaken at a time of comparatively cheap energy costs.

The architectural design has resulted in a deep plan layout for the building, with a resulting need for supplying conditioned air to internal areas. The distances involved in distributing conditioned air and the need for variation in conditions between zones, together with the heat gains associated with the deep plan layout, has resulted in the use of a dual duct high velocity air conditioning system which incorporates cooling from both absorption and compression refrigeration plant.

The boiler plant consists of three economic steam boilers each rated at 14,500 lbs per hour from and at 212°F. The boilers are fired automatically by dual fuel burners using natural gas as the main fuel and 35 sec oil as a stand-by alternative.

Steam at boiler pressure is utilised to drive the steam engines providing site electrical generation. Low pressure exhaust steam from the engines is passed through calorifiers for low pressure hot water heating and domestic hot water supplies, and is also utilised for the absorption refrigeration plant.

Steam at boiler pressure is used, through pressure reducing valves, as the heat source for calorifiers situated at six other locations on the hospital site. Boiler steam is also reduced in pressure for process work in the main kitchen and for sterilisation.

Main Electrical Services and Generating Plant

The electrical supply to the hospital is derived from the Electricity Board's 11 kV network via a composite switchboard which feeds two 500 kVA, 11,000/415 volt transformers connected in parallel to the main 415 volt switchboard which is divided into essential and non-essential distribution circuits.

Coupled to the main 415 volt switchboard are two 250 kVA steam driven generators one of which normally runs in parallel with the public supply producing electricity proportional to the demand for exhaust steam.

On failure of the public supply the hospital non-essential load is automatically disconnected and the steam generators assume their stand-by role in providing an uninterrupted supply to the essential distribution. A diesel generator is available to maintain boiler house electrical services in the event of failure of both the public supply and the steam driven generators.

The two twin cylinder compound vertical reciprocating steam engines are operated at 120 psig steam pressure at engine stop valve, exhausting against 7 psig back pressure, to develop 200 kW (290 bhp) at 428 revolutions per minute. The engines drive 415/240 volt, 3 phase alternators each of which is normally rated at 250 kVA at 0.8 power factor with automatic voltage regulation.

Figure 5 indicates the steam consumption–power output relationship quoted by the engine manufacturer and *figure 6* is derived from this relationship.

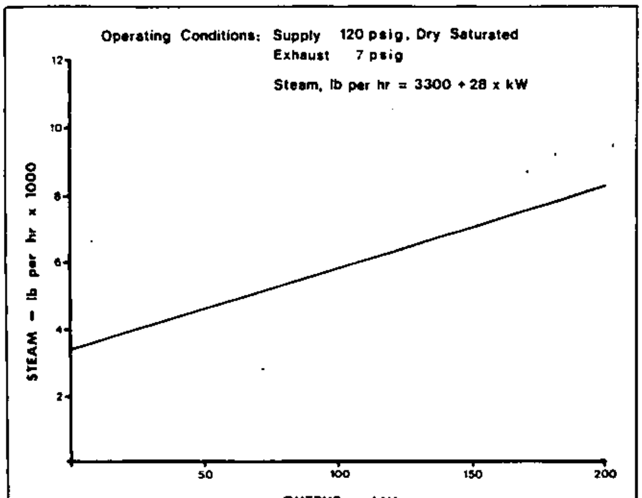


Fig. 5 Steam Consumption for Two Cylinder Compound Engine coupled to a 250 kVA Alternator

Operating Conditions

The conditions of steam entering and leaving the engine are required so that costs can be assessed by a heat energy division between power and heating. The quality of steam from the boilers can be expected to be reasonably consistent. Nevertheless, the throttling of the steam supply to the engine by back pressure control will alone introduce variations in steam conditions which are much more complex than in the case of an engine running constantly at a fixed load.

Two assumptions are made in respect of steam conditions in order to proceed to an annual cost analysis.

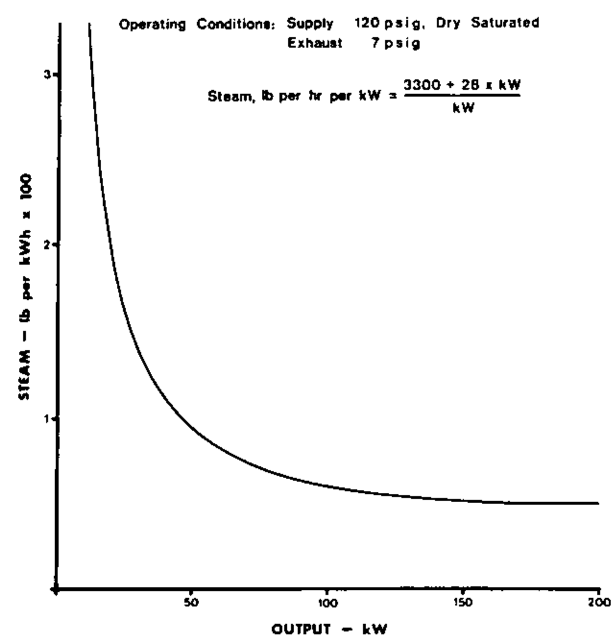


Fig. 6 Steam Consumption for Two Cylinder Compound Engine coupled to a 250 kVA Alternator

Reference has already been made to the difficulty in obtaining accurate measurements and unless extensive research is contemplated it is necessary to assume a constant dryness fraction for the exhaust steam which is representative of the loading conditions experienced over the costing period under scrutiny. The dryness fraction of steam entering the engine is also assumed to be constant. This approach is likely to be taken by a Plant Engineer assessing periodic performance. Dryness Fraction of steam entering engine assumed to be 0.97. This is based on knowledge of the boiler plant and advice from the boiler manufacturer.

From Steam Tables:
Entropy before expansion at 120 psig:

$$0.503 + 0.97(1.076) = 1.546$$

Entropy after expansion to 7 psig: $0.342 + q(1.384)$
For Constant Entropy (Isentropic Expansion)

$$1.546 = 0.342 + q(1.384)$$

Dryness Fraction of exhaust steam: $q = 0.87$
From Steam Tables:
Total Heat of steam entering engine:

$$321.8 + 0.97(871.5) = 1{,}167 \text{ Btu/lb}$$

Total Heat of exhaust steam:

$$200.6 + 0.87(957.6) = 1{,}034 \text{ Btu/lb}$$

Adiabatic Heat Drop across engine:

$$1{,}167 - 1{,}034 = 133 \text{ Btu/lb}$$

It is interesting to note that the exhaust steam would be 13% wet after ideal isentropic expansion to 7 psig and would not be satisfactory for heat exchange purposes.

Unless extensive research is contemplated it is necessary

to assume a dryness fraction for the exhaust steam which is representative of loading conditions experienced during the time period under scrutiny.

Dryness Fraction of exhaust steam is assumed to be 0.92. This is based on advice received from the engine manufacturer.

From Steam Tables:
Total Heat of exhaust steam:

$$200.6 + 0.92(957.6) = 1{,}082 \text{ Btu/lb}$$

Representative Heat Drop across engine:

$$1{,}167 - 1{,}082 = 85 \text{ Btu/lb}$$

The measurement of the steam quantity passing through the engines was achieved by deduction of the metered quantities used elsewhere at boiler pressure from the total quantity produced by the boiler plant. Although this method is subject to small inaccuracies that may exist in the steam metering it avoids any measurement directly across the engine.

Annual Costing

Proportion of steam cost attributable to generation: $85/1{,}167 = 7.3\%$
Steam passed through engines: 51.7×10^6 lb
Electricity site generated: 56.5×10^4 kWh
Steam consumption per kWh: 91.5 lb
Cost of steam production at hospital: £1.88 per 1,000 lb
Cost of steam for generation per kWh:

$$\frac{1.88}{1{,}000} \times 91.5 \times \frac{7.3}{100} = 1.25\text{p}$$

Total electrical consumption: 442.5×10^4 kWh
Electricity from Public Supply: 286×10^4 kWh
Cost per kWh of electricity from Public Supply:
1.92p per kWh

Site generation provided 13% of the total electrical energy demand of the hospital during the year reviewed.

Figure 7 shows the result of applying the costing procedure on a monthly basis. *Figure 8* illustrates the monthly electrical demand of the hospital by division between the public supply and site generation. Perhaps this division is best seen as the percentage contribution made by site generation, as shown in *figure 9.*

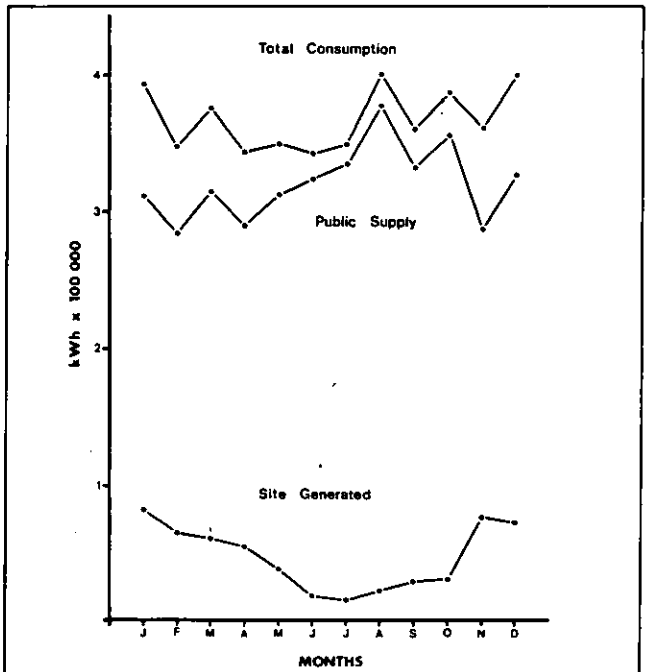


Fig. 8 Hospital Electricty Consumption

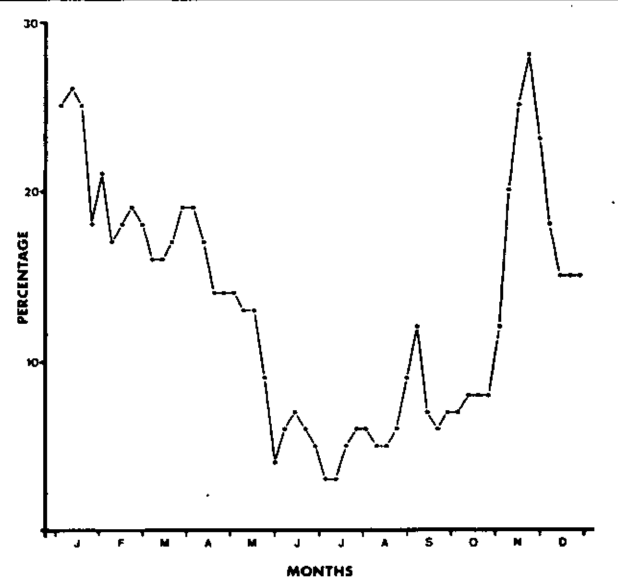


Fig. 9 Contribution made to Hospital Electrical Energy Demand by Site Generation

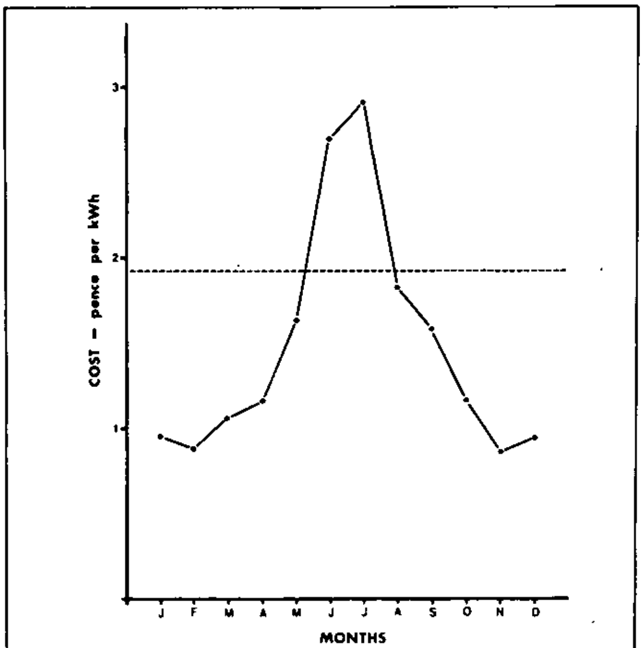


Fig. 7 Monthly Generation Steam Cost

The annual maintenance cost on this type of generating plant is likely to fluctuate from year to year with the occurrence of planned major overhauls. There is, therefore, some justification for dissipating non-annual costs over the years between recurrence. It is also reasonable to deduct the operation and maintenance cost that would be otherwise expendable, for alternative standby facilities in the form of diesel generator sets, if steam driven site generation was not employed. On that basis a cost of 0.2 pence per kWh was found currently applicable. Maintenance costs of this type of engine are notably low in comparison with other types of prime mover. The proven reliability of the reciprocating steam engine is also well known.

The retrieval of capital costs has not been considered here in what is regarded essentially as a review of operational experience. Clearly such an element should be included in the true cost of site generated electricity. What measure of the capital investment that can be justified by energy conservation should be given careful consideration.

The benefits of operating this type of site generation are highly dependent on the loading conditions encountered. Care should be taken in making comparisons with site generation at other hospitals since only installations controlled in a like manner are in any way comparable.

Plant Operation

A comparison of the maximum/minimum levels of generation output *(figures 10 and 11)* with the monthly maximum demand from the public supply *(figure 12)* indicates that, in general, site generation reduces the maximum demand chargeable within the Electricity Board Tariff. The cost benefit is dependent, however, on the type of tariff applied.

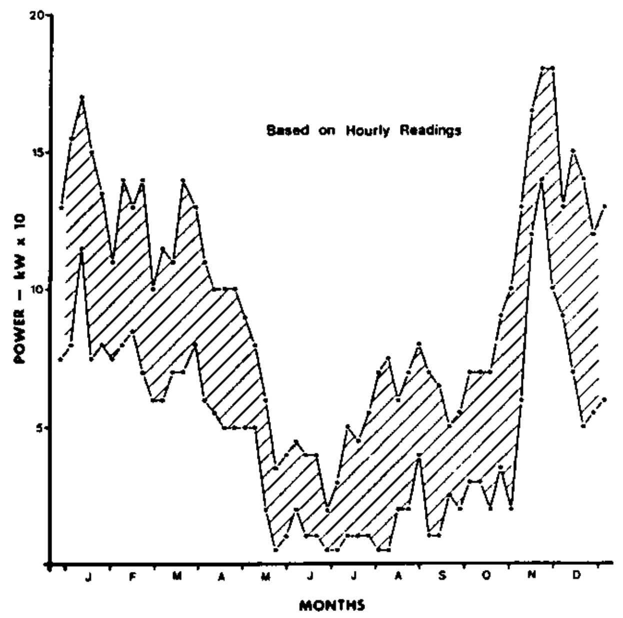


Fig. 10 Maximum and Minimum Levels of Generated Output

As a result of the analysis made here the Health Authority were advised of a case for considering an option to change to a seasonal maximum demand tariff. Such a tariff appears beneficial for two reasons. The highest maximum demand from the public supply will occur in the low cost Summer months, as a result of the contribution from site generation being at its lowest, and the maximum contribution from site generation is made in the high cost Winter months. The seasonal maximum demand tariff, which has only recently become available from the Electricity Board concerned, will become mandatory from 1980.

In the cost analysis made here the benefit from the reduction in maximum demand contributed by the site generation has been disregarded since the tariff charge applicable is based on the highest maximum demand recorded in the preceding 11 months. Since this occurs in

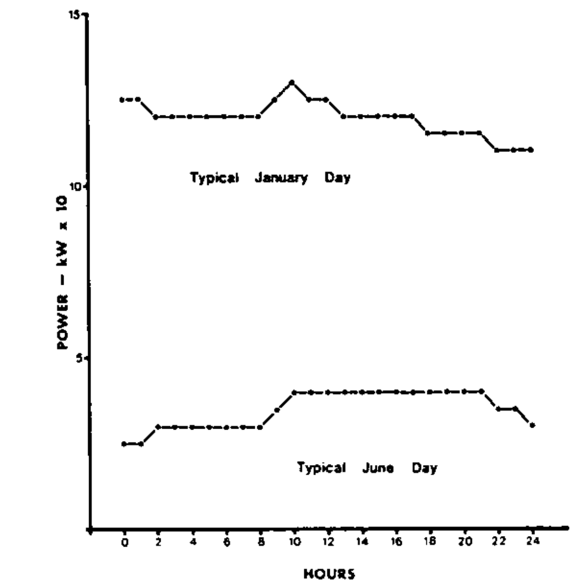


Fig. 11 Daily Variation of Generated Output

the Summer site generation contributes only a marginal reduction.

The peaks evident in *figure 12* can only be explained against the background of developments at the hospital. The first phase of development included three compression refrigeration units of 140 hp, 80 hp and 50 hp full load ratings respectively. Second phase development saw the installation of a single 100 ton absorption refrigeration plant operated by engine exhaust steam. As a result of restrictions on space the siting of the absorption plant was remote from the engine house and necessitated an increase in engine back pressure from 5 psig to 7 psig. The increased use of exhaust steam by the absorption unit is clearly beneficial to site generation, but the detrimental effect of increasing the back pressure should be recognised.

The peaks of maximum demand are directly attributable to two reasons. In high Summer the absorption refrigera-

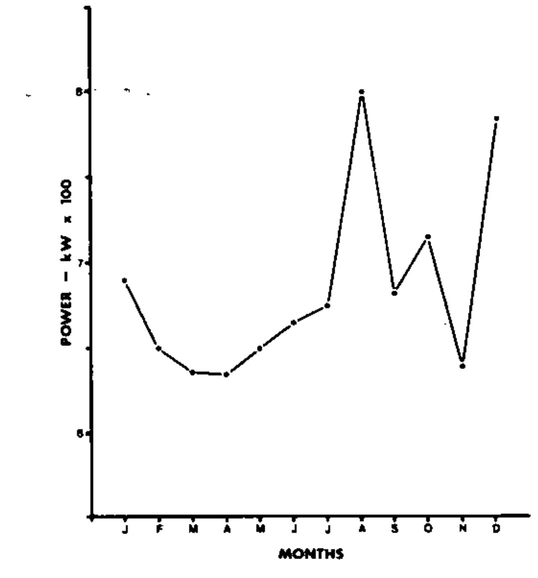


Fig. 12 Monthly Maximum Demand from Public Supply

tion capacity requires supplementing by compression refrigeration. Any maintenance down-time on the single absorption plant requires substitution by the compression plant. If these factors are excluded the variation in monthly maximum demand shows the expected rise and fall which are directly related to the contribution from site generation.

A case emerges for the replacement of all or part of the compression plant by absorption plant. The benefit would be twofold. The use of exhaust steam would increase in Summer while the high electrical loading associated with the compressors would diminish. The resulting plant availability would also obviate the use of compression plant during absorption plant maintenance down-time.

The steam consumption shown in *figure 13* indicates that the decision to distribute steam at boiler pressure to calorifiers located remotely from the central plant has resulted in a reduction of approximately 10% in the steam for heating that could otherwise have been used at low pressure after expansion through the engines. Most of these calorifiers are partially or totally shut down for the Summer months and, therefore, do not constitute a steam load that would significantly contribute to increased generation during the Summer.

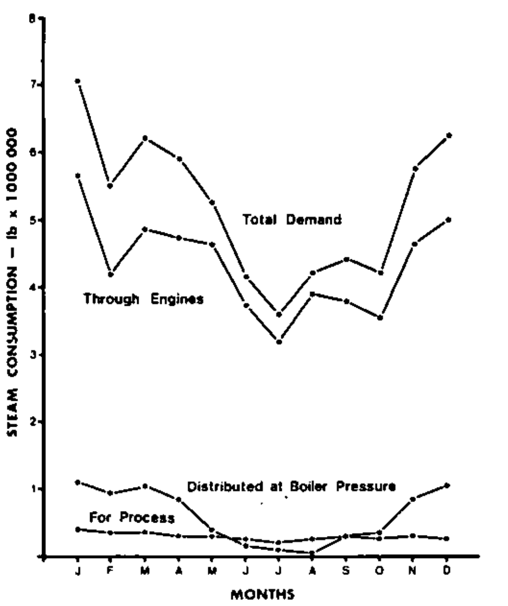


Fig. 13 Hospital Steam Consumptions

Should the exhaust steam demand drop below the no-load value for the engine with the alternator coupled to the hospital busbars, then power will be imported from the public supply in order to maintain the engine at a speed synchronous with the electrical system. The engine is then said to be 'motoring'. The condition is only likely to arise during the Summer months when the exhaust steam demand may reach an exceptional low. Indications of motoring are limited to a reading of zero kWh and reversal of the kWh readings on the alternator instrumentation panel. There is merit in the provision of an audible no-load alarm. When the engine is motored it acts as a pump for the steam being passed through and there is always the possibility of damage due to recompression of steam and the resultant rise in temperature. The engines are designed to operate without cylinder lubrication and any tendency towards superheating the steam passing through will give rise to problems with piston rod packing and piston rings. Motoring should not be tolerated for more than short periods of time since it is incompatible with energy conservation and good operational practice.

Emergency Stand-by Facility

On failure of the public supply the bus-coupler between the essential and non-essential sections of the main switch-panel opens leaving the essential load connected to the generator. Simultaneously the back pressure control is disconnected enabling the steam control valve to open fully and allowing the generator to meet the essential demand. The excess exhaust steam will be blown to atmosphere.

Unfortunately due to phased development at the hospital the maximum essential demand has become greater than the output of one alternator. This results in the possibility of the alternator tripping on overload. Whether this actually happens clearly depends on the essential demand at the time of a public supply failure. A consequence of a loss of emergency supply is a close down of boiler burners. This demonstrates the absolute necessity for a diesel generator capable of restoring a power supply to the boiler house thus enabling a steam raising capability to be maintained. The growth in essential demand has given rise to a high risk of overloading the steam driven alternator. This has resulted in the use of an arrangement whereby the diesel generator installed starts automatically on failure of the public supply and becomes ready to accept load. A manual changeover switch enables the boiler house essential circuits distribution to be disconnected from the essential section of the main switch panel and connected directly to the diesel generator.

It would appear that some load can be shed from the essential busbars for at least a short period of time without detriment to essential hospital functions. This suggests that there is scope for transferring some circuits from essential to non-essential, or using some other method which will reduce the present maximum essential demand of approximately 350 kW to below the 200 kW output of one steam driven alternator.

It will take 30-45 minutes for the alternative engine to become available from a cold condition. If the engine is already warm it will take approximately 10 minutes to run up to speed before the alternator can take load. The use of both steam driven generators will give an emergency generating capacity greater than 50% of the normal demand of the hospital. The additional cost of dumping steam at times of emergency is clearly of secondary consideration in the case of one engine. The high essential load may also justify the further cost of the second engine.

The diesel generator installed is rated at 210 kVA although the output required for boiler house essential load is probably under 35 kVA. Provision has been made for this generator to be connected by manual synchronisation with the hospital essential busbars. The provision of a diesel generator much larger than that required by the boiler house essential load is not relevant to this type of site generation, so only a small proportion of its costs should be allocated to generation by the steam engines.

The flexibility of the gas fired boiler plant is such that the single steaming boiler will have enough capacity to meet the steam demand of one engine going on to full load on occurrence of failure of the public supply. If the boiler plant suffers a complete failure of power supplies then recovery time is dependent on the firing condition of the burners at the time of supply failure. Close down of a burner in the high firing condition will require a minimum of six minutes before refiring on the restoration of power. The boiler on hot standby can be fired after two minutes purge time.

The boiler plant was originally fired by coal using sprinkler stokers. The response of the coal fired plant was less rapid than with the present gas firing and the coal feed system was subject to mechanical failure. It is interesting to note that the coal fired plant was less subject to shut-down as a result of the momentary voltage drop that is inevitable when the alternator experiences a large change in load on going from in-parallel running to emergency supply. This is due almost entirely to the sensitivity of the gas valves on the burners now used.

Further Engineering Considerations

Care must be taken to select calorifier temperature controls that do not create rapid and heavy changes in demand for exhaust steam. There is a need to reduce as much as possible the duty imposed on the back pressure control. The heavy and sudden cyclic demands for steam that are associated with instantaneous water heaters, for example, have proved difficult to reconcile with maintenance of a steady back pressure.

Back pressure control of the quantity of steam entering the engine is by pneumatic operation of the control valve. Experience has shown that this positive pneumatic operation is also desirable on the dump valve that releases excess exhaust steam to atmosphere during emergency running.

Engine–alternator sets should be adequately sited with correct foundations so that there is no possibility of nuisance from noise and vibration. Similarly, the positioning and silencing of steam dump outlets can be critical. Adequate access should be provided around and above the engines to facilitate major maintenance overhauls. Although these final points may at first appear obvious they are worthy of comment since insufficient attention at the design stage can lead to operational problems.

Conclusions

It is suggested that there can be benefits both in energy conservation and cost reduction from a correct application of this method of site generation. These benefits will clearly depend on efficient operation of the plant but are even more conditional on decisions made during the design of the installation. An attempt has been made to identify the interrelated factors which determine whether potential benefits are achieved or diminished.

The power output from this type of site generation is inherently variable and highly dependent on correlation with heat demand. In that sense the site generation cannot be regarded as a package in isolation from the other engineering services. It may well be concluded that the greatest obstacle to the economic application of this combined power-heating arrangement is the attempt to reconcile it with the provision of a particular level of emergency generating capability. Nevertheless it can be seen from the case study that the concept can be economically viable notwithstanding the imperfections apparent in this particular application.

The concept is worthy of further detailed study particularly in respect of the retrieval of capital investment. It is understood that this is the subject of a current study by Inter-Authority Engineering Study Group No 6.

It is hoped that this paper can be of some assistance in any Present Worth or Equivalent Annual Charge study made when the capital costs of various site emergency generation options are being evaluated. Nevertheless the primary objective has been to assist those concerned with the operation of similar existing installations.

Should we have served to dissuade just one Engineer from the complete dismissal of the reciprocating steam engine as a viable prime mover for emergency generation at hospitals then the writer will be more than content. It is a brave Sage who asserts that the future holds no place for the type of concept described here.

Acknowledgements

The Author wishes to make acknowledgement first to WHTSO for permission to allow him to give this paper, and secondly to colleagues who have assisted with its preparation. Mr D. Samuel and Mr J. E. C. Machin have been particularly helpful. The writer is also grateful for the assistance given by Engineering Officers of the Area Health Authority concerned with the case study.

Product News

Electro-Magnetic Louvred Ventilator

Designed for fitting into the building structure to provide a weathered opening for smoke venting, the Plusaire 100mm electro-magnetic operated moveable louvre meets the statutory fire precaution requirements for corridors and stair-wells in blocks of flats and maisonettes, and provides a safeguard in keeping escape routes clear of smoke and preventing oxygen reaching and feeding the fire.

In the first instance the louvre is installed at high level to allow the smoke to escape, and in the second instance the louvre is located at low level to prevent air feeding the fire.

Greenwood Airvac have produced two distinct types of louvre panel with a 10 watt electro-magnet for fitting within the louvre wall box and available for either 'fail safe open' or 'fail safe closed' operation. The counter balanced louvre blades are controlled by the electro-magnet which is wired in circuit with smoke detectors or override switches.

The louvre blades of the 'fail safe open' type are retained in the closed position by the electro-magnet. When the electrical circuit is broken by the smoke detector or the override switch, the magnet is de-energised and allows the louvre blades to swing automatically to the open position. Similarly the blades of the 'fail safe closed' type are retained in the open position until the circuit is broken and the blades are closed.

Plusaire moveable louvre panels are purpose-made from pre-galvanised steel in any length from 500mm to

1,500mm and heights from 500mm to 1,500mm preferably in increments of 100mm.

Screens to prevent entry of birds, insects and vermin can be fitted to the 'fail safe closed' louvres if required.

Greenwood Airvac Ventilation Ltd, PO Box 3, Brookside Industrial Estate, Rustington, Littlehampton, West Sussex. Tel. Rustington 71021.

Medical Alarm Systems

The required standards for the Central Distribution of Piped Medical Gases within British hospitals, as set by the Department of Health, are probably the highest in the world. Part of the equipment specified is an alarm system to indicate to engineering and medical staff the status of the various gas, vacuum and compressed air systems. Since the location of the points of use may be scattered throughout the hospital, the alarm requirement is rather different from normal 'high reliability' systems, ie information is to be given from the various plants to the system and this is to be visually and audibly indicated at locations possibly many hundreds of metres apart.

Applied Pneumatics Ltd (part of the APS Group) have manufactured alarm units for this application for some years and recognised a requirement for substantially reducing the cost and complexity of installation for these sophisticated systems which have to be 'tailored' to each individual hospital. Two years development and extensive co-operation with BOC Medishield Pipelines (who are, of course, the principal suppliers and installers of medical gas systems in Britain) has resulted in a new alarm called the 'Mediplex'.

The great advantage of Mediplex is that it distributes information on a basis using only four wires (conventional alarms use up to 14 wires).

The maintenance requirements are kept to a minimum and extensive use of plug-in printed circuit boards facilitates 'instant' service if required. The system even includes a communication unit which greatly reduces commissioning and routine test times.

The Mediplex will be marketed in the UK by BOC Medishield Pipelines and overseas by Applied Pneumatics.

Further information from: Ken Lawton, Applied Pneumatics Ltd, Hertfordshire House, Wood Lane, Hemel Hempstead, Herts HP2 4SU.

An 'Eyes and Ears' Surveillance System

Scanring I — a high-speed surveillance system that can monitor from 25 to 999 stations — is being marketed in the UK by Cass Electronics Ltd, Crabtree Road, Thorpe, Surrey.

Scanring I offers electronic scanning that can be adapted to deal with temperature variations, power and plant failures, breakdowns, flooding, fire and break-in detection. All information is fed via telephone-type cable to a desk-top control unit where alarm calls are registered audibly and visually, a buzzer alarm sounding until the operator presses a read-out button and receives digital indication of the station which has picked up the fault.

Scanring can handle two levels of alarm priority and store up to 64 alarms in each priority category, relaying each alarm to the controller in turn. A second memory unit stores each call until the fault has been located and repaired.

The Scanring I system is based on plug-in electronic cards for easy maintenance and the system can, on special order, be expanded to cover 10,000 separate points, monitoring each point ten times per second.

Full details of Scanring I and the other Scanring surveillance systems from Cass Electronics Limited, Fire and Security Division, Crabtree Road, Thorpe, Surrey. Telephone: Egham 6266.

Surgical Monitoring System

Spacelabs have introduced a Surgical Monitoring System.

The system provides multiparameter vital signs monitoring for major cardiovascular and trauma operating theatres. It is compact and portable.

The system has features such as alphanumeric memory displays, large screen repeater scopes, full screen deflection for pressure waveforms and precision electronic calibration markers on the CRT. Transducer calibration is a four-second automatic operation.

'On Board' Electrosurgery and Defibrillator Protection Circuitry ensures measurements and tracings are not affected by electrosurgical procedures.

There is an optional four-channel waveform recorder which can provide precalibrated recordings or double as a Trend Recording System.

All amplifiers are optically isolated and the surgical monitor and recorder can be pedestal mounted with ceiling/wall mounts available for the large screen remote monitor.

For a fully illustrated colour brochure contact: John A. Humphrey, Managing Director, Novamed Ltd, 107 Kingsway, Petts Wood, Kent. Tel. Orpington 25281.

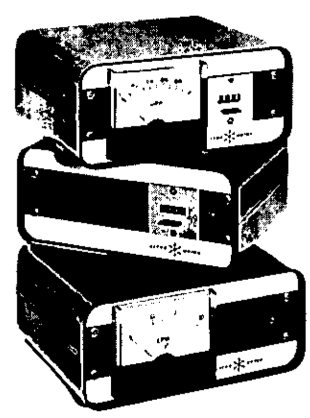
Litre Meter at Laboratory '78

Litre Meter Ltd make a versatile system of fluid measurement equipment suitable for use in laboratories; measurements down to 20 ml/minute being obtainable. All the flow meters employed have an accuracy better than 1% of full scale and use the same turbine on jewelled bearings to give a digital and analogue output. This modular construction enables Litre Meter to offer the system at surprisingly low cost.

For measuring larger flows, the Metre Meter series start from 2 litres/minute and cover flows up to 20 tonnes/minute, still using the same precision turbine and bearings. To handle the many laboratory chemicals they are available in nylon, PVC, acrylic, stainless steel and titanium.

Instruments are available to give flow rate (as an analogue or digital indication) or flow totals or both. The equipment is either for panel or rack mounting, or free standing. Some instruments are in sealed housings suitable for outdoor or hostile environments. A number of new instruments will be presented at the exhibition for the first time.

A selection of West Hyde instrument cases and electronic equipment will also be shown. *Further enquiries to: Litre Meter Limited, Unit 9 Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET. Telephone: 02406 2235.*



Pressure Boosting Pump for Individual Hospital Shower Units

Stuart Turner Ltd have developed the Stuart Shower Boosting Pump which makes it possible to boost water pressure to individual shower heads in hospitals in situations where insufficient room in the roof cavity makes it necessary to mount the header tank immediately above the point of delivery.

A height differential of 150mm (6in) between the header tank and the shower rose is required for efficient operation and the flow control switch comes into operation immediately the mixer valve is opened.

Installation of the pump is simple and siting is not critical — though Stuart Turner do recommend that it be sited on the floor if possible. Connection must be between the mixer valve and the shower rose so that blended water is delivered under pressure to the rose. Output is 350 gallons per hour (26.2 litres per minute) at 6.5 psi, or 100 gallons per hour (7.6 litres per minute) at 13 psi.

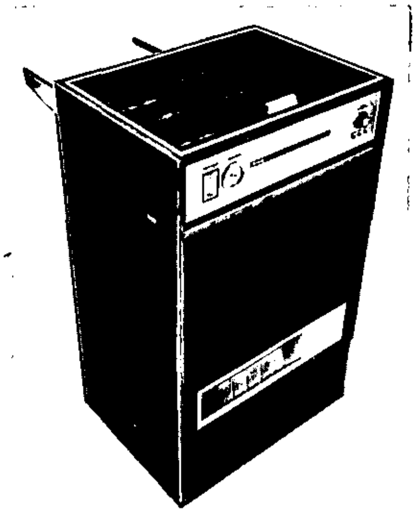
The centrifugal pump unit is mounted on an extension of the motor spindle and all internal pump parts are in brass or other non-ferrous materials. A patented Stuart carbon gland is fitted and motors are available in standard AC form, 220/240 volts, for the home market and alternatives can be supplied for 110/115 volts, 60 cycles, for overseas. In the latter case the maximum motor speed is raised from 2,850 rpm to 3,400 rpm increasing both output and pressure.

The Stuart Flow Switch is of the solid state type and is fully encapsulated. No setting-up or adjustment is required, operation being fully automatic; the control switch terminates the flow, with a delay of a few seconds, when the mixer valve is turned off. The retail price is £75 excluding VAT.

For further information contact: Stuart Turner Ltd, Market Place, Henley-on-Thames, Oxon.

New Kodak RP 'X-Omat' Processor Model M6AW with Ambient Water Wash

As part of a continuing programme supply, for medical use, automatic X-ray processors which provide substantial energy and water savings, Kodak Limited is pleased to announce their 90-second processor which eliminates heated wash water while providing consistent high-quality and fully-processed radiographs.



The Kodak 'X-Omat' Processor Model M6AW features a new air heat exchanger which helps to control developer temperature, thus making the processor independent of hot-water availability. Since air temperature varies significantly less than water temperature, control of the developer temperature can be well maintained.

In addition, to containing all the features currently offered by the model M6A-N, the Model M6AW can also provide the potential for increased departmental economies as a result of decreased energy consumption, reduced water requirements and simplified installation.

The dimensions of the new Processor are as follows: width 30 inches (76.20 cms), height 48½ inches (123.19 cms), length 22½ inches (57.15 cms).

The Processor weighs approximately 525 lbs with the processing tanks filled with solution. The processing cycle is 90 seconds for fully-processed, dry and ready-to-read radiographs. It has a processing capability of 385 sheets of film per hour, and will process all the listed sheet roll sizes of Kodak 'X-Omat' films, Ortho G Film, 'Min-R' Film, PFC and PF Films, and 'Kodak' Nuclear Medicine NMB and NMC Films at the rate of 66 inches per minute.

The developer thermostat, heater and air heat exchanger accurately control developer temperature to ± 0.3°F. Fixer temperature is controlled by its proximity to the developer tanks and by a developer solution heat exchanger in the bottom of the fixer tank. Ambient water from 40-90°F (4.32°C) is used to wash the radiographs. A flow control valve in the Processor regulates water flow to 1½ gallons per minute.

Further information may be obtained from: Medical Sales, Kodak Limited, PO Box 66, Hemel Hempstead, Herts HP1 1JU. Telephone: 0442 61122.

TN3 Medical Gas Differentiator

The TN3 Medical Gas Differentiator was covered in the June 1978 issue of *Hospital Engineering*. The manufacture, sales and servicing of this instrument is now being handled by Bedfont Technical Instruments Ltd, of 97 High Street, Hampton Wick, Kingston-upon-Thames, Surrey KT1 4DG. Telephone: 01-943 1457. Telex: 837 384.

Low Surface Temperature Radiator

A new natural convector radiator which combines high heat output with low surface temperature has been introduced to meet the rising demand for safe temperatures as regards heating surfaces, particularly in hospitals and homes for geriatric or mentally handicapped patients. The unit consists of a modified version of the proven Hudevad Plan radiator to which a specially designed protective front plate is fitted on-site. The front plate is 2 mm thick steel and is easily assembled to the emitter. It is higher and longer than the emitter and can, if necessary, serve as a wall-to-wall barrier. Dimensions are: height 300 mm to 1,000 mm in 100 mm increments; length 400 mm to 6,000 mm in 40 mm increments.

High Heat Output

A front plate touch-temperature of only 40°C at 82°C flow is achieved with negligible loss of heat output because reduced radiation is compensated by increased convection. This effect is assisted by a deflector plate which runs continuously under the top return edge of the front plate. Heat output per linear metre at $\Delta t = 56°C$ ranges from 0.461 kW (1,573 Btu/h) for the smallest emitter to 2.777 kW (9,476 Btu/h) for the largest. Seven different heights and four thicknesses of emitter can be used in lengths from 152 mm to 5,930 mm. Test pressures are 6 or 10 bar.

Details from: Hudevad Britain, 24 Upper High Street, Epsom, Surrey KT17 4QR.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

Croydon Area Health Authority

Area Works Department

ENGINEERS

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The Department has vacancies for two enthusiastic Engineers (male or female) to assist the Area Engineer over the full range of his duties. The posts are graded Assistant Area Engineer and will provide ideal experience for future Area/District Engineers or Works Officers. Membership of the IMechE, IEE or CIBS is required but applicants in the process of obtaining membership of these Institutions will be considered. Whilst the duties of the posts will be general, one Engineer will take a special interest in the Efficiency of Energy Utilisation and the other in Safety in its broadest aspects.

Application forms and job descriptions may be obtained from the Area Personnel Department, Croydon General Hospital. Telephone: 01-688 7755, ext. 29 or 31.

Applicants requiring further information or advice regarding the posts are invited to ring the Area Engineer — Mr. A. L. Jones — telephone: 01-689 2211, ext. 137.

Hospital Engineer

(Up to 24 points)

Salary £4,206-£4,857.

Applications are invited for the above post based at St John's Hospital, Goole.

The successful applicant will be responsible to the District Engineer for the efficient management of the Engineering Maintenance Services and minor capital works within the Goole Sector of the Scunthorpe Health District.

Application form and job description from: District Personnel Officer, Trent House, Hebden Road, Scunthorpe, S Humberside DN15 8DT. Tel 0724 64151.

Applicants wishing to discuss the post should contact either the District Engineer or the District Works Officer on Scunthorpe 3481.

Closing date for applications: September 18, 1978.

Scunthorpe District

Humberside Area Health Authority

CAMBRIDGESHIRE AREA HEALTH AUTHORITY (TEACHING)

New Addenbrooke's Hospital

Assistant Hospital Engineer

required to assist the Hospital Engineer in the organisation and maintenance of all engineering services. Applicants (male or female) should hold an ONC in Electrical Engineering or an alternative acceptable qualification and have completed an apprenticeship in electrical engineering or have otherwise acquired a thorough practical training.

Salary scale £3,888 to £4,377 per annum.

Application forms and further information from the District Works Officer, District Works Office, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QQ. Telephone Cambridge 45151 ext 7361, to whom completed applications should be returned as soon as possible.

UGANDA

Hospital Engineer

with practical experience of all aspects of Autoclave and General. Steam Maintenance required at once. Generous salary, car and accommodation provided, no age limits, single man preferred, chance to escape to the sunshine before winter!

Write: Managing Director, Portal Engineering Supplies Limited, PO Box 6582, Kampala, Uganda.

To place an advertisement in the next issue of **HOSPITAL ENGINEERING,** appearing on **October 6, 1978,** please contact: **Hospital Engineering, 17 St Swithin's Lane, London EC4, 01-623 2235/8** by **September 25** latest.

King's Health District (Teaching)

ASSISTANT ENGINEERS

Salary: £4,242-£4,731 pa inc.

The minimum requirement for these posts is an ONC in Electrical / Mechanical Engineering or equivalent qualifications. The jobs offer excellent training opportunities and full support given for further studies. Previous experience of maintenance engineering (mechanical/electrical) preferable.

Application form and job description for the above posts from Nigel Sewell, Deputy Administrator, Dulwich Hospital, East Dulwich Grove, London SE22 8PT. Tel 01-693 3377, ext 3209.

Warwickshire Area Health Authority

Rugby Health District

Assistant Engineer

Applications are invited for the above vacancy which arises due to promotion of the present holder. The successful applicant will assist the Hospital Engineer with the operation and maintenance of all plant and services throughout the District.

Applicants must have completed an apprenticeship in Mechanical or Electrical Engineering or otherwise acquired a thorough practical training appropriate to the duties and responsibilities of the post, and shall hold an ONC in Engineering or an acceptable alternative qualification.

Salary scale commencing at £3,888 per annum rising by six annual increments to £4,377 per annum.

For further information about this post, interested applicants should telephone R. Chatwin, District Works Officer (Tel Rugby 72831, ext 506). Application form and job description available from Personnel Officer, Rugby Health District, 24 Warwick Street, Rugby (Tel Rugby 72831, ext 507).

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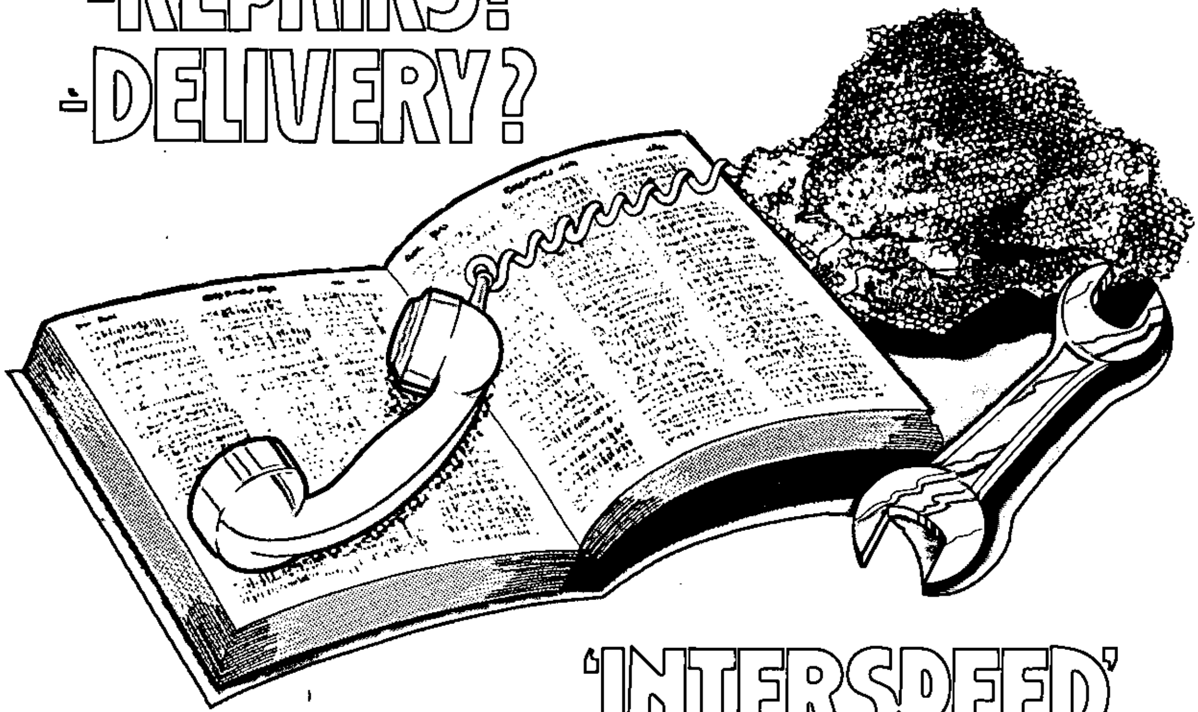

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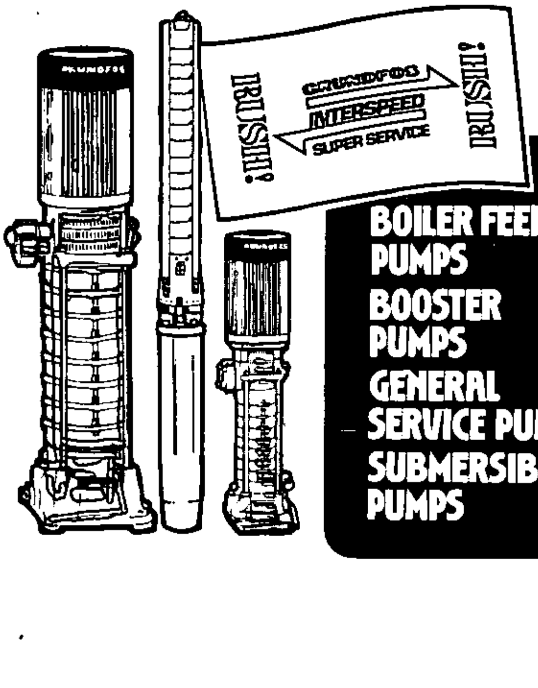

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