The Journal of the Institute of Hospital Engineering June 1982

HOSPITAL ENGINEERING

International Federation Issue

7th International Congress Report
Amsterdam May 1982

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Editor
Christopher Tanous TD

Advertisement Manager
Kate Oriel

All correspondence relating to the Journal should be addressed to:

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The Institute of Hospital Engineering
20 Landport Terrace
Southsea, Hants PO1 2RG, England
Telephone:
Portsmouth (STD 0705) 823186

Secretary
J. E. Furness MBE VRD*

Hon Librarian
D. L. Hall Esq., FIHospE MIPlantE
MRSH MBIM LHA
49 Fitzroy Avenue
Harborne
Birmingham B17 8RL
Tel: 021-554 3801, ext. 4838 (Office hours)

The International Federation of Hospital Engineering
126 Albert Street
London NW1 7NF, England

HOSPITAL ENGINEERING

The Journal of the Institute of Hospital Engineering

International Federation Issue No. 42

I.F.H.E.

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Volume 36 No. 5 **June 1982**

Front Cover:
Jan de Vries presents his paper at the International Congress in Amsterdam.

Neither the Institute nor the Publisher is able to take any responsibility for views expressed by contributors. Editorial views are not necessarily shared by the Institute

International Federation News

New Post for Past President

We are pleased to announce that Eduardo Caetano, former President of the International Federation of Hospital Engineering, is now a Professor at The National School for Public Health (Escola Nacional de Saude Publica) having successfully completed his public examinations at the end of February.

IHF Special Study Visit

France — Computerised Hospital Information Systems 14–21 November 1982

Between 1978–1981, the International Hosptial Federation (IHF) organised a number of special study visits to different countries, including England, Sweden, USSR, Mexico, Canada and the USA. Three more such visits are planned for 1982: one in Hungary on co-ordination of hospitals and primary health care; one in USA on health care planning in big cities; and one in France.

The purpose of this study visit will be to demonstrate and discuss progress — and problems — in the development of computerised information systems for the planning and management of hospital services, including the application of computers for clinical information and management. The visit is being organised in collaboration with the Hospices Civils de Lyon, which is the second largest hospital group in France, serving a population of 2 million people.

Applications

Applications should be made on a form available from the IHF at 126 Albert Street, London NW1 7NX. Early application is advised.

23rd IHF Congress HOSPINTEX '83

The 23rd congress of the International Hospital Federation (IHF) and Hospintex '83, an exhibition devoted to hospital equipment, will take place at the Palais de Beaulieu at Lausanne in Switzerland from 27th June to 1st July, 1983.

Greater economy, greater efficiency and greater humanity will be the three main themes of the Congress. In conjunction with these, Hospintex '83 will feature the new products and the most recent developments in the field of hospital technology. These subjects fit into the overall picture of **Rational Construction** (hospital design, engineering, planning, building materials and fittings, lifts and means of transport, electrical installations, power, heating, refrigeration, safety, mobile units, turnkey hospitals, environmental protection, water and air treatment), **Efficient Management** (administration, computer applications, office techniques, insurance, specialist literature, meals-on-wheels) and **Modern Operation** (hotel-type equipment, diagnostic and treatment equipment, sanitary installations, sterilizing equipment, kitchens, dining-rooms, stores, food, staff equipment, laundry, ward furniture, clothing, linen, cleaning, maintenance, disinfection etc).

Throughout the Congress, round table meetings will be organised between exhibitors and participants with a view to getting a better grasp of the needs of the hospital sector in keeping with its very special characteristics.

Institute News

Ian Murray Leslie Awards 1982

These Awards, which have now been running for eight years, are designed to encourage the development of the communication skills of all members of the building industry and to facilitate the exchange of knowledge. Winners in previous years have written on subjects as diverse as the settlement of contractual disputes, the future of rented housing, services co-ordination, force majeure and vandalism on building sites.

This year's entries to the Open Competition — for which a Silver Medal and prize of £200 may be awarded — will need to discuss one of the following subjects:

The building industry is fettered by its contractual procedures. Discuss giving attention to the significance of communication, relationships within the building team, and the close collaboration of builder and designer.

Services account for an ever increasing proportion of the initial cost of buildings. Are the builder and services contractor equipped to achieve effective co-ordination. If not what can be done?

How can computer technology be harnessed to improve building efficiency.

Secondment to industry — a challenge and a solution for those in further education. Discuss.

Anyone interested in competing for the Ian Murray Leslie Awards should contact The Head of Information, The Chartered Institute of Building, Englemere, Kings Ride, Berkshire SL5 8BS. Telephone: Ascot (0990) 23355.

Anaesthetics Update

A special course entitled 'Update in Anaesthesia and Intensive Care, 1982' is being held on the 17th and 18th of June.

The course is aimed at Consultants and trainees and is organised by the

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*Reduction in heating costs compared with requirements of UK Building Regulations for the Conservation of Fuel and Power.

YORKON

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Department of Anaesthetics at the Royal Postgraduate Medical School of the University of London.

Subjects for discussion include modern trends in resuscitation and in ventilator design, current status of local opiate analgesia, anaesthetic mortality, hazards with equipment and standards and regulations relating to safety.

Further details are available from the School Office (SSC), Royal Postgraduate Medical School, Hammersmith Hospital, Du Cane Road, London W12 0HS. Tel: 01-743 2030 Ext. 351.,

Reliability Conference 1983 call for Papers

Reliability '83, one of Europe's principal platforms for the dissemination of new ideas and techniques of assessing and assuring reliability in industry, will be organised by the National Centre of Systems Reliability and the Institute of Quality Assurance at the Metropole Hotel, National Exhibition Centre, Birmingham, from 6th to 8th July, 1983.

The organisers have issued a call for papers and 250 word synopses should be submitted by 30th June this year, followed by a 4000 word paper by 31st March, 1983.

Synopses of papers should be submitted to Mr. A. Cross, National Centre of Systems Reliability, U.K.A.E.A., Wigshaw Lane, Culcheth, Warrington WA3 4NE.

How many apprentices will you take on?

Apathy now towards training craft apprentice fitters and fitter/welders, on whom efficient engineering services in hospitals will depend in the future, may lead to serious skill shortages in the late 1980s.

Training is the only way to replace skilled people who leave the heating, ventilation and air conditioning industry. You don't know how soon you will need extra skilled people — yet it takes a long time to train somebody to a high standard of proficiency. A school-leaver recruited this year will not qualify as a craftsman for four more years at the earliest.

Relying on "poaching" craftsmen or engineers trained by other employers can drain the pool of skilled men. A much more constructive approach is to build a skilled team by "growing your own". People you train as apprentices are most likely to remain loyal, giving you good service for quite some time.

It is in the interests of all responsible for the future of engineering services to maintain the level of apprentice recruitment as high as humanly possible now. The Heating and Ventilating Contractors' Association is committed to doing everything possible to this end and will readily work with all sectors of the industry to achieve it.

Further information is available from Kieran Duignan at the HVCA Careers Service, ESCA House, 34 Palace Court, Bayswater, London W2 4JG. Tel: 01-229 2488.

Appointment of Branch Officers for 1982/3

Midlands Branch

K. W. Ashton	Chairman
A. P. Ballard	Treasurer
W. Turnbull	Secretary — 3 Rowallen Road, Four Oaks, Sutton Coldfield, West Midlands

Southern Branch

D. W. Chaplin	Chairman
R. P. Boyce	Secretary/Treasurer — 35 Newport Drive, Fishbourne, Nr Chichester, West Sussex PO19 3QQ

East Midlands Branch

F. P. Smith	Chairman
S. A. Lees	Secretary/Treasurer — 7 Rothervale Close, Beighton, Sheffield S19 6BZ

Forthcoming Branch Meetings

Southern Branch *Hon Sec: R. P. Boyce Chichester (0243) 781411*

13th July 1715	Branch Meeting	Southampton General Hospital

East Anglian Branch *Hon Sec: M. Brooke Great Yarmouth (0493) 50411*

17th July	Visit to new District General Hospital, Gt. Yarmouth	

Yorkshire Branch *Hon Sec: J. Bate Wakefield (0924) 890111 Ext 293*

14th June at 1400 hrs	Total Energy Stations Presented by Mr. S. Whitehead Station Superintendant Leeds General Infirmary	Donald Kaberry Lecture Theatre Leeds General Infirmary Great George Street, Leeds LS2

6 Branch Meeting

12th June 1000 hrs		John Radcliffe Hospital, Oxford

Scottish Branches Conference *T. M. Sinclair Glasgow (041) 332 9696 — 3 Morven Way, Kirkintilloch G66 3QL*

28th, 29th and 30th October	Information Technology Year 1982	Walton Conference Centre, Southern General Hospital, Glasgow

Those wishing to attend any of the above meetings please contact the relevant Local Secretary.

Cor Sonius

New President of IFHE

Mr Cor P Sonius of Holland, Chairman of the Dutch Institute of Hospital Engineering, was elected at the Council Meeting which immediately preceded the opening of the International Congress.

Mr Sonius has had an interestingly varied career, becoming a Hospital Engineer about 20 years ago. Before that he originally qualified as an electrical engineer, and worked for 20 years for a transformer manufacturer. He then had 10 years as a contractor, so his overall experience is as wide as could reasonably be expected for one man! He has been involved with the Dutch Institute for about eight years, and became a member of the International Federation Council at the last Congress, held in Washington in 1980.

Talking to the Editor about this year's Congress, Mr Sonius said that he was pleased with the general proceedings, and the number and quality of papers being presented. Sadly, the worldwide economic recession certainly seemed to have kept the numbers of those attending well down, and one or two countries had sent disappointingly small numbers.

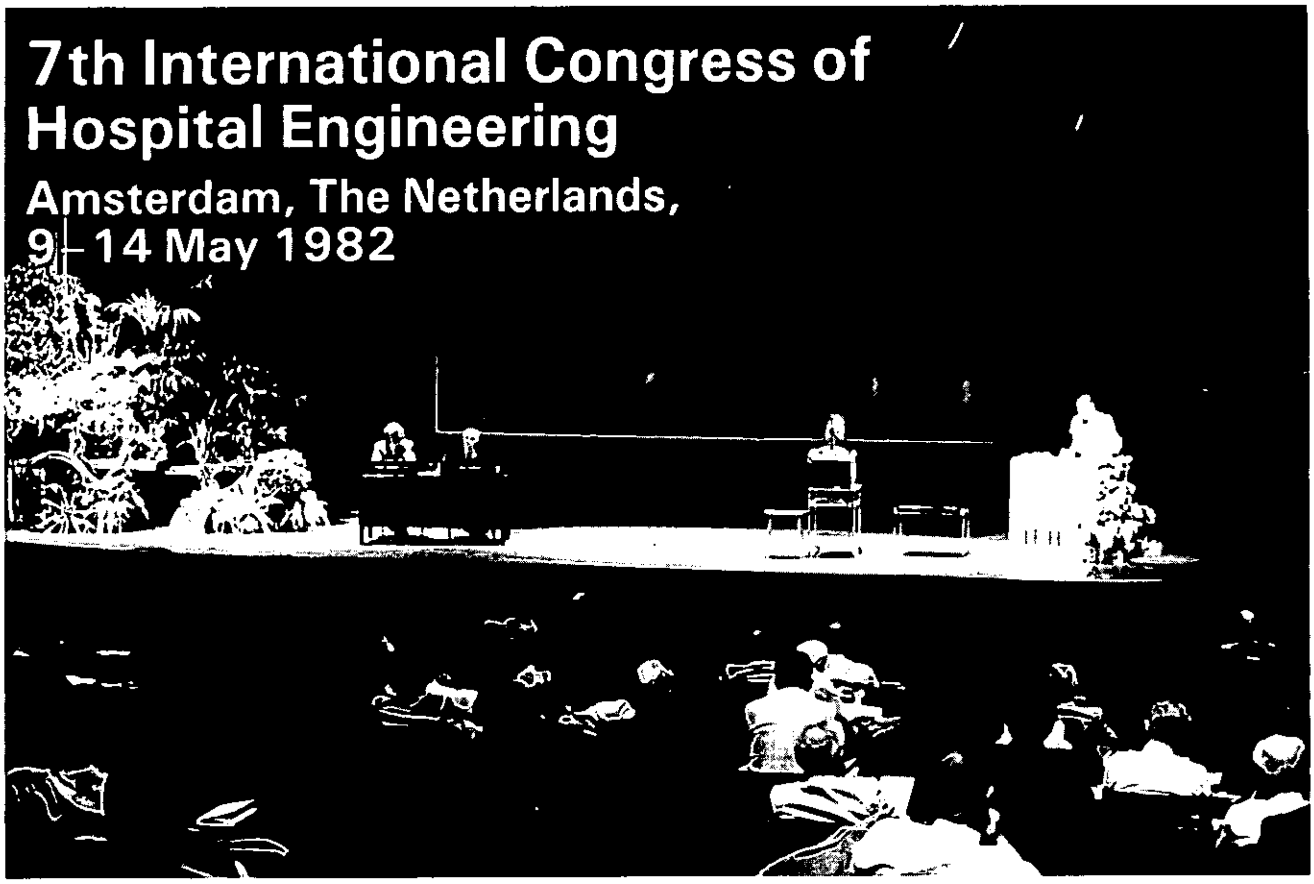
Discussing the future development of the Federation Mr Sonius said that he hoped that it would be possible to allow individuals from other professional bodies into membership, to further expand the base of the organisation. He also hoped that it might prove possible to attract support from industry and other groups, all of which would help to increase the financial base of the Federation, and thus to continue its very satisfactory development over the last few years. The Federation's main aim was still, as ever, the exchange of knowledge between all countries, and particularly between the developed and the less-developed countries.

As a move towards the development of the Federation, it was proposed to change the present situation, in which there is just one annual meeting of the whole Council, by appointing an Executive Council consisting of the four main officers and three other Council members. This would enable the more routine business of the Federation to be progressed with more speed and efficiency although there is, of course, no intention of removing from the main Council the power of decision on major matters.

In his private life Mr Sonius is a family man, with 3 daughters and 5 grandchildren. Sadly, Mrs Sonius was taken ill just before the Congress, and was not able to be present. In the past he was much involved with the Round Table in Holland, and has also been a keen sportsman for many years, playing tennis and billiards. He is also a regular bridge player.

7th International Congress of Hospital Engineering

Amsterdam, The Netherlands, 9–14 May 1982



Above: *The dramatic lighting enhances the effect of the well-appointed RAI conference centre in which the Congress was held. Here Jan de Vries, well-known to readers as a former Northcroft medal winner for a paper in* Hospital Engineering, *delivers his paper. Also seen on the platform is Eduardo Caetano, a former President of IFHE.*

Left: *The new President, Mr Sonius, flanked by two of his colleagues, Nico Snell, Chairman of the Scientific Committee* (left) *and Leo van Namen, Secretary to the Organising Committee.*

Below: *Members of the organising committee relax during a break in the proceedings.*

Above: *A typical informal contact of the type that makes congresses so well-worthwhile.* Right to left), *Vinson Oviatt, Immediate Past-President, Mr U Gessner from Switzerland, one of the speakers, and Dr Ken Murray, an IFHE Council Member, from the DHSS, England.*
Right: *Bob Cottrill, newly appointed Vice-President of the IFHE, from Melbourne, Australia, who will preside at the next International Congress, to be held in his own country in two year's time.*
Below: *Two well known Englishment arrive in style at the Official Reception given by the Burgomaster and Aldermen of Amsterdam at the Van Gogh Museum. The President of the Institute, John Constable has just stepped ashore, preceded by his immediate predecessor as President, Lawrence Turner.*

President's Opening Remarks

As President of the International Federation of Hospital Engineering, I take great pleasure in welcoming all of you to our 7th Annual Congress. In particular I would like to extend a special welcome to her Excellency the Minister of Public Health, Mrs. Gardeniers-Berendsen, who has graciously consented to do us the honour of opening this Congress.

An extra welcome to all our guests who have responded to the invitation to be present at this official opening.

Before I turn the proceedings over to the Minister, I would like to make a few remarks of my own.

The International Federation of Hospital Engineering, now numbering members in 34 countries, states its objectives in the statutes as follows:

1. to promote, develop and disseminate hospital engineering technology;
2. to compare international experience;
3. to promote the principle of integrated design by improved collaboration among the professions;
4. to promote more efficient management of operation, maintenance and safety of hospitals, their engineering installations, equipment and buildings;
5. to offer collaboration with other international organisations.

One of the most important means the Federation has of realising these goals is the organisation of international congresses. Following Italy, the U.K., Greece, France, Portugal and the USA., it is now the turn of the Netherlands to host the 7th International Congress of Hospital Engineering.

As an international Federation we wish to express our appreciation to the Nederlandse Vereniging van Ziekenhuistechnic for taking on the imposing task of organising this congress.

The costs involved in health care, both national and international, remain a constant subject of discussion, and rightly so, for they take up a large share of our available income.

Often however discussion is carried out in the wrong way.

As far as I know, the Netherlands possess one of the best health systems in the world, yet every day the cry goes up for further expansion and improvements. At the same time, cries can be heard "It's getting too expensive!" It goes without saying that these two matters cannot be reconciled. The community must make a choice. More health care at more expense, or less expense and, as a result, less care.

It is obvious that within the field of health care, efforts must be made to achieve and maintain practical facilities which operate as efficiently as possible. And this is an area in which the hospital engineer can make a very real and fundamental contribution.

The modern hospital has been compared to a luxury ocean liner, but one containing a great deal of highly advanced equipment.

A good management team is essential for the proper administration of such an important institution, a management team in which the hospital engineer has his place and which in fact could not function without his participation.

On the one hand the activities of the hospital engineer have a direct influence on the well-being of the patient.

We can think here for example of the air-conditioning installation, the lighting, radio, television, the nurse-call systems, oxygen facilities, monitoring equipment, elevators and other installations.

On the other hand the hospital engineer can also co-operate indirectly with his fellow advisers by bringing his wide experience to bear in the design and construction of new health care institutions, thereby determining how buildings, equipment and installations are to be maintained. He can thus exercise a considerable influence on future operating costs.

An important contribution in the control of the costs of health care can also be made by the hospital engineer if he is called on to give a critical appraisal of proposals for the expansion of existing facilities and the replacement of equipment.

The enormous diversity of technical matters with which the hospital engineer is involved makes his work extremely fascinating, but also requires a high level of training and wide experience.

By means of this Congress, we hope to achieve a fruitful exchange of experience and practical knowledge on an international scale.

A large problem in setting up a congress programme is the great variety of interest shown by the various participants. Colleagues from the technically developed countries naturally want to discuss the most modern and advanced systems, whereas colleagues from less developed countries often say: "What you're talking about is beyond our means, but even if we could pay for it, we don't have people with enough technical know-how to maintain such systems".

The programme committee has done its best to take these opposing points of view into consideration.

I would like to return briefly to the lack of technical know-how in the less developed countries.

This problem and the training of personnel are matters of real concern to the International Federation.

Just recently, from 18 April to 7 May, a course for senior hospital engineers from throughout the world was given, by the Institute of Hospital Enginering in the "Management and Engineering Centre" in Falfield, England. This course was given under the auspices of the International Federation. Given the quality of this practical training, it is regrettable that only a limited number of participants were involved. I would like to take this occasion to stimulate interest in future courses of this kind and to bring this unique opportunity to the attention of colleagues in the developing countries.

If we can be assured of sufficient participation, we will most certainly continue these training sessions. Please make your wishes in this respect known to the General Secretary.

After this bit of publicity for an extremely worthwhile initiative, I would like to conclude my introduction by saying that this Congress will be a success not only if you get a lot out of it, but above all, if you contribute a lot *to* it.

Minister's remarks

In her speech Mrs Gardeniers — Berendsen discussed the progress and problems of the Dutch Health Service. In conclusion she said, "I should like to round off my speech by pointing out that the special nature of hospital buildings and the requirements that are made of installations and equipment mean that energy is a major and complex problem in the health sector. I was gratified to learn that so much attention is to be paid to the energy problem during this congress, and this one of the the reasons why I shall be very interested to see the results of your discussions in due course.

Your reputation certainly suggests that this congress will achieve much and I hope that your talks will be fruitful. You are goint to be focussing on an extremely important field and it would be a source of great satisfaction to me if you were to bear in mind that the results of your discussions will be of inestimable service to sick people.

Ladies and Gentlemen, I hereby declare the 7th International Congress of Hospital Engineering open."

Sommaires en Français

Des Normes Internationales pour l'equipement électromédical.

G GAIKHORST and I M LOOY

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L'article commence par un examen de la nécessité de normes, de la manière dont celles-ci sont éstablies et de l'importance de la mise en application que peuvent envisager différentes nations.

Ceci est suivi par un examen des activités de la Commission Electrotechnique Internationale (CEI). On explique la philosophie en matière de sûreté et l'on donne aussi une explication des paramètres de sûreté pour l'équipement, la mise en oeuvre de l'équipement en toute sécurité, ainsi que la maintenance, et les directives pertinentes en cours de préparation par le Comité Technique 62 de la Commission Electrotechnique Internationale.

La technologie appropriée

Un défi aux ingénieurs et techniciens.

CHRISTINE HOGG

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Christine Hogg est un Directeur Général du Groupe d'Action sur les Technologies et Resources Médicale Appropriées qui s'est développé à partir de la commission de santé rurale du Groupe de Développement de Technologie Intermédiaire. Celui-ci fut créé en 1977 pour considérer les différents moyens de fournir des soins médicaux offrant d'autres solutions possibles à la places des mesures normalement acceptées et d'un coût élevé. Les programmes de soins médicaux primaires nécessitent l'assitance de technologies appropriées et le Groupe a pour objectif de considérer les technologies, l'equipment et l'education de prévention médicale qui sont efficaces et d'un coût pour ceux-ci. Parmi les sujets de projets acutellement considérés, figurent les maladies diarrhéiques, la prévention des handicaps et la rééduction, ainsi que l'hygiène dentaire. AHRTAG est l'un des centres qui collaborent avec l'Organisation Mondiale de la Santé et une organisatin de bienfaisance agrée.

Dans son article, Christine Hogg soutient la thèse que, tandis que les pays riches de l'Europe et de l'Occident, disposant de sommes importantes pour les soins médicaux, supposent que les meilleurs soins médicaux sont fournis dans le cadre d'une médecine basée sur les hôpitaux et une technologie avancée, il est possible que cet argument ne soit pas nécessairement vrai ou faisable dans le cas des pays en voie de développement du Tiers Monde. Par ailleurs, l'équipement conçu dans les pays industrialisés est souvent extravagant sur le plan du perfectionnement et ne sera pas, dans bien des cas, capable de supporter les rigueurs du service dans les pays en voie de développement. Même à supposer que l'équipement soit fourni à ces pays, des difficultés énormes se posent sur le plan de la formation du personnel, de l'entretien, de la réparation et du remplacment de l'equipement.

En conclusion, elle déclare que la mise au point d'équipements pour faire face aux besoins des services médicaux dans les pays en voie de développment nécessite une demarche toute nouvelle de la part des concepteurs et des ingénieurs. Les pays en voie de développment utilisent déjà un grand nombre de choses qui se sont avérées d'excellentes troubailles et c'est à partir de ces modèles qu'il faut développer des technologies plus appropriées. Pour réussir, l'étude et le développement d'un équipement quelconque doivent être entrepris en collaboration étroite avec les membres des services médicaux qui vont effectivement se trouver amenés à l'utiliser.

Le Journal d'un Formateur

Le développment de l'efficacité de gestion du Personnel des Travaux.

David Bray

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Les cours de Falfield/Keele sont organisées au Hospital Estate Management and Engineering Centre (Centre des Services Techniques et de Gestion des Biens Hospitaliers) à Falfield dans le Gloucestershire.

Ces cours ont pour but de développer les compétences en matière de gestion des personnels des travaux employés dans le cadre du Service National de Santé et, afin que les débats se déroulent au niveau le plus élevé possible, on organise deux cours, un pour les cadres moyens et un pour les cadres supérieurs.

Le contenu des deux cours est le même et ceux-ci sont organisés autour de différentes disciplines, comme les communications, l'organisation, l'administration, les rapports, les compétences verbales, le travail en équipe, les relations industrielles, la présentation, les problèmes et modes de comportement, le leadership et la prise de décisions.

Le cours met l'accent dans une large mesure sur la participation individuelle et le travail en équipe et, à cette fin, les participants sont divisès en petits groups confiès chacun à un membre du personnel assumant le role de formateur qui peut les guider et offrir quelques suggestions mais qui s'efface dans la mesure du possible et laisse les membres du groupe développer les débats ayant trait à une situation susceptible de se produire dans un hôpital ou dans une zone due Service National de Santé. Chaque groupe se voit attribuer des problème de la manière la plus réaliste possible.

Les cours durent une semaine et durant cette période les soixante participants résident à Falfield.

International Congress Paper

Mr. Gaikhorst is the Secretary of the International Electrotechnical Commission's sub-committee 62A on 'Common Aspects'.
The article first appeard as a paper at the 7th International Congress of Hospitals Engineering held in Amsterdam in May.

International Standards for Medical-Electrical Equipment

GERRIT GAIKHORST and I M LOOY (The Netherlands)

Introduction

In the medical treatment of patients we see nowadays a tendency to find an optimum. Due to this, the patient is subject to an increased number of diagnostic and therapeutic treatments in which medical equipment is involved. However this equipment is becoming more and more complicated and the probability of unwanted effects is rapidly increasing.

The use of electric power for medical equipment may introduce an additional hazard.

Basic research in this field resulted in the following threshold values of electrical current through man as shown in Figure 1.

The figures relate to shock received through intact layers of skin, which is a relatively good insulator. This condition does not apply when a patient has an intracardiac electrode or saline-filled catheter within the heart, the safety afforded by intact skin and tissue having now been by-passed by the wire or fluid column.

The vulnerability of the heart to micro-shock under such conditions cannot be over emphasised, as a current level very much lower than quoted above may be capable of causing ventricular fibrillation.

The susceptibility of the heart muscles to fibrillate under locally applied electrical stimulation has been the subject of research work, carried out mainly in dogs, with attempted extrapolation to man. It has not yet been possible to establish definitive levels of current capable of causing ventricular fibrillation in man in these circumstances, nor have the effect of levels of anaesthesia and metabolic or bio-chemical states been considered in this context. On the limited evidence at present available, it seems that current levels between 100 and 750 MA may cause ventricular fibrillation in man and this has led to *specifications for* electro-medical equipment with a direct connection to the heart requiring maximum leakage currents of 50uA.

Internationally, a number of voltage bands are accepted and 50V a.c. (or 120V d.c.) is regarded as a safe voltage.

A potential difference of 50V in an installation may occur due to the disconnection time of a safety device. The disconnection curves of such device are such that 2.5 times the nominal current had to be disconncted in a given time e.g. 5 s for a quick fuse and 12 s for a slow working fuse.

If a fault current is lower than the value mentioned above the current may flow for a longer time.

The 50V is regarded safe as the likelihood that a human being will touch such a potential difference is very small in normal houses. Moreover there will be always an 'environmental resistance' between the man and the voltage source. The use of electrical domestic appliances is restricted to small periods of time. However in a number of countries it is required that handles or parts of equipment which are intended to be held by hand are connected to protective earth.

In factories or workshops the situation is different as the tools which are used may come in contact with the workers for a longer time. Floors used in such an environment are generally made of a material with a lower resistance for electrical currents, reasons why in factories other requirements apply.

However both in the homes and in the factories the human beings are healthy and have the possibility to react in abnormal circumstances.

In medically used rooms the situation is different in three aspects:

— Patients may be connected for a longer time to medical electrical equipment e.g. patient monitor equipment.

— Electrical equipment may be connected directly to the human heart (e.g. external pacemakers). In this case the natural protective barrier, the skin, is by-passed.

— The patient may be unable to defend himself or to escape, because he is ill, unconscious, anaesthetised or immobilised.

Beside these three main aspects electrical equipment which is used in medical practice may produce, unintentionally or otherwise, a number of hazards:

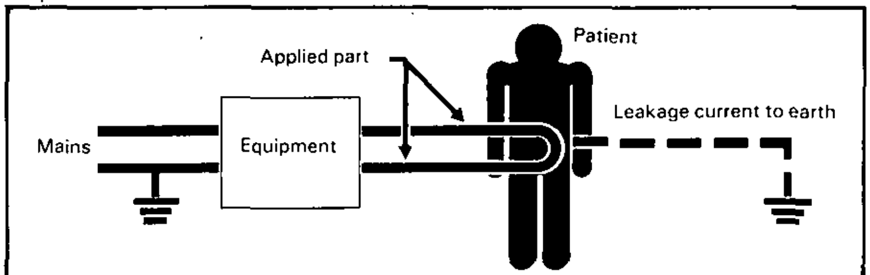
— due to the energies delivered when functioning properly;

— due to the energies delivered in the case of first fault conditioning, or

— due to breakdown where:

a) the well-being of the patient depends upon the functioning of life-supporting equipment, or

Figure I: Patient connected to medical electrical equipment.



Physiological response	Alternating current (mA)	Direct current (mA)
Threshold of feeling	1	5
Muscular paralysis	15	75
Ventricular fibrillation	50	250

b) the nature of examination or treatment does not allow interruption or repetition.

These hazards can be imposed upon:
- — the patient;
- — the user of the equipment;
- — the surrounding personnel;
- — the equipment or installation.

Reliability of functioning is regarded as a safety aspect for life-supporting equipment and where interruption of an examination or treatment is considered as a hazard for the patient. Adequate construction and lay-out which serve to prevent human errors are regarded as safety aspects. Safety precautions are considered acceptable if they provide adequate protection without an undesirable restriction of normal functions.

Generally it is presumed that equipment is operated under the jurisdiction of qualified or licensed persons, that the operator has the skill required for a particular medical aplication and that he acts according to the instructions for use.

A safety level however can only be settled by a number of technical rules given in a General Standard or if applicable in Particular Standards for particular equipment.

In the circuit between the mains, which is in a number of countries connected to earth and the patient a number of safety provisions are necessary. *(See Figure 1).*

The electrical installation shall provide a protective earth and in the potential differences shall be at a lower level than in a normal living room.

For rooms in which only electrical equipment is connected to the patient and his skin is not by-passed, a potential difference of 25V a.c. (or 60 d.c.) is regarded as safe.

In those rooms in which electrical equipment is connected via cardiac catheters to the ventricle a maximum potential difference of 10mV is required.

The equipment shall have safety provisions in order to minimize the likelihood that the leakage current through the patient may reach an unacceptable level. On the other hand, hazards like energies delivered to the patient, mechanical hazards, absence of functioning etc. shall be avoided.

From different studies it is found that hazards which occur in hospitals are caused by the failure of the human being involved in the treatment of the patient, and a relative high percentage of 50–60% is mentioned. In the event of more complicated equipment being used, this number will be certainly increased.

The majority of these accidents are caused by improper use of equipment and inadequate electrical installation. Training of the medical staff and maintenance of equipment and installation is essential. To give guidance to the user of the equipment, a code of practice will be of much help.

Standards

In a number of countries it is required by law that electrical equipment shall be safe. However such laws does not explain what is meant be 'Safe'. The only way to prescribe safety is by a set of technical rules — the so-called 'Standards'.

In the Standards, terminology is defined in order to provide a clear communication, measuring methods are prescribed and safety aspects are required.

In a number of countries National Standards are prescribed and these standards are used in conjunction with the National Law.

However the production of medical electrical equipment requires more and more high-level technology staff and investment in the industry. As an example, the CAT-scanner is mentioned with a yearly turnover in 1980 of US$530 mil. In 1975 approximately 20 companies were producing this type of equipment. At the beginning of 1981 only 10 companies remain and by the end of 1981 only 5 companies are still in this market.

This trend is going on in the entire field of the medical-electrical equipment and now there are only a small number of production centres which deliver equipment world wode which require global standards.

The International Electrotechnical Commission

In 1906, about 75 years ago, electrical engineers agreed to establish the IEC (International Electrotechnical Commission), an international body for the establishment of international Standards.

The main object of these International Standards is to provide:

an international language by establishing terms, definitions and symbols used on equipment;

standard units for the expression of physical qualities of the equipment concerned;

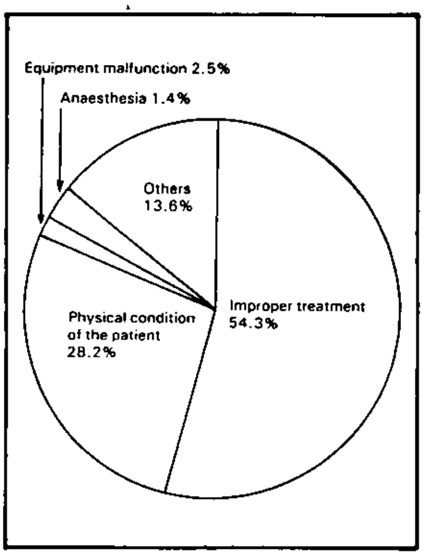
standard test methods in order to verify the requirements stated in the standard.

The standard making procedure requires experts in the particular field of the standard. At national level, it is often difficult to find the specialists as mentioned here. On an international level, this is much easier. The procedure for the final agreement on a standard in the IEC is well prescribed in the rules and regulations and national committees, members of the IEC, are responsible for the final decision.

At the moment the following general information on the IEC could be given based on 1981 figures:

There are at present 44 IEC National Committees. There are at present 200 IEC Technical Committees and Sub-Committees. Some 100 IEC Technical Committee and Sub-Committee meetings are being held each year, not counting the meetings of the approximate 600 existing Working Groups. Approximately 25,000 technicians and Science members contribute to the work of IEC VIA Technical Committees, Sub-Committees or Working Groups. The IEC is issuing each year an average of some 100 to 150 publications, totalising between 4,000 and 5,000 pages of bilingual International Standards. The IEC member countries consume approximately 80% of the world's electrical energy and make use 90% of the electrical and electronic products. There are at present over 1,200 IEC standards representing a volume of some 40,000 pages of bilingual International Standards.

Figure 2: Hazards in hospitals.



IEC/TC 62-Electrical Equipment in Medical Practice

In the IEC the committee TC 62 is responsible for standards applying to medical electrical equipment.

In order to cover the whole field, which is estimated at approximately 6,000 different types of devices, 4 different sub-committees were established:

1. Common aspects, covering general safety requirements (IEC/SC 62 A).
2. X-Ray equipment up to 400kV, covering particular standards for diagnostic and therapeutic X-ray equipment up to 400kV (IEC/SC 62 B).
3. High energy radiation equipment covering therapeutic equipment, and equipment for nuclear medicine (IEC/SC 62 C).
4. Electromedical equipment, covering the particular standards for medical electronic equipment, mechanical and optical equipment (IEC/SC 62 D).

IEC/SC 62 A had published in 1977 a General Safety Standard. The other Sub-Committees had issued particular safety standards in addition to the General Safety Standard.

The general standard is in actual use in a large number of countries. By the end of 1981 a number of 2,000 copies were sold. The standard is translated in Italian, German, Hungarian, Finnish, Russian and Japanese. A translation in Chinese is in preparation. The reason for these translations is that national laws refer to the General Safety Standard and the text had to be produced in the local language.

In a number of countries the standard is adopted as a National Standard and implemented in the National Standard System.

The Safety Philosphy

The safety of medical electrical equipment is, as described in IEC Publication 513, part of safety situations, composed of: safety of equipment; safety of the installation in medically used rooms; and safety of application.

Safety of equipment is generally required for normal use and normal condition and for a number of defined single fault conditions.

Safety is a compromise between the acceptance of a risk and the costs involved in avoiding safety hazards.

The total safety of equipment may consist of:

1. Precautions incorporated in the equipment (unconditional safety).
2. Additional protective precautions, such as the use of shields or protective clothing (conditional safety).
3. Restrictions in the instructions for use concerning transport, mounting and/or positioning, connection and the position of the operator and his assitants in relation to the equipment during use (descriptive safety).

Generally safety precautions are presumed to be applied in the order as described here. They may be realized by correct manufacturing (which includes knowledge of methods of production and environmental conditions during manufacture, transport, storage and use), by application of redundancy and/or protective devices of mechanical or electrical nature.

The most important part of the philosphy is to protect the patient, the operator and surroundings as far as possible without restricting the normal function of the equipment.

While realising this, solutions that give adequate protection are preferred. This is realised in the standards for equipment, safety provisons in the electrical installation for the supply of the equipment and guidelines for the safe application of medical equipment.

The safety requirements on equipment are based on the following items:

1. Medical electrical equipment shall be supplied from a mains supply in which a number of safety provisions are realised.
2. A single fault in the equipment shall not create a safety hazard for the patient, the operator or surroundings.

In order to achieve a safe power supply in certain critical areas, where equipment is connected externally to the patient, the potential differences shall be restricted to 25V in order to avoid dangerous currents through the patient, which may cause ventricular fibrillation. In rooms with intracardiac procedures these voltages are limited to 10MV. In the requirements for the electrical installation for rooms outside the hospital, the potential differences are restricted to 50V.

The fields mentioned above are based on the fact that the medical profession should decide on the medical procedure which should be undertaken in certain medically used rooms. With respect to safety of the patient, it is important to know what extent medical electrical equipment is used. The following categories could be mentioned:

— there is no equipment involved during the treatment of the patient;

— equipment is used but only for an external contact with patient (e.g. non-invasive blood pressure measurement);

— equipment is used and an electrical contact is made inside the patient's body (e.g. by needle electrodes);

— equipment is used and a direct electrical contact is made to the heart or major blood-vessels of the patient.

Safety aspects covered in the Equipment Standards

The general safety standard for medical electrical equipment is necessary because of the particular relation of such equipment to the patient, the operator and the surroundings.

An individual item of equipment may be safe as a single entity, a number of items of equipment, simultaneously connected to a patient, can increase the micro-shock hazards.

The equipment is designed for well defined environmental conditions like temperature ranges, humidity, voltage and frequency deviations.

The user has to realise, before using the equipment, that the equipment will operate within the limits specified by the manufacturer and based on the requirements in the standard.

The electrical hazard is caused by the fact that the human body is connected in an electrical circuit. The mains supply in many countries is connected to earth required by the system of distribution of the electrical energy.

If the human body is connected to ground and at the same time a conductive connection is established with the mains a current can flow through the body. This current depends on the resistance in the circuit.

Protection against electrical shocks caused by currents not resulting from the specified physical phenomena of the equipment shall be obtained by a combination of the following measures:

— prevention of contact between the body of the patient, the operator or a third person and parts which are live or may become live in the case of an insulation failure by means of enclosing, guarding or mounting in inaccessible locations;

— restriction of voltages on or currents from parts which may be touched intentionally or unintentionally by the patient, the operator or a third person.

These voltages or currents may be present during normal use or may appear in single fault conditions.

Generally, this is obtained by a combination of:

— limitation of voltage and/or current, or earthing;
— enclosing and/or guarding of live parts;
— insulation of adequate quality and construction.

The amount of electric current flowing in the living body which may cause a certain degree of stimulation varies from individua, according to the way in which the connection to the body is made and according to the frequency of the current applied and its duration.

Currents of low frequency flowing directly into or through the heart considerably increase the danger of ventricular fibrillation. For currents of medium or high frequency, the risk of electric shock is less or negligible, but the risk of burning remains.

The sensitivity of the human body for electrical currents, depending upon the degree and nature of contact with the equipment, leads to a classification of equipment according to the degree and quality of protection. This is described in terms of the maximum allowable leakage current (types B, BF and CF equipment).

Types B and BF equipment are suitable for applications involving external or internal contact with the patient excluding the heart. Types CF equipment is suitable for direct cardiac application.

In conjunction with this classification, the requirements for allowable leakage currents have been formulated. The absence of sufficient scientific data concerning the sensitivity of the human heart for currents causing ventricular fibrillation still presents a problem.

Nevertheless, engineers are provided with data, enabling them to design equipment, so for the time being the requirements represent what is considered reasonable safe.

The requirements for leakage current were formulated taking into account the following considerations:

a) that the possibility of ventricular fibrillation is influenced by factors other than only electrical parameters;
b) that the values for allowable leakage currents in single fault condition should be as high as is considered safe, tasking into account statistical considerations, and
c) that values for normal conditions are necessary to create a safe condition in all situations by providing a sufficiently high factor with respect to single fault conditions.

The measurement of leakage current has been described in a way which enables the use of simple instruments, avoiding different interpretations of a given case and indicating possibilities for periodic checking by the user of equipment.

Effects of mechanical overloads, material failure or wear can be avoided by:
— means which interrupt the energy-supplying (for example, fuses, pressure valves) as soon as overloading occurs;
— means whilch guard against or catch flying or falling parts (caused by material failures, wear or overload) which may constitute a hazard.

The requirements for the protection against mechanical hazards are divided into:
— a part describing hazards caused by damage or deterioration of equipment (mechanical strength);
— and several parts describing hazards of a mechanical nature caused by equipment (injury by moving parts, by rough, sharp edges and corners, by instability, by expelled parts, by escape of pneumatic or hydraulic power, by vibration and noise and by breakdown of patient supports and of suspension means for equipment parts).

Equipment may become unsafe because it is damaged or deteriorated:
— by mechanical stresses such as blows, pressures, shocks, vibration;
— by ingress of solid particles, dust, fluids and moisture and aggressive gases;
— by thermal and dynamic stresses;
— by corrosion;
— by loosening of fastenings of a moving part or a suspended mass, and
— by radiation.

Protection against breakdown of patient supports and suspensions can be provided by redundancy or the provision of safety catches.

Attention is paid to the effects of a power interruption concerning unwanted movements, removal of compression forces and removal of patients from uncomfortable positions.

Equipment parts which are intended to be held in the hand or positioned on a bed must be sufficiently robust to withstand a fall.

Instruments may be subject to vibration and shocks, not only when transported but also when used in vehicles. This may be covered by environmental condition tests.

Electrical equipment, used in areas in which flammable anaesthetics and/or flammable agents for disinfection or skin cleaning are applied, a risk of fire may exist if such anaesthetics or agents are mixed with air.

Ignition of such atmosphere or mixture may be caused by sparks or by contact with parts having a high surface temperature.

The requirements, limits and tests are based on the results of statistical considerations obtained from experiments with these atmospheres of ether with air and mixtures of ether with oxygen. The requirements restrict the surface temperatures. Electrical circuits are enclosed in enclosures with pressurised inert gas or clean air or in enclosures with restricted ventilation.

An important part: is the construction of the mains part of equipment and the way the connection to the supply mains will be established. Furthermore requirements for the creepage distances and air clearances between live parts and accessible metal parts are prescribed.

A chapter is devoted to the accompanying documents to the equipment. The documentation for medical electrical equipment is regarded as an essential part of the equipment. There are two types of documents.

The instructions for use will give guidance for the user in the application of the equipment. They contain instructions for use of the equipment directed to the medical staff, who in general do not have sufficient knowledge of the electrical safety aspects; instructions are given for disinfection, sterilization, etc.

In the technical description, guidance is given to the user for the maintenance and safety inspection of the equipment. Indicated are which spare parts should be used, the technical details like drawings, etc., are indicated. Instructions are given for the performance of safety tests and calibrations.

Reference to other publications is only made if such publications are of a general nature, that is: not restricted to particular equipment types. In other cases requirements and tests may have been adopted unmodified or slightly modified without quotation of the source.

Safety provisions in the electrical installation

The safety of equipment during application depends highly on the safety provisions in the installation to which it is connected.

In all countries safety requirements exists for houses and factories. These requirements are based on the fact that in these rooms healthy people are living or working and in general no continuous contact is made to electrical equipment or installation parts. At the moment the safety provisions of such installations are based on the restriction of a touch voltage of maximum 50V. If an unintentional contact is established the resistance incorporated in the circuit due to e.g. floor covering is such that a threshold of feeling is avoided.

However in medically used rooms in which patients are treated with medical electrical equipment a continuous contact may be established or the patient may be treated in such a way that his natural protection against currents is by-passed. Electrodes may be connected to the human heart. In such critical areas it is essential that potential differences shall be restricted.

In case the public mains system fails an emergency power supply will take over the normal supply in order to continue the medical treatment.

High frequency electromagnetic field may cause interferences and malfunction of equipment. The standard for installation describes methods to measure these fields and provisions prescribed to avoid interferences.

As a minimum requirement the installation shall be build to the so-called 5-wire system (three-phases, neutral and separate protective earth conductor). Depending on the local regulations and the way equipment is used in the treatment of the patient a number of well prescribed safety provisions can be build in the electrical installation in addition to the basic requirement, so the hospital can make a selection which safety provisions they regarded as optimal in the particular medically used room.

The following provisions are prescribed:

Potential differences

The provisions made are all designed to prevent potential differences, or maintain them within permissible limits, in view of the medical functions to be carried out in the areas concerned.

Potential differences in the direct proximity of the patient may give rise to inadmissible currents passing through the patient, and should be prevented.

The maximum touch voltages are restricted to 25V by the requirement of 0.2 Ω as a maximum resistance between the protective earth conductor busbar and the protective earth contact in the wallsockets. This provision is recommended in rooms where patients are treated without using equipment or only treated with equipment externally.

Potential equalization

If potential equalization is carried out strictly, all accessible metal parts are interconnected. This avoid the possibililty of long-duration potential differences occurring near the patient.

Restriction of touch voltages in rooms equipped for direct cardiac application

In these rooms it is recommended to restrict the touch voltages between exposed conductive parts and extraneous conductive parts in the patient environment to 10mV.

Residual current operated protective device.

Equipment with a higher power consumption of more than 63 A rated value of the overcurrent protective device and permanently installed may be connected to the mains protected by a residual-current-operated protective device with 300 mA tripping current.

Other equipment may be protected by residual-current-operated protective devices with 30 mA tripping current.

Other equipment may be protected by residual-current-operated protective devices with 30 mA tripping current.

Electrical equipment installed more than 2.5 m above floor level is excluded (e.g. general lighting).

Isolating transformers

The main purpose of the isolating transformer is to ensure safety of the mains supply in a given area. The transformer provides a supply which is isolated from earth. Any earth fault occurring in a piece of equipment connected to the -floating network does not result in disconnection and normal operation can continue. The maximum output power shall be restricted to 7.5kVA.

Isolating transformers

The Main purpose of the isolating transformer is to ensure the safety of the mains supply in a given area. The transformer provides a supply which is isolated from earth. Any earth fault occurring in a piece of equipment connected to the floating network does not result in disconnection and normal operation can continue. The maximum output power shall be restricted to 7.5kVA.

Insulating fault monitoring

When isolating transformers are used, it is essential to know when an insulating fault has caused the floating secondary network to lose its initial values. This can be ascertained by monitoring the insulation resistance of the network.

High and low frequency electromagnetic interference.

Considerable savings may be achieved by taking into consideration external or internal sources of interference at the stage when the building is planned.

A careful planning of the lay-out of power cables in and outside the building is essential.

The effects caused by frequency interference may arise either from the mains supply or from radiation of other equipment. A substantial prevetnive effect can be achieved by connecting equipment which is known to cause mains interference directly to the supply source, os the impedance is kept as low as possible. When necessary, mains filters can be used in order either to prevent mains interference or to prevent mains-borne interference from affecting the equipment.

Electromagnetic radiation may produce an effect in both the low frequency and high frequency ranges. Low frequency interference can be offset by maintaining the sources of interference at a sufficient distance.

Cables carrying heavy current should be kept away as far as possible from sensitive measuring equipment. High frequency interference sources, such as diathermy equipment or high freqency equipment used for surgery or electrocoagulation should be kept as remote as possible from rooms used for ECG, EEG or EMG measurements.

Power supply cables for these special rooms can be fitted with special shielding during installation. Furthermore, such rooms can be shielded to keep high frequency magnetic radiation fields outside the measuring area.

Measures to prevent electrostatic charges.
Electrostatic charges may give rise to shock reactions to the operator or could cause sparking and hence fire.

To prevent the accumulation of electrostatic charges, air conditioning may be provided for such areas, ensuring that temperature and humidity are maintained at a given level.

Another possibility is to install an electrically conductive floor. Through the lower resistance the electrostatic charge will flow to earth. One of the basic requirements of an electrically conductive floor is to maintain as large and as permanent a conducting surface area as possible with the local ground, while keeping the cost to an acceptable level. In the building and construction industry concrete is used almost universally in the footings and foundations of buildings and is the basis for structures. Since concrete is in close contact with an inherent low resistance caused by carbon products added to the concrete.

A good electrical contact with the ground is made through electrodes which take the form of metallic plates, rods or strips. The standard prescribes the resistivity tests.

Emergency power supply
Apart from the minimum lighting required for rooms, corridors, staircases, etc., it should be borne in mind that for most equipment an interruption of a few seconds (not more than 15 s) in the mains supply can be regarded as permissible. An emergency generator will take over the mains supply. The installation standard prescribed the voltage and frequency deviations from the emergency power supply in order to continue with safe operation of equipment.

Safe use of Electromedical equipment

The safe application will take in account:

— an adequate traiing and instruction of the medical staff on the safe use of equipment in the hospital based on the instructions for use provided by the manufacturer;

— a preventive maintenance programme on equipment and installation to ensure the safe and continuous operation of the medical equipment.

Since all electromedical equipment must be regarded as a potential source of danger in hospitals, it is necessary to subject their use to certain conditions on safety grounds. The user is responsible for safety of application, and he must take particular steps to ensure safe operation at all times.

Training and instructions programmes
Users education based on the instructions for use is important. This is nowever an organisational matter and could not be covered by a standard. The user shall make himself familiar with application of standards.

The users must be taught to avoid physical abuse of the equipment and not to exceed the capabilities of devices.

The operator should make himself familiar with the symbols used on the equipment and should be aware on abnormal situations, indicated by overheating or unusual noise. In addition they must be taught to perform simple maintenance tasks themselves, incuding cleaning and visual inspection on wear and fatigue.

Preventive maintenance
Preventive maintenance includes performance testing, replacement of parts which are subject to wear, etc.

Staff members with medical training must familiarise themselves with the electronic features of the equipment.

Hospital technical staff members, who are responsible for judging the safety of the equipment, must acqure a grounding in medical and physical concepts as well as a thorough understanding of the equipment design and construction with a veiw to ensuring safe application. They must be able to calibrate the equipment or supervise its calibration by others. They must collaborate on short instruction programmes for the medical staff, nursing personnel or patients. Technical staff must be able, if required, to discuss with medical staff subjects connected with interference problems arising when combinations of electromedical equipment are used.

Special attention should be drawn to:-

- Frayed or damaged power cables and broken plugs or socket outlets which must be replaced.
- Prevent the use of supply cables over four metres in length.
- Prevent the use of extension cables. Prevent the use of adaptors.
- Equipment leakage current testing in accordance with standards should be carried out regularly.
- Equipment earthing should be checked regularly with an earth tester, which injects 25 A for 5 s into the equipment earth circuit.
- The neutral-to-earth loop impedance of all power supply points, socket-outlets and metal in the patient environment should be checked regular with a neutral to earth loop impedance tester, which injects 10A-25A for 5 s into the loop circuit.

The capability of the maintenance programme will depend largely upon the expertise of the clinical engineering technical staff and on the repair facilities and stock parts available. In some cases, out of hospital service contracts may be a more economic solution, although this approach generally has the disadvantage of longer down-times.

The maintenance should be performed at regular intervals based on the local situation of the hospital.

Hospital administrators generally require economic justification for the expansion of activities into new areas. Such justification includes reduction in repair costs. Another economic benefit of good design, increased safety and reliability is a reduction of hospital costs due to decrease in equipment related accidents and associated law suits against the hospital.

Safe operation
When acquisition of new medical equipment is planned a critical evaluation should be made of equipment on the market. In equipment selection specific attention should be given to the standards to which the equipment is designed and constructed. Preference should be given to equipment desinged to International Standards as such equipment is used in different countries. The manufacturer should be asked to provide specifications on the standards to which the equipment is designed.

After the training as mentioned under 8.1. the safety of the patient will be enhanced if the staff attending a patient observe the following precautions:

- Avoid the possibility of becoming an electrical connection between metal parts in the patient environment and the patient, by using one hand only.

- Avoid touching the patient with one hand and adjusting equipment with the other.
- Avoid touching guide wires, transducers and catheters etc., with one hand whilst adjusting equipment or other devices with the other hand.
- Wear rubber gloves when handling catheters whenever possible.
- If chathethers must be handled with the bare hands in an emergency, ensure that the hands are dry.
- Check the equipment as a shelf for liquids which may spill and enter the equipment.
- If equipment fails, disconnect it from the power supply first and then the patient, before attempting to correct it.

It is essential that the medical specialist consults a clinical engineer before he puts the equipment in actual use.

Present state of affairs

Publication 601-1 is in revision at the moment. After the publication was issued the experience in manufacturing and testing was gathered. As an important step it could be mentioned that the standard will now have only requirements and tests.

In an Appendix a rationale will be given. So the reader can find the explanation why a requirement or a test was formulated in the way it is expressed in the standard.

This is a considerable improvement of the document which will be appreciated by everyone.

A number of requirements and tests need further study and proposals were circulated to national committees for comments.

So detailed information is now available on the humidity preconditioning tests, the dielectric strength tests, requirements on equipment used in areas where flammable atmospheres or mixtures are administered and requirements and test on mains supply transformers.

However, it is estimated that the revised document will be available in 1984.

In the meantime a considerable lot of effort is put into the preparation of particular standards and a number of documents are now in the final stage of preparation.

The document on the electrical installations in hospitals will be issued soon under the accelerated procedure and the opinion of national committees will be asked for.

The documents on the safe use of medical equipment are still under discussion in the working group. As a first try a document as code of practice to the medical staff is circulated to national committees. From the comments received we can learn that a new approach should be followed.

From the results of research done on the accidents with equipment we can see that:

60% of the equipment was not used properly;

20% of the equipment was connected to an inadequate installation;

10% no proper maintenance was carried out on equipment.

Furthermore we can learn from a study carried out by California Hospital Association in 1975 that 60% of the injuries on patients could be associated with medical staff responsibilities.

These studies show us clear where we should take action and a document understandable for the medical staff and drawing the attention to the hazards involved in the safe use of medical equipment should be our main task.

To instruct the operator of medical equipment makring is necessary. However due to miniaturisation it is not always possible to mark equipment parts with a text. Symbols displayed on medical equipment are very instructive and the operator need not to read a long test but can immediately see what is the meaning of the particular function.

A collective standard is in the final state of preparation and this document will assist to avoid that different symbols are used for the same function.

Many of the symbols listed have already been used for years on equipment and will be familiar to experts in that particular field, the meaning of others may become clear when viewed in context on the equipment itself, but it msut be appreciated that it is impossible to make self-evident the meaning of all symbols on complex equipment. However it is noted that the meaning of all symbols used on equipment shall be explained in the accompanying documents to the equipment.

A major activity if the IEC is to prepare a vocabulary in which terms and definitions in a particular field are listed. A vocabulary on medical radiology is in the final state of preparation. This document contains a compilation of terms and their definitions as used in safety and performance standards issued by SC 62 B and SC 62 C.

All terms are concerned with Medical Radiology but are restricted to technical and physical subjects of a nature specific to Medical Radiology.

An index in French and English is included. This index contains further a list of terms which should not be used in IEC standards because they are obsolete or not sufficiently defined or otherwise ambiguous.

The above gives a review on the total effort spend on the International Standards.

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In this thought provoking article Christine Hogg, an Executive Director of the Appropriate Health Resources and Technologies Action Group, describes a new approach to giving aid to developing countries.

Clearly, as in so many other fields, the nature of such aid is not given sufficiently careful consideration.

It is hoped that this Article might stimulate trained engineers in the developed countries of the world to devote expert attention to engineering solutions to some of the problems of primary care in the developing countries.

Appropriate Technology: A Challenge to Engineers

CHRISTINE HOGG BA(Econ.) Dip SAF(Oxon).

Introduction

It is estimated that 60% of equipment in hospitals in developing countries is out of use or never used, due to the lack of trained personnel or the lack of spare parts. Even if the problems of manpower and of repair and maintenance could be solved, this equipment would not make any significant difference to the health of the majority of the world's population. Technologies appropriate to the circumstances and health needs of developing countries are needed. The challenge of designing and developing equipment which meets the real needs of poorer people is one that ought to be taken up as a matter of urgency.

The Problem

Until recently, most people in Europe and the West have tended to assume that the best health care is provided in high-technology, hospital-based medicine, and that this must inevitably be true for the rest of the world. Other people, however, do not believe it is true even of the developed world. Most of the advances against the infectious diseases of the last century — for example, tuberculosis, cholera and diptheria — were made as a result of public health measures. Furthermore, some of the sophisticated technologies to be found in hospitals are of unproven clinical value, such as intensive care of coronary disease and the use of foetal heart monitors.[1&2]

In spite of all our advances in knowledge and technology, it is still estimated that eighty per cent of people in developing countries have no access to health care. The high infant mortality rates, the prevalence of disabling diseases and the short life span are caused mainly by diseases that we know how to prevent and to treat: bilharzia, malaria, trachoma, polio, diarrhoeal diseases, leprosy.

In 1977 the World Health Organisation declared their objective of 'Health for All by the Year 2000'. By then it was clear that more doctors and more and better equipped hospitals could not bring health care to most of the people. Equipment and machinery in hospitals are often not in use, due to the lack of technically trained personnel or the lack of spare parts. Even in countries where there are colleges for technical training, the low salaries offered by the Government service cannot attract employees from industry. New equipment is usually ordered by people who have no technical training so that new purchases are often unsuitable, even the electrical voltage may be wrong. Equipment is imported from many different countries and this diversity causes further maintenance problems.[3]

Often equipment donated by aid agencies is already obsolete in the country of origin and spare parts are no longer available. Even for newer equipment, spare parts are rarely ordered at the same time as the equipment so that even if the skills for maintenance exist, the equipment cannot be repaired.

Hospitals are mainly based in towns and are often not intended to serve most of the population in rural areas or those who cannot afford the fees. Hospitals cannot provide a service to distant areas or establish community based health programmes. However, if the technological skills and materials are supplied to help communities build their own wells and maintain them and to understand the importance of clean water, there will be a much greater improvement in health than by building any number of hospitals and centres of excellence!

In order to bring health care to those who now have no access to it, the World Health Organisation, government and international agencies have increasingly emphasised the development of primary health care programmes and on developing appropriate technologies for health.

The Solution: Appropriate Technology?

What is 'appropriate technology'? A technology is appropriate if it effectively does its job in the circumstance where it is used. The concept of appropriate technology developed from that of 'intermediate technology' developed by Dr E Schumacher.[4] Intermediate technology is defined in terms of its complexity relative to the high technology of the Western world and the simplest hand tools of less developed countries.

Appropriate technology may not be low technology, it may be quite sophisticated, depending on what it is to do and in what conditions. However, equipment that can be manufactured in the country where it will be used, is desirable from three points of view. Firstly, it will be cheaper than imported equipment; secondly, if equipment is manufactured locally, it means that the skills and materials to carry out repairs and maintenance will also be available. Thirdly, local manufacture will create employment.

Appropriate technology can only be defined as appropriate or inappropriate in terms of local conditions. An electric autoclave is appropriate where a regular and reliable power supply exists. It is inappropriate where the supply is irregular or the generator often breaks down.

However, there are some constant factors which have to be considered in designing and developing technologies for health care in developing countries.

1. Most developing countries have limited resources to spend on health care, and foreign currency in particular is scarce. For example, in the UK, public expenditure on health is US$204 per capita, in most developing countries it is less than US$5 per capita.[5] In such circumstances it is not realistic to design expensive equipment, however efficient, for use in rural clinics.

In a project in Chandigarh in India, neonatal tetanus has almost been eliminated. As a part of their training programme the traditional Birth attendants are issued with a simple kit including a razor, a piece of soap, a small bottle of disinfectant and some lint.

In a recent survey carried out by the Dental Health Service Unit of the Appropriate Health Resources and Technologies Action Group, it was found that in many countries the availability of even simple emergency treatment is limited more by a lack of basic hand instruments and drugs, than by a shortage of health personnel able to provide such care. Aid agencies often supply a dental unit, which generally includes a dental chair, light, drills, aspirator and spitoon which cost around £6000. For this amount of money you could supply 20 kits of basic instruments as well as drugs and materials for one year, for a primary health care worker with training in dental emergency dental care.[5]

2. All situations are different, and no technology can be designed without familiarity with the conditions in which it will be used. Many health centres or even district hospitals do not have a regular electricity supply. So alternative power sources must be used. Solutions to this problem have ranged from a pedal powered centrifuge to solar powered refrigerators. If the roads are bad, or flooded for long periods of the year, mobile units will be useless. There may be no vehicles or little fuel, and so equipment which is to be taken to villages, must be able to be carried on a bicycle or by hand. Portable cold boxes to fit on the back of a bicycle have been developed in order to maintain the 'cold chain' for vaccines.

3. It must be robust to withstand difficult conditions. Fragile mobile units will be useless on rough roads. For example, a wheelchair or invalid tricycle must be able to go over rough, sandy or muddy terrain without getting stuck. Pneumatic tyres will puncture on thorny ground.

4. Repairs must not involve expensive imported spare parts. Taking again the example of the wheelchair, bicycle wheels are often used, because they are available in most countries, and so will the skills exist to mend them. Wheelchairs are often made from steel tubing. However, the construction demands accurate welding skills, and a wooden framed structure may be stronger and will certainly be easier to repair or adjust to suit the individual.

Conclusion

Designing equipment to meet the needs of health services in developing countries requires a fresh approach from designers and engineers.

There are already many good ideas in use in developing countries and it is on these designs that we must develop more appropriate technologies.

For success, the design and development of any equipment must be carried out in close collaboration with the health workers who will actually be using it.

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Footnote

The Appropriate Health Resources and Technologies Action Group (AHRTAG) developed out of the rural health panel of the Intermediate Technology Development Group. It was set up in 1977 to look at ways of providing health care which offer alternatives to high cost credited practice. Primary Health Care programmes need the support of appropriate technologies, and the Group aims to look into effective and affordable technologies, equipment, health education and training for them. Current project areas include diarrhoeal diseases, disability prevention and rehabilitation and dental health.

AHRTAG is a collaborating centre for the World Health Organisation and a registered Charity.

For further information write to AHRTAG, 85 Marylebone High Street, LONDON W1M 3DE. Telephone 01-486 4175.

An account of the Middle Management 'Keele' Course held at the Hospital Engineering Training Centre at Falfield in 1981.

Mr Bray lectures in the Environmental Department at the Hospital Estate Management and Engineering Centre, Falfield and has served as a course tutor for a number of years on the Keele Management courses.

The Diary of a Course Tutor

Developing the Management Effectiveness of Works Staff

DAVID BRAY

Dear Diary,

Saturday

'It' is with us again. The course that is fundamentally different from all the others run at Falfield.

Constructed around a membership of sixty it is the only course to run this week, served by all the 'hotel' facilities of the Centre.

It is not a technical course, but one which deals with the skills required by the works staff when dealing with people, assessing priorities, making the 'best' decision and describes these topics as the 'Intangibles of Man Management', but behind the locked *door of the Tutors Retreat (a room set* aside for the restoration of spirits) they become 'the ability to let *somebody else* have *your* own way!'

To acquire these skills, each of our course members must have the opportunity to participate in the exercises which are set as part of each session, and also in the running of the course. To this end, the course is divided into six groups indentified by the colours Blue, Brown, Gold, Green, Purple and Red. Each group is supervised by a tutor who is a guide and mentor, and who has to be able to 'step back' to allow the group discussion to occur. This proves to be very difficult sometimes, but it is essential if the groups are to learn from the experience.

The tutors pre-course briefing started at 2.30p.m. on the Saturday with Maurice Burke in the chair. In attendance were:-

John Clark, Course Director
Jim Gough, Deputy Course Director and Brown Group Tutor
George Stephens, Gold Group Tutor.
Jim Parker, Purple Group Tutor.
Frank Williams, Red Group Tutor.
Duncan Macmillan
Tommy Thomas, Green Group Tutors.
Harry Pethen, Centre Administrator
To me, the honour — Blue Group Tutor.

All the detailed preparation had been completed following management team discussions. Everyone knew the format and objectives of each of the course sessions and used the meeting to plan and practice tactics.

The team members expect nothing from the course members that they are not prepared to give themselves, the session briefs alone provide ample evidence of that fact.

It would appear to anyone not familiar with our meetings that the only sound we hear is the studious scratching of pens and the occasional learned comment. In addition to working as a team, we also play as a team (often at the same time) and the meetings are thoroughly enjoyed by all who attend. Today's efforts were concluded this evening with dummy runs through the projects.

Sunday

This morning the meeting was adjourned to the Northcroft Hall and our group rooms so that we could complete our physical preparations.

I wondered, laying out the materials provided for the production of visual aids, whether this course would also produce an 'artist' whose contribution to a group presentation *would have such a visual impact that* it would create a lasting impression.

After lunch the course began for us with the arrival of the first course members. I enjoy discussing the aims of the course with the assembling course members, searching for the familiar faces of those who have attended technical courses at the Centre, indentifying the members of my group.

The formal opening session provided for the sixty or so course members an introduction to the course, by the Chairman, Maurice Burke, a welcome to Falfield from the Principal, Mr J Barnes, and an introduction to the tutors, by John Clarke all in thirty minutes.

It demonstrated that the week would not be a rest cure for jaded works staff and that time would be of the essence throughout.

The initial group meeting went well. It is amazing how quickly the human animal adapts to new situations. Here are a group of nine individuals, strangers to each other and to me, who after a few brief introductions prepare to work together as a team and also to volunteer for the initial tasks which the group are required to perform for the whole course.

And so to bed for all except the two groups charged with the responsibility of stage managing the first of the three assignments — the Monday evening entertainment.

Monday

Lesson for today — the benefits of team work, when applied to the decision making process, are wasted if the results of the discussion and the solution to the problem cannot be presented effectively.

First the plenary session, when the techniques of effective presentation were discussed, and then group exercises providing an opportunity to practice the verbal and visual skills.

The exercise was of interest to the observer in the group room, in that the group had 3 distinct problems to solve:-

1. How to work as a team, without everyone pulling in different directions at the same time.
2. How to apply to the exercise the skills available to the team and arrive at a satisfactory solution.
3. How to present the solution to the rest of the course.

During this first exercise, a disproportionate amount of time was spent solving the first problem, with the result that insufficient time was available for problems 2 and 3.

It was a valuable lesson however, because the mistake was not repeated in the two subsequent exercises today, all the effort being directed towards the decision making process and the presentation of the solution.

During the final session this afternoon we were briefed by course members' Organising Committee on the finer details of the after dinner entertainment.

This would be "The Falfield Factor" (based upon the television series *The Krypton Factor*, and would take the form of a series of inter-group competitions, the winning group being presented with the 1974 Keele Challenge Cup.

After a taxing first day, this was welcomed by all as an opportunity for light-hearted participation. It did not however prepare us for the reality of Mr Barnes, who had adopted his "Mr Hyde" aspect. Could this be the same man who had welcomed the course to Falfield yesterday? Bow tie, lapel microphone, clip board loaded with questions, professional presentation and devastating arsenal of audio and visual effects. I felt the contribution made to the score by Duncan Macmillan and myself was particularly valuable, but we were subject to occasional abuse by the M.C.

I was pleased that Blue Group, as part of the Organising Committee, was not represented in the winners enclosure. Unfortunately, our co-organising group, Green, did not appear to have played to the same set of rules, and the trophy was presented to their Captain.

The competition was followed by a barbeque on the lawn in front of the Main House. This provided an opportunity for relaxation, with a hamburger in one hand and a pint glass in the other, and was a particularly successful means of completing the inter-group introductions started by 'The Falfield Factor'.

The efforts of the catering staff, led by Sheila Forsythe, as they braved the smoke and flames of the pit, were much appreciated.

Tuesday

A general heading of 'Industrial Relations' was used for the sessions today. It covered a varied collection of topics assembled by Mr. Body, a Superintending Works Officer with the DHSS, such as industrial legislation and tribunals, grievance procedures, disciplinary procedures, counselling interviews, case studies and human relationships with comment from management, personnel and trade union viewpoints. A comprehensive package! The union viewpoint, and a partisan one at that, was put with great vigour by Alan Black of UCATT. A very effective foil was provided by Patricia Voaden, the Principal Employment Officer of the South Western RHA, who put the case for management with style.

The groups had to use role-playing techniques to solve the exercise problems. A good manager must be objective, seeking the best decision for the service (the patient) and not just for the professional department. It is essential to be able to examine a problem from the viewpoint of each of the interested parties. A difficult technique perhaps, mastered only by those who make the effort to communicate with all disciplines, and at all levels within the service. Good managers do do it!

Having reached a decision, the groups were able to verify their conclusions by discussion with our guest speakers, who visited the rooms to observe and, when invited, participate.

The video recordings of the disciplinary interview and the Industrial Tribunal were valuable examples of typical situations, and highlighted the need to act in a reasonable manner at all times and obey the *rules!*

The two showings fo the film *Get off your a____!* were separated by group discussions. This really is a good film for highlighting the skills needed by a good manager of people as was confirmed by the groups comments.

After dinner; a free discussion evening. The groups were free to discuss all the things that have been arranged for them to do. The tour of the centre's laboratories proved of particular interest to the 'builders', now that works orientated courses are available. The optional public speaking tuition in the Hall is being well attended.

Wednesday

Interactive Skills — more role-playing exercises, but with a difference. The group appointed an interviewer and an interviewee, who were then separately briefed on their roles, and they conducted the interview with the rest of the group observing the discussion.

This was when the 'actors' came to the fore, elaborating on the background detail almost to the point of tears. Also, the 'strong' personality, who ignored the brief given to him by the group, and was then brought to heel at the end of the interview.

During the plenary discussion directed by Dr. Murray, an Assistant Chief Engineer with the DHSS, the value of the session was highlighted by the number of 'learning points' which had been identified.

The Project

Problem: How to ensure that each course member has an opportunity to practice all the techniques which have been taught.

Solution:

Form each group into a Management Team. Each group member has a role to play, such that the team will represent the views of a range of hospital disciplines.

2. Identify a number of problems, not necessarily works orientated, which are currently being experienced by a large local district general hospital.
3. Transport the group to the Hospital, where the team investigates the problems from the viewpoint of the various disciplines.
4. Direct part of the group to prepare a report.
5. Arrange for the rest of the group to meet formally to discuss the report and reach a concensus decision.
6. Report upon the problem, the solution and the decision making process to the course.

After lunch the course was transported to the Gloucestershire Royal Hospital where we were welcomed and then afforded a structured tour of the site. Since one of the problems concerned Staff Social Facilities, our team felt that the appearance of a nursing sister carrying a tennis racquet might have been a 'fix'.

By the end of the afternoon we had reached 3.

This evening — The Debate. The chamber was laid out in the main lounge with a raised platform for the Speakers and the Chairman, John Clark. John was firm in his control of the debate, but his humourous guidance was such that everyone entered into the spirit of the occasion, with speakers being exposed to a mild amount of good natured barracking — just like the Commons, only more restrained! The two Guest Speakers Mr C Davies and Mr R Body with their seconders and supporting speakers had done an excellent job in marshalling their arguments, the final vote resulting in a narrow defeat for the motion "That this House considers that the present trend in education results in a lowering of standards". All good experience to temper the manager's spirit and perhaps good news for all involved with Falfield courses.

After the debate, more public speaking tuition and burning of midnight oil by working parties preparing reports for tomorrow.

Thursday

Today was the climax of the week's endeavours. The information so carefully gathered yesterday had been compiled into reports. All round the Hall, groups of people could be seen surrounding gesticulating tutors who were advocating the joys of becoming Community Physicians or Finance Officers.

At 10.15, a silence fell as six District Management Teams were called to order to consider a full agenda, the final item of which was a report on the Gloucestershire Royal Hospital problem. It was a great success. The most important feature of the exercise was the way in which the various members of the group interacted. It was clear from this afternoon's reporting session that the group members had been able to use many of the skills which they had been taught, and to appreciate how valuable they would be back in the work place. The quality of the presentations was very high, the techniques having been practised throughout the week.

To round off the day — the Course Dinner. The meals this week have been of a consistently high quality, but tonight the catering staff excelled themselves. If that were not enough, we were treated to some very erudite speeches by men able to comment upon both the course and the NHS with authority, and define the contribution we can make to the latter as the result of the former. Short speeches were also made by two course members, and a warm glow could be detected emanating from the tutors who could see their sows ears of the previous Sunday perform like the most silken of purses.

After dinner, sitting in the lounge with my group, I savoured the tremendous changes which had occurred since Sunday. They were very relaxed, but that was to be expected, after such a dinner and knowing that they had successfully completed their final tasks. I was most impressed by the feeling of confidence. Knowing now what they must do to manage effectively, they were looking forward to applying the techniques. Emotionally, they were off to change the world.

Friday

This mornings, last night's guests had to 'sing for their supper' during a wide ranging discussion on their personal experiences in Management. The different approaches adopted in industry and the NHS to resolve similar problems, eg Consensus vs. Authoritarian decision making, were of particular interest to the audience during question time.

The final group meeting is always a sad occasion. The group completed formal assessments of the course, a written confirmation of many of the recorded comments from the social encounter yesterday evening.

After lunch — the anticlimax. All have left for home, the exciting hustle and bustle of the course replaced by quiet personal relections on the week.

PS March 1982

This week, two course members have returned to Falfield, and have been greeted like long lost friends. Their lasting impressions of the course are fond memories of the team spirit and friendship of the group, confidence, based upon their improved ability to tackles routine management tasks, and the number of techniques available to them when unusual problems are encountered. Finally, the knowledge that, irrespective of individual discipline, the new District Works Departments will need professional managers, the common requirement being the skills and techniques identified and practised on the course.

The 1982 Courses

The programmes for both of the 1982 courses will retain the same basic character as previous courses. The course content will be amended and updated, which is normally a continuing process, but even more important this year, because of the effect that reorganisation will have on Management generally, and on Works Staff in particular.

The course programmes will be structured round such subjects as Communications; Organisation; Administration; Reporting; Verbal Skills; Team Work; Industrial Relations; Presentation; Behaviour Problems and Patterns; Leadership; Decision Making.

In addition, exercises and projects in which these managerial skills can be practised and developed will be included. In connection with this, ability to tackle routine manage-considerable emphasis will be placed on the intangible aspects of management, where interactive skill and politics are required.

The advanced course is aimed at a senior level of staff, whose experience is usually much broader than that of the target population of the middle course. Consequently, while many of the titles of the sessions appear similar, the standard of the exercises and discussions are adjusted accordingly, and a conscious effort is made to widen the difference in standard between the two courses.

The inclusion of members from all disciplines in the Works Organisation is now well established and is of considerable importance, in that Engineers, Architects, Surveyors, etc., can mix and learn about their common problems for each other.

Broadly speaking the courses are split into the following two categories:-

Middle Management Course — K13. 11th to 16th July

Senior Engineers and Senior Building Officers

Engineers and Building Officers

RHA Works Staff up to and including TA1

Foremen with potential for promotion

Senior Management Course — K14. *17th to 22nd October*

Senior RHA Works Staff

District Works Officers

Works Staff above Senior Engineer and Building Officer

Professional Staff of Consultants

Tutors for 1982

The tutors for the two courses for 1982 will be drawn from the following:-

J M Gough, Sandwell DHA
D Macmillan, Trafford DHA
B E Thomas, East Anglian RHA
W Nicholas, Suffolk DHA
J A Parker, Norfolk DHA
G E S Stephens, Falfield
F J Williams, Coventry DHA
D J Bray, Falfield

Course Directors:- John K Clark and Maurice J Burke.

Course Fees for 1982

The course fee for members within the National Health Service in England and Wales is £120, which includes meals & accommodation. For all others, including staff of consultants, the cost is £240, inclusive.

Nominations and enquiries should be made to the Principal, Hospital Estate Management and Engineering Centre, Eastwood Park, Falfield, Wooton-under-Edge, Gloucestershire, GL12 8DA. Tel: Falfield (0454(26027.

Product News

Inner London Community Psychiatric Hospital launched

Work started in April on a brand new £3 million hospital unit for mentally ill people in London's inner city.

The new unit — which will provide 60 in-patient beds and an 80 place day hospital for psychiatric patients, as well as 56 beds and 40 day places for elderly confused patients — will form part of St Charles Hospital, Exmoor Street, North Kensington. There will also be out-patient clinics for all types of patients.

Dame Betty Paterson, Chairman of the North West Thames Regional Health Authority, cut the first sod on the site on Thursday, April 15th.

The psychiatric unit will be linked with another new unit at St Mary's Hospital, Paddington, which is already under construction, to provide the Paddington and North Kensington Health Authority with a comprehensive service for mentally ill patients within its own district boundaries.

This will mean there will be no further need to send patients to distant hospitals like Springfield in Tooting and Horton in Surrey. Patients will be cared for in their own local community hospital — conveniently placed for relatives and friends to visit them.

The design of the new unit at St Charles aims as far as possible to get away from the typical hospital environment — beds will be ordinary divans instead of hospital beds, for example — so that the patients who need to spend some time there will feel comfortable and relaxed about their treatment.

Teaching of medical students will take place at both St Charles and St Mary's, under the aegis of the St Mary's Hospital Medical School.

The construction contract has been let by the North West Thames Regional Health Authority to the firm of French Kier Ltd in the approximate sum of £3.2 million. Fees and equipment are estimated to cost a further £1 million. Architects for the scheme are the Maidment & Brady Partnership. Work started on site on Monday, April 19 and the contract period is 2½ years. The unit should be operating early in 1985.

Mobile Workcentre

Earl (Barton) Engineering Services Ltd., of Northampton, announce that they are now sole agents for a functional workcentre which is a new concept in mobile workshop facilities. By providing tool storage space, a working surface which can double as a seat or step, and easy transportation, the workcentre is extremely practical and can result in considerable savings in time and energy.

Storage capacity is more than adequate for the varied equipment required by skilled personnel away from their workshop or home base. The compartment is large enough to take large items such as electric drills, extension leads and wrenches. For smaller tools, drill bits, taps etc., there are five compartments on rigid pivots. All compartments are lined with a ribbed rubber, providing a non-slip surface. The same material is used on the 13 × 24 ins. top.

In the open position the top is clipped to the handle giving a firm working area. Stability is ensured by extensions to the handle which raise two of the four wheels off the ground. With the top down, the workcentre can be used for sitting or standing on.

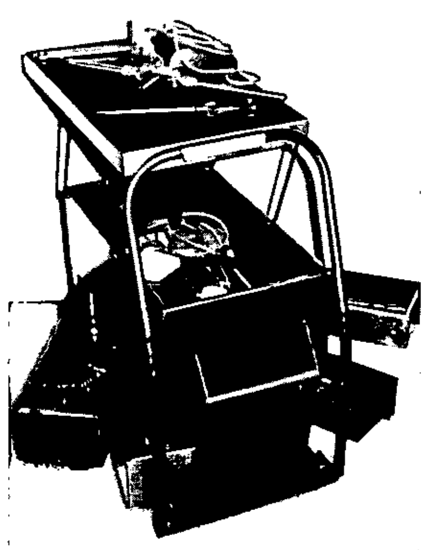
Low friction nylon bearing wheels allow the unit to be moved easily about using the main handle. Substantial lifting handles are also provided at each end so that the workcentre can be lifted in or out of a vehicle.

Security of the contents is taken care of by a central locking facility which can hold the handle down and prevent access to all compartments. The owner or user can fit a propriety lock or padlock according to requirements.

Closed dimensions of the unit are 14½ ins. wide × 25 ins. long × 20½ ins. high. Construction is from 14 swg mild steel, welded, dressed and stove enamelled in textured blue resulting in both a rigid unit and an attractive appearance. Tota weight in 70 lbs and the unit is competitively priced at £85 plus VAT and carriage.

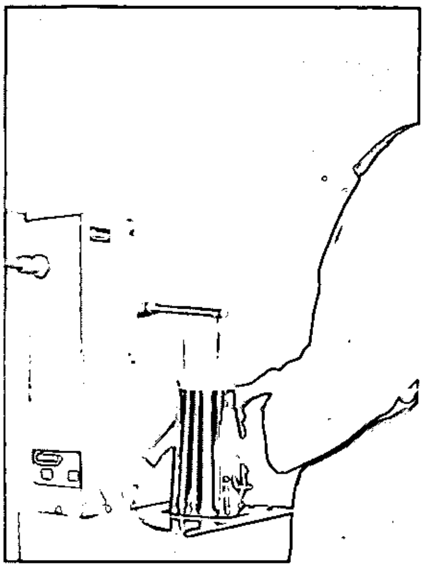
Further details from Graham Jones at Earl (Barton) Engineering Services Ltd., Titley Bawk Avenue Earls Barton, Northampton NN6 0LA. Tel: 0604 811277.

Earl (Barton) Engineering Services new workbench.



Calomax Push Button Boilers Chosen For Third World Installations

Efficiency, reliability in service and prompt delivery are given as reasons for the choice of a Calomax push button water boiler currently being installed in Mbeya Maternity Hospi tal, Tanzania. Other recent installations have included maternity units in Zimbabwe and Fiji.



The Calomax ESL electric water boilers installed by Interplan Hospital Projects, a Division of Charles F. Thackray Ltd, boil fresh water at the touch of a button, but use no power at all until the water is required, making valuable fuel savings. Only fresh boiling water can be delivered by these compact units, an essential feature for bacteria free water needed in the preparation of baby milk.

Charles F. Thackray has used Calomax boilers in installations, throughout the world for the past 15 years and the introduction of electrically operated models has widened the possibilities of inclusion in many more situations where really fresh boiling water is required for the production of hot beverages and other uses.

Calomax (Engineers) Ltd of Leeds supply two sizes of instant fresh water boilers to meet all capacity requirements in both electric and steam operated versions. The units are slim-line and the larger sizes occupy less than $^3/_4$ ft^2 of work surface.

Further information from Calomax (Engineers) Limited, Lupton Avenue, Leeds LS9 7DD, Yorkshire. Tel: Leeds (0532) 496681.

The Watt Committee on Energy Report No. 11

The European Energy Scene
ISSN 0141-9676

Papers presented at the Tenth Consultative Council of the Watt Committee on Energy, London 21st May 1981.

The European nations adopt different approaches to the problems of energy supply for various reasons, including the differences in their resources compared with those of the U.K. These are the subject of papers by authors from five member nations of the European Community, including the U.K.; following their original presentation at a Watt Committee meeting, these papers are published as *Watt Committee on Energy Report No. 11* with a report of discussion and an Appendix.

Contents

D. le B. Jones: *The energy scene in the United Kingdom;*
G. W. van Stein Callenfels and E. F. Bunge: *The energy situation in the Netherlands;*
J. de Pemille: *Energy and the steel industry in France: present situation and future prospects;*
G. Meurin: *German experience of the oil price crises;*
H. Larsen: *Danish energy planning after 1973 and its implementation;*
Discussion
Appendix: A. Cluer: *Energy intensity in the European scene;*

April 1982. vi + 54 pages, illustrated.

Postage and packing charges: U.K., free; Europe, £1.80 per copy; rest of world, £4.00 per copy (airspeeded), £1.80 (surface mail).

Cheques should be made payable to The Watt Committee on Energy Ltd, and sent to 75 Knightsbridge, London, SW1X 7RB.

Cost Effective Energy Control Brochure

Holec Energy of Station Road, Horsham, West Sussex has published a 16-page, illustrated colour brochure describing its latest generation of microprocessor-based energy management systems for buildings.

Using distributed microprocessors and advanced control techniques to eliminate energy wastage in building heating, ventilating and lighting, the Holec Energy system claims to save up to 30% on fuel bills and will normally pay for itself in only one to two years. It can be applied to the majority of buildings including factories, office blocks, schools, hospitals, recreation centres and multiple buildings of all types.

Particular emphasis has been placed on making the system simple to understand and easy to use, so that it can be operated without specialised skills and with a minimum of training. Operator interaction is in clear, English language statements and easy to read graphic displays are used extensively.

The Holec system uses equipment of modular design, features two levels of distributed control and employs standard software packages which can have extra routines written in to suit individual requirements. Consequently, installations can be tailored to the exact size and cost needs of a customer. System expansion is also easily achieved.

Control is implemented by the recognised method of employing autonomous distributed controllers which can be linked back to a central supervisory computer. However, by using low cost, self-powered interface units which can be located at some distance from their controllers a second level of distribution is achieved and installation costs can be significantly reduced.

Further information from: Rea Publicity Limited, Broadmead House, Hassocks, West Sussex. BN6 8AN. Tel: Hassocks (079 18) 5641.

Automatic Condensate Elevator

The A.C.E. type Compact Automatic Condensate Pump and Receiver Unit has the special feature of a low profile cast iron receiver with two inspection covers. Vertically mounted electrically operated pump/s with discharge capacities up to 1,350 g.p.h. (6,317 litres per hour) at 93 degrees C. (200 degrees F.) depending upon discharge head. The Units are complétly pre-wired, with magnetic float switch, contactor starter and isolator.

The A.C.E. Unit is available in two sizes, No. 101 & 202, either as duplex or single model, with $^1/_2$ H.P. motor at 2,800 r.p.m. on the No. 101 size and 2 H.P. at 2,800 r.p.m. on the No. 202 size, for 3 phase electrical supply.

Contact: Calenge-Watkins Ltd., 97 Harrington Road, Stockwood, Bristol, BS14 8JP. Tel: 0272 836717.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

Argyll and Clyde Health Board

SECTOR ENGINEER

Paisley District General Hospital

A suitably qualified and experienced Engineer is required to initially form part of the Commissioning Team for the above hospital due to be completed in 1985 and commissioned in 1986. Once commissioning is completed the person appointed will be assimilated into the local Management Team or into another management post within the Board on a similar grade.

Qualifications

Applicants must, at a minimum, be qualified in accordance with Whitley Council PTB requirements, ie HNC in Electrical Engineering with endorsements in Mechanical Engineering, Applied Heat and Mechanics, and Business Administration, or, HNC in Mechanical Engineering with endorsements in Electricity and Business Administration. The holding of Higher qualifications would be an advantage, preferably those leading towards a professional qualification.

Experience

Applicants must have wide experience of all aspects of hospital engineering and management preferably in large general hospitals. Applicants should have experience of commissioning and contract procedures and the operation and maintenance of HV electricity distribution and coal combustion systems.

Salary scale — £7963–£9429.

Application forms and job description may be obtained from the Area Personnel Officer, Argyll and Clyde Health Board, Gilmour House, Gilmour Street, Paisley PA1 1DU, Tel: 041-887 0131, Ext. 215 to whom completed applications should be returned not later than 23 June, 1982.

BLOOMSBURY HEALTH AUTHORITY

The Middlesex Hospital London W1

PLANNER MANAGER

Salary: £8000 – £9000 inclusive plus 15% maximum allowance.

Responsible for the control of four Planner Estimators recruited to work on a recently introduced Incentive Bonus Scheme for works staff at The Middlesex Hospital in Central London.

The Planner Manager should have had considerable experience in the operation of and estimating for works staff Incentive Bonus Schemes.

Consideration will be given however to existing Senior Works Officers who can demonstrate a sound knowledge of preventive planned maintenance and an appreciation of the skills involved in carrying out these works. Suitable training for these candidates will be arranged after appointment.

Candidates should hold an appropriate works measurement qualification or in the case of Works Officers an HNC.

Application forms from: Henry Stanley, District Building Officer, The Middlesex Hospital, Mortimer Street, London W1N 8AA. Tel: 01-580 6559.

Engineer

Salary Scale: £6583–£7425 per annum.

New Entrance to the National Health Service, normally commence on the minimum of the scale. An incentive bonus scheme payment may be made.

You will be based initially at the West Kent General Hospital and will assist a more Senior Engineer in the maintenance and operation of all engineering plant equipment and services.

Applicants must have completed an engineering apprenticeship and possess an ONC in engineering or an equivalent qualification.

Application form and job descriptions obtainable from the District Personnel Office, 103 Tonbridge Road, Maidstone, Kent. Telephone Maidstone 56676. Ext: 33.

Closing date – 19 July, 1982.

The above post is open equally to both men and women.

Maidstone HEALTH AUTHORITY

Whether your telephone system needs 1 more line or 999...

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We've recently been fully approved by British Telecom to engineer, supply and install PABX 3 and 4 equipment, for connection to it's national network.

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Norton Telecommunications Limited
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