AFRC CE USERS CROUP MEETINC
INSTITUTE OF HORTICULTURAL RESEARCH
NVRS WELLESBOURNE 2 OCTOBER 1986

PROGRAMME

10 00	Coffee
10 30	Welcome by Professor Bleasdale
10 35	"Phytotoxicity in glasshouses" Dr R C Hardwick
10 55	"Introduction to MVRS computerised glasshouse control system Mr C L Dudley
11 15	Users Croup Discussion. Chairman: Dr C C Hole
12 35	Lunch
13 45	Continuation of discussion -if necessary
14 00	Tour of facilities Controlled Environment Insect Rearing Glasshouses
15 30	Tea and informal discussion

AGENDA

1. Approval of minutes of 1985 meeting
2. Matters arising
3. Management, staffing, running costs
4. Maintenance, servicing, spares
5. New CE facilities (JI)
6. Energy management/reclamation
7. Control systems
8. Sensors, instrumentation and monitoring
9. Lighting
10. Plant growth problems
11. Any other business
12. Date and location of next meeting

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AFRC CE USERS GROUP MEETING,1986 AT THE INSTITUTE OF HORTICULTURAL RESEARCH, WELLESBOURNE LIST OF PARTICIPANTS.

G.FRANKLAND	AFRC HQ
H.G.JONES	AFRC HQ
J.W.HINE	AGRI
B.A.WILLIAMS	AGRI
P. C.LONGDEN	BROOM'S BARN
S.H.CROTHERS	DEPT AGRICULTURE, NORTHERN IRELAND
J. WEIR	ELECTRICITY COUNCIL
G.E.WILSON	IFR BRISTOL
R.ABRAHAMS	IHR LITTLEHAMPTON
R. COX	IHR LITTLEHAMPTON
R.RANDALL	IHR LITTLEHAMPTON
J.ROSS	IHR LITTLEHAMPTON
J.L.BREWSTER	IHR WELLESBOURNE
G.E.CROWHURST	IHR WELLESBOURNE
C.L.DUDLEY	IHR WELLESBOURNE
R.C.HARDWICK	IHR WELLESBOURNE
C.C.HOLE	IHR WELLESBOURNE
B.LANCASHIRE	IHR WELLESBOURNE
A.MORGAN	IHR WELLESBOURNE
J.R.ALDOUS	JII
D.M.HARVEY	JII
R.H.HUGHES	LARS
P.R.TURNER	LARS
P.TATHAM	MAFF HARPENDEN
I.PEARMAN	RES
P.BROWN	UNIVERSITY OF BIRMINGHAM
L.INCOLL (+2 COLLEAGUES)	UNIVERSITY OF LEEDS
K.R.BAMBRIDGE	UNIVERSITY OF NOTTINGHAM
S.J.STOCKLEY *	UNIVERSITY OF NOTTINGHAM
D.DICKINSON	UNIVERSITY OF READING
D.EDWARDS	UNIVERSITY OF WALES ABERYSTWYTH
C.F.EAGLES	WPBS
B.WILSON	WYE COLLEGE

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MINUTES OF THE 1986 MEETING OF THE AFRC CE USERS GROUP

A meeting of the AFRC CE Users Group was held on Thursday 2 October, 1986 at the Institute of Horticultural Research, Wellesbourne (formerly the National Vegetable Research Station).

Chairman : C.C. Hole

1. Minutes of the last meeting.
   The minutes of the 1985 meeting at the John Innes Institute were approved with the comment from D. Harvey (JII) that, with reference to item 8 concerning cases of temporary closure of facilities as a result of local economies, there was no AFRC policy regarding this but stations affected should still contact AFRC HQ as stated.

2. Matters arising.
   There were no matters arising from the minutes.

3. Management, staffing and running costs.
   C.Hole (IHR Wellesbourne) reported running costs of £5 and £10 per unit per day respectively for Saxcil cabinets and growth rooms at Wellesbourne. These were considerably different from previously reported estimates of other stations. In reply to a query, it was confirmed that these estimates included both running costs and staff salary overheads. R.Randall (IHR Littlehampton) stressed the future importance of such estimates in relation to a likely increase in the proportion of private contract work.
   J.Weir (Electricity Council) inquired whether anyone had examined daily demand profiles of their facilities. It appeared that no-one had, but I. Pearman (RES) said that they were about to begin an energy survey of their establishment, because consumption was very high (c. 2 million units per annum). At present they were attempting to save some 15% by not running some CE units. S.Crothers (Department of Agriculture. NI) was reducing costs by running on the cheaper night tarriff where possible. It was pointed out by J.Weir (Electricity Council) that in addition to using the cheaper night tarrif, costs could be cut by understanding the demand profile and thus reducing peak loads . In response to a question from P.Longden (Broom's Barn), he confirmed that it was often more cost effective to trim the peak demand than to reduce the number of units consumed. B.Wilson (Wye College) noted that charges resulting from peak demand were usually higher during the winter months.

4. Maintenance, servicing and spares.
   R.Randall (IHR Littlehampton) reported that they and JII were having problems obtaining spare parts and support from Weiss for microprocessor controls. He suggested that it may become necessary to request AFRC to exert some pressure on the manufacturers, particularly in respect of future contracts.
   R.Cox (IHR Littlehampton) had experienced problems with the Melinex covering on the Weiss cabinets, which was turning black or grey under conditions of high humidity and temperature. He thought this may have resulted from a reaction between the aluminium in the sheet and the metal cabinet wall, but had not been able to reproduce these symptoms

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outside the cabinet. D.Harvey (JII) had encountered similar symptoms with some sheets of the material. The problem at IHR Littlehampton was sufficiently bad to require the recovering of the whole cabinet. D.Dickinson (Reading University) advised that this could be facilitated by putting soap solution on the adhesive surface before hanging. L.Incoll (Leeds University) asked whether the reaction was with the adhesive, plastic or aluminium layer and suggested that it should be possible to have the grey product analysed.
B.Williams (AGRI) has fitted Nobel units to all of his Saxcils and therefore has a large stock of Duotronic controls and variac spares available. Since the report last year of fires in Saxcil lamp wiring looms there had been further problems. R.Abrahams (IHR Littlehampton) reported a similar fire and B.Williams (AGRI) had detected overheating on plugs in their looms.

5. New facilities.
D.Harvey (JII) briefly summarised his written report on the performance of Weiss growth rooms. A copy of this report is circulated with these minutes.
R.Hardwick (IHR Wellesbourne) inquired how JII measured a temperature variation of +0.2°C. D.Harvey replied that this assessment of the temperature control performance of the rooms was done with JII and Weiss aspirated probe units. These were not the units which were used by the microprocessor control.
In all but one of the JII rooms, humidity control was achieved by wet and dry bulb psychrometry. The room designed to provide very low temperatures used a 'Vaisala'-type humidity sensor which appeared to have operated as well as the psychrometers. However, there had been many control problems with this room and JII were uncertain whether these had arisen from sensor or microprocessor shortcomings.

6. Energy management/reclamation
It was reported by D.Harvey (JII) that the heat reclamation system associated with the JII CE facility had supplied four glasshouses with heating at a saving of £4,500 p.a.. P.Longden (Broom's Barn) asked what was the capital investment required to achieve this. J.Aldous (JII) replied that this was difficult to specify because it was an integral part of a larger scheme and that there were many variables which were subject to change after the initial cost/benefit exercise.
In reply to a question by P.Longden (Broom's Barn) on the availability of grants for energy management systems. R.Hardwick {IHR Wellesbourne) said that the Department of Environment would give up to 25% of the capital cost if the system was novel and one was prepared to open it up to visitors.
As a result of a question from R.Cox (IHR Littlehampton), it transpired that, JII apart, only IHR Wellesbourne and AGRI were attempting to reclaim energy losses. Waste heat from cabinets was used by the former to heat an adjacent laboratory and the latter to heat a potting shed. D.Dickinson (Reading University) warned that in schemes such as this which relied on fans to move warm air, one needed to be careful about the use of the destination room since fan noise and dust could create problems.
C.Hole (IHR Wellesbourne) asked if anyone had recently compared the relative costs of producing distilled and deionised water. No response

was forthcoming.

7. Control systems
J.Ross (IHR Littlehampton) reported that the Stonefield control system on their Saxcils occasionally resets itself spontaneously.
C.Hole (IHR Wellesbourne) reported that the Apple based monitoring system used at Wellesbourne now incorporated control of day/night switching of lamps and temperature regimes. It ran in parallel with the electromechanical clocks which acted as a back-up.

8. Sensors, instrumentation and monitoring
IHR Littlehampton are disatisfied with the accuracy of calibration of sensors. R.Abrahams said that they were hoping to buy some good equipment to enable assessment to 0.04% accuracy and it was indicated by R.Randall that initially they hoped to be able to offer a calibration service to the Institute of Horticultural Research.
R. Hardwick (IHR Wellesbourne) agreed that it was important to have a reliable means of estimating accuracy and informed the meeting that an error analysis of Wellesbourne's system had been done by D.Andrews (Lab Practice, August 1985, p67) and that accuracy was traceable to NPL standard through the use of a certificated thermometer.
L.Incoll (Leeds University) asked if anyone was using the "tumble-dryer" type of humidity sensor. IHR Littlehampton had built some units incorporating these, at a cost of about £50. Experience with similar equipment built at IHR Wellesbourne was that they operated satisfactorily indoors within a limited temperature range.
H.Jones (representing AFRC HQ) commented that they did not work outside (e.g. in orchards) because they became damaged by high humidities and condensation at night.

9. Lighting.
It appeared, as a result of an inquiry by J.Weir (Electricity Council) that high output fluorescent tubes were being used only by Wye "College. However, a number of sites had incorporated the "slimline" (25mm dia.) tubes. PEL Reading had replaced tubes, starters and chokes on one Saxcil cabinet and AGRI were trying out the tubes only. IHR Wellesbourne had also examined the replacement of tubes only and had modified a Saxcil cabinet to take a single bank of 51 "slimline" tubes. B.Willams said that this had been tried at AGRI but light output appeared to decline rather quickly.
D. Harvey (JII) had found that the metal halide lamps in the JII Weiss growth rooms had shown only small changes in spectral composition with time, but thought that there may be differences between individual lamps. This was confirmed by J.Weir (Electricity Council) as likely to be the main source of concern. Light output from these lamps was thought by D.Harvey to be fairly stable, declining some 30% in three years.
On the topic of lamp life, L.Incoll (Leeds University) inquired how often users changed their lamps. At IHR Littlehampton lamps were changed at 5000 running hours. At LARS and IHR Wellesbourne replacement was at 7000 hours, with the former changing a third of their lamps at this time amd the latter estimating the time of change on a computer-based diary of individual lamps. L.Incoll commented that usage appeared to be based on time and not light output, to which

C.Hole (IHR Wellesbourne) replied that the age of replacement was taken from a light output versus time relationship. R.Cox (IHR Littlehampton) stated that they continually monitored their light output and J.Weir (Electricity Council) said that after an initial steep drop in output the reduction was about 15% between 200 and 7000 hours. Subsequently, output was lost more rapidly. B.Wilson (Wye College) commented that the Philips tri-phosphor high frequency lamps lost only 10% at 7000 hours. On the topic of high frequency lamps, the meeting was informed by J.Weir that any fluorescent tube could be run at high frequency, but the manufacturers had chosen to introduce this with the tri-phosphors.

10. Plant growth problems.
R.Cox (IHR Littlehampton) reported that tomato plants grown in Saxcil cabinets at 20 Wm-2 ("winter levels") and high humidities developed intumescence, characterised by a swelling of parenchyma cells and a yellow appearance. He thought it may be due to a deficiency of u.v. or far red light and experiments examining the effects of additional incandescent lighting at various humidities were being done. It was thought that the symptoms sounded somewhat like those of oedoema, which IHR Wellesbourne had observed on tomato plants grown at higher light intensities.
A talk by R.Hardwick (IHR Wellesbourne) on "Phytotoxicity in Glasshouses" emphasising the problems associated with the volatilisation of di-butyl phthallate (DBP) from plastics, generated some discussion. R.Randall (IHR Littlehampton) told the meeting that there were still plastics manufacturers who were not aware of the problems presented by DBP. D.Harvey (JII) asked what was the solubility of DBP in water and whether it was a problem in this phase. R.Hardwick replied that, although there were reports of effects of dissolved DBP on fish he had not found any convincing evidence of phytotoxic effects from aqueous DBP. In response to a number of questions R.Hardwick summarised that there was no need to ban plastics from glasshouses or CE since there were plenty of plastics available which did not contain DBP. If without apparent explanation plants stopped growing or died where previously they were normal and healthy, then one might suspect plastics. Manufacturers did not always know the exact formulation of their plastics, so the best check was to do a bioassay and if possible GLC of the surrounding air. It appeared there was little hope of the introduction of a British standard because of the increased costs involved.

11. Any other business.
Discussion here related primarily to lighting and has been recorded in 9.

12. Next meeting.
The meeting was pleased to accept the kind offer, subject to confirmation, from D.Dickinson of PEL, Reading University as the venue for 1987. The choice of a date during the last week in September or the first week of October was left for PEL to decide.

JII's new CE Facilities: Report presented at the AFRC CE Users Group meeting, NVRS, Wellesbourne OCT 2 1986

General points:

Commissioning trials of the eight new walk-in CE rooms, as manufactured by Weiss Technik Gmbh, were carried out in October 1985. Due to various problems that arose, final acceptance and completion of the contract with Weiss was delayed until January 1986.

The materials and engineering of the Weiss growth-rooms attained a high standard. However, during commissioning it was found that some of the growth-room performance specifications had not been met.

Once the various defects had been rectified most of the new g-rooms were found to be reliable and able to run for long periods giving reproducible environmental conditions.

Equally important was that growth studies using a range of plant species showed no evidence of toxic side effects on plant growth. Seemingly normal healthy plants were readily obtained.

Lighting:

Light intensity was found to be at least 30% less than the design level. This was despite the fact that Weiss had carried out their own calculations as to how the specification should be met. The shortfall was primarily due to the absence of suitable reflectors within the lamp plenum. Weiss have since supplied these.
The intended method for varying the light intensity by switching in or out multiples of six evenly spaced lamps was found to be satisfactory.

Uniformity of light was improved by the reflective Melinex coated walls, but a snag was that during commissioning at high temperature (plus high humidity) some patchy grey discolouration occurred on some sheets of Melinex. A similar reaction with Melinex has been previously reported by C.R.Holbourn (GCRI) as minuted at the 1984 meeting of the CE Users Group.

Temperature:

Control of temperature within the g-rooms was found to hold set point with greater precision than JII's original tolerance specification of 0.5'C.

Programmable temperature ramps (say between day and night set-point) also worked accurately.

Humidity:

The humidity is here regulated by saturating the air at a pre-determined dew point temperature that yields a known water vapour pressure deficit when that air is reheated to the growing condition temperature. Control and monitor of this process is by wet and dry-bulb platinum resitance probes. The method has proved to be accurate and reliable.

The wet-bulb wicks have required replacement after two or three months use despite the fact that these wicks are continuously irrigated with deionised water. Access to the wicks is badly designed, requiring the removal of benching and a rear pannel in the growing area. Also, the thin glass coating of these probes is too easily broken in servicing.

Air Flow:

The vertical air flow rate (at one meter from floor) varied by a factor of two depending on position in the room. This was traced to insufficient air baffle. Weiss have since provided additional perforated air-flow restrictor plates for mounting in the under floor ducts.

The monitoring of C02 confirmed that adequate air mixing occured. Air flow fans were remarkably quiet and efficient in opperation. The manual preselectors for air-speed and fresh air make-up (fmu) rate proved to be effective except that fmu varied according to the number of g-rooms on at any one time.

Microprocessor:

Each g-room has independant microprocessor control, namely a Weiss ZPGB5 unit. In the event of a power-cut the program memory is not lost, but when power is restored some units were found to go back to the beginning of their program and require a manually activated restart, while others would automatically carry on from where they had left off.
Weiss's explanation was that two versions of the ZPGS5 had been installed. In either case, the time of start-up always fixed the phase relationship between program time and actual time of day.

Neither version of the ZPG85 accorded with JII's original request for a system in which the clock would be unaffected by a power cut in order that the program could retain its original phase relationship.

Programming:

Many essential details on programming were unclear in Weiss's instruction booklet as supplied translated from the German version. If JII had not also received on-site instruction from Weiss, programming could not have proceeded as effectively as has been the case.

Preparation and entry of a program requires careful planning since any subsequent entry or deletion of just a single line means re-entering the entire program from the modified part onwards. This arises because the instruction set for each channel (one function per channel) has to be formatted in segments which in turn must be numerically consecutive both within and across channels.

As an aid to programming, the ZPG85 issues prompts which default to the next logical step required in the program, but this is not foolproof. The snag is that the prompts will echo the sequence relating to the previously held program. The segment no.s increment correctly by default but there is no indication when the channel no. needs to be incremented, the latter being manual input.

A further complication is that the main program has to be followed up with a separate initialisation program that defines the starting point status for each channel.

Breakdowns:

During commissioning many problems arose with equipment that had stood idle since the mid-1983 mothballing of the project.For example the hygroscpopic lithium chloride rotary drums of the chemical air-drier units as fitted to four of the g-rooms. All manufacturers guarantees had long since expired by the time commissioning started.

Several breakdowns have occured over the last ten months, Some brought the respective g-room out of action for some time (requiring the transfer of experiments to another g-room) though most breakdowns could be dealt with promptly and the room soon back in action.

The faults were briefly as fallows: one memory board failure; two NTX board failures! about eight relays (solid state and mechanical); three lamp switch gear; at least four floods; two rooms cut out on high temp alarm; one high temp alarm failed to activate.
Any breakdowns relating to central refrigeration plant are not recorded here but it is useful to note that the Mimic Board, intended for continuous monitoring of the entire installation, proved to be invaluable.

Heat recovery :

The waste heat recovered from the central refrigeration plant has successfully met the heating requirements of the four glass-houses currently connected to the system. This corresponds to a saving of about £4500 in gas consumption in a full year. Waste heat will also serve the recently completed laboratory suite adjacent to the growth-rooms.

D.M.Harvey 23 September 1986
John Innes Institute, Colney Lane, Norwich.