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PESTICIDES DEVELOPMENT PROGRAMME IN INDIA

DP/IND/80/037

INDIA

Technical report: Assistance in the installation, testing and operation of analytical instrumentation and electronic and microprocessor-controlled devices

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of S. Déri,
expert in instrumentation/electronic instruments

United Nations Industrial Development Organization
Vienna

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Explanatory notes

The monetary unit in India is the rupee (Re).

Besides the common abbreviations, symbols and terms, the following have been used in this report:

GC	gas chromatography
GLS	gas liquid chromotography
HIL	Hindustan Insecticides Limited
HPLC	high-pressure liquid chromatography.
IR	infrared
lm	lumen
PCB	printed circuit board

Mention of the names of firms and commercial products does not imply endorsement by the United Nations Industrial Development Organization (UNIDO) and the United Nations Development Programme (UNDP).

ABSTRACT

As part of the large-scale project "Pesticides Development Programme in India" (DP/IND/80/037) for which the United Nations Industrial Development Organization (UNIDO) is acting as executing agency for the United Nations Development Programme (UNDP), an expert in instrumentation and electronic equipment was fielded in September 1984 for a mission of four months.

The expert's duties according to his job description were to advise on specifications and to assist in the installation, testing and operation of analytical instrumentation, and in the adjustment and putting into operation of the electronic and microprocessor-controlled devices of the instrumentation laboratory.

The expert found that due to the fact that civil works for the laboratory buildings were behind schedule, most of the equipment had been stored on site for up to two years, which caused damages to the sensitive instruments and made manufacturer's guarantees useless. In some cases essential parts were missing or no manuals supplied with the equipment. Also, a number of apparatuses had been inadequately installed by the respective local agents. The expert therefore had to supervise repairs and do a great deal of trouble-shooting.

His main recommendations are summarized below:

(a) As the laboratory buildings are far from being satisfactory, because the sensitive instruments are exposed to moisture, dust, temperature fluctuation and vibration, that situation should be remedied by making certain modifications, such as the erection of partitions in the instrumentation laboratory, which are described in detail in the report. The design of the new laboratory building should be altered to ensure a suitable environment for the instruments;

(b) His recommendations regarding safety (electrical wiring, fume-hoods etc.) should be implemented without delay, as the present situation constitutes a health hazard;

(c) An Instrumentation Department should be established within the Research and Development Centre of the Hindustan Insecticides Limited;

(d) Contacts with the well-equipped laboratories of the University of New Delhi should be pursued to obtain advice and assistance for the smooth operation of the Centre's analytical laboratory.

CONTENTS

INTRODUCTION

The main objective of the project "Pesticides Development Programme in India" (DP/IND/80/037) for which the United Nations Industrial Development Organization (UNIDO) is acting as executing agency for the United Nations Development Programme (UNDP) is to assist in the expansion and improvement of the pesticides industry in India, or, more specifically, in the adaptation of appropriate and economic technologies for their production, especially of quality formulations.

To that end the project received different types of sophisticated instruments and equipment, mainly through UNIDO, which are placed in the Research and Development Centre of the Hindustan Insecticides Limited at Udyog Vihar, Gurgaon, near the New Delhi airport.

The second stage of project activities, as described in the project document, include the installation and commissioning of laboratory equipment and instruments in the laboratories and in the pilot plant, for which activities an expert in instrumentation and electronic equipment was fielded for a period of four months starting on 20 September 1984.

The expert's duties according to his job description (see annex I) were to advise on specifications and to assist in the installation, testing and operation of analytical instrumentation, and in the adjustment and putting into operation of the electronic and microprocessor-controlled devices of the instrumentation laboratory. The expert proceeded according to a work plan which is given in annex II.

The expert would like to make the following general observations, which are discussed in more detail in chapters I and II.

Premises

The premises of the Research and Development Centre of the Hindustan Insecticides Limited have been completed, except the building for the executives. The furniture for laboratories is partly installed, partly under construction.

There are several infrastructural problems which are troublesome: (a) the almost continuous shortage of electricity which practically paralyses normal work; (b) the ambient temperature which is too hot during the hot season and too cold (15°C) in winter; (c) the lack of protection against the effects of dust-storms for the laboratories, of fume-hoods although pesticides and their vapours are extremely poisonous, and of a special protection against rodents (rats) which can seriously damage the expensive instruments.

The electrical network inside the buildings is of poor quality and reliability. Almost all joints are loose, and the so-called safety earthing constitutes a danger for the staff and the instruments. The main switch board of the Centre contains only faulty breakers, and the laboratories do not have a main switch to cut off electricity in the case of emergency.

Instruments and equipment

An inventory list of the instruments and equipment supplied by UNIDO is given in annex III.

All the instruments and equipment, except the corrosion testing cabinet KS-300, were inspected from the point of view of installation, and most of them are now properly installed.

The stand-by generator has arrived on site and will be installed in the near future.

National staff

The organigram of the Research and Development Centre is shown in annex IV. M. Lal, who is the General Manager of the Research and Development Centre, is the project co-ordinator and the counterparts of the expert in instrumentation/electronic equipment are M. K. Pillai, who is in charge of the centralized facilities and activities, and S. K. Khetan, who is in charge of the project activities of the Centre.

The vacancy in central instrumentation has not yet been filled. K. L. Soni and M. Mani normally deal with instrumentation, but, if necessary, the whole national staff helps out in that area.

I. ACTIVITIES AND FINDINGS

A. Instruments

Autofraction collectors (Reichert Chemie Technik)

Both autofraction collectors had to be repaired and properly adjusted. The relais of the moving mechanisms had contact failures, the batteries for the timers were ruined after the long storage time (they were delivered in May 1982), and a lead of a large condenser got broken during shipment.

A list of the missing parts was sent to UNIDO in December 1984. In order to be able to use one of the collectors, a distributor-arm was made locally pending delivery of the original part. The second collector is also functioning, however without a drops-counter.

It is recommended that the collectors be switched on for at least one day per month.

Freeze drying plant (Leybold-Heraeus GmbH)

During inspection prior to installation it became apparent that some vital parts were missing and UNIDO was informed of all details.

The CH 330 Combitron meter, originally hermetically sealed, was blocked at grade 25 by an iron particle between the moving coil and the magnet core. It was repaired and now performs well.

One of the Thermovac gauges was out of work from the beginning. This device monitors the vacuum to ensure that the lids are air-tight. One of the lids fails completely, because it has a hole. Without a good Thermovac gauge it is impossible to install the equipment.

It is imperative to evacuate the diffusion-unit with the rotary vacuum pump to prevent the pollution of the diffusion pump. The diffusion-pump filter has now been filled with alumina balls, and the rotary-pump outlet connected to the oil-recuperator unit. (Until installation, the outlet of the rotary pump was open and a large ant was found in the oil!)

Various types of electro-mechanical balances (Sartorius, Bosch)

All of them needed some repair and adjustment before installation. For example, the built-in weights were not in the right places; the optical system was maladjusted etc. Now they all are working well. To maintain their accuracy it is important to keep them in horizontal position when moving them around and to avoid even the smallest shocks.

Spectronic 20 spectrophotometer (Bausch and Lomb)

That device was delivered in May 1982 and the first attempt to install it was made in November 1984.

The meter was completely blocked although it was originally sealed. The inspection showed that the edges of the central magnet, made of special ferrite, were corroded and the ferrite-particles stopped the moving coil. The cover of the coil-holder was broken. The instrument was repaired and now works well. However, as it seems that the failure was caused by unsuitable material used for the core-magnet, the same problem may arise again after a few years.

Dissolved oxygen meter (Krüss)

The electrode of that device was corroded. After cleaning, inserting a new membrane and replacing the batteries, the temperature-sensor of the thermo analyser was calibrated to a mixture of ice and water and now performs well.

The standard chemical pills were spoiled because of exposure to the humid air.

Electrophoresis equipment Q65 (Vetter GmbH)

The inscription on the plaques of the control panel are in German, which is a handicap. A more serious design-problem is that the pilot-lamps for cooling and voltage are similar in shape and size to the buttons in the same column, and that they are not strong enough to withstand even a slight push. This was the reason that those lamps got pushed into the instrument.

This has been rectified, and protective labels were affixed, bearing the proper English inscription. After adjustment of the cooling system the instrument works satisfactorily. To ensure a smooth operation of the cooler, it should not be adjusted below -5°C.

Centrifuge CRU 5000 (Damon-IEC Div.)

As it was not possible to switch on the centrifuge, the cover had to be removed in order to get access to the inside of the equipment. This was somewhat complicated, because during transportation or storage one of the fixing screws got bent. It was then found that the transformer does not get the primer voltage. This was repaired and some adjustments made, and the centrifuge as well as the cooling system are now working well. Only the speedometer is not operating because of faulty pulse PCB. The equipment is therefore usable, but the speed of the rotor can be read only from the scale of the adjuster knob, with a tolerance of ± 10%.

It should be noted that the "start" knob is working only when the timer is switched on, and that the "temperature" knob (cooling) should not be set below -5°C.

Polarograph (Sargent-Welch)

The toothed wheels of the moving chart were wrongly assembled. The clutch of the moving mechanism is made of cork and because of the dry weather it became loose. After repairing it works well.

Automatic KF-titrimeter (Fisher)

The automatic injection syringe was not functioning; the tubing of the equipment as well as the O-ring were in a wrong place. This was corrected and the equipment now works well.

Refractometer (Bausch and Lomb)

This equipment needs 110 V and was supplied with a special (American) mains plug. After modification it is possible to plug it into the 220/110 V transformer of the micron photosizer. Otherwise it would need a transformer of its own. The equipment works well.

Moisture determination balance (Ohaus)

The equipment arrived in August 1982 and was installed in November 1984. The balance spring was connected to the main beam and the tare lever, and the optical path was adjusted properly. The knob of the timer was loose and the balance needed a zero-adjustment. The apparatus is in good condition now.

Incubators IMC-700 and IMF-600 (Gallenkamp)

These apparatuses which were received in June 1982 and installed October 1984 are performing satisfactorily.

Micron photosizer (Seishin)

The micron photosizer arrived in January 1983 and was installed in June 1984. The equipment works well.

Autoliners (Dessga)

Received in August 1982 and installed in December 1984; the apparatuses work well.

Aerosol generator (Sartorius)

That piece of equipment was received in July 1982 and installed in December 1984. After some adjustments the generator works satisfactorily.

Airborne micro-organism and dust sampler (Sartorius)

The sampler arrived in August 1982 and was installed in December 1984. During the installation it became evident that the special filter-holders and filters were missing. This was pointed out in a note to the project co-ordinator. The other parts of the instrument are in order.

Selective 5000 ion analyser (Beckman)

The analyser was received in June 1982 and a first attempt to install it was made in September 1984. The electrodes should be equipped with standard connectors, but they had not been ordered. When Beckman was later requested to supply them they replied that they no longer have parts for that old model. As electrodes with standard connectors are available on the local market, an attempt will be made to fit them into the analyser.

Potentiometric titrator (Mettler)

The titrator arrived in January 1983, and when the Neopharma Instrument Corporation, a local agent, made an attempt to install it in November 1984 they found that the display-component (a special sandwiched display tube) was out of work. As this component is an integral part of the main PCB, a new PCB was required and the manufacturer was contacted regarding the matter. Upon receipt of the PCB, the local agent will continue the installation. So far the instrument cannot be used.

Deep-freeze cabinets VL-120 (Heraeus-Vötsch)

They arrived in June 1982 and one of them was installed by the staff in April 1984. That cabinet became faulty in October 1984, and the trouble-shooting showed that the contacts of the starter relay were burnt.

When the second cabinet was checked it was found that its electrical circuit had been wrongly assembled. Since there is no service manual available, it was impossible to rectify the mistake. The starter relay of that cabinet was therefore put into the other cabinet, which now works well, while the second one is out of function.

Thermal analyser 1090 (Du-Pont)

This equipment comprises a thermal analyser and a data processor, including the following units:

Differential scanning calorimeter 910
DTA cell 902
Press for preparing sample tablets 901
Computing integrator SP 4100

It arrived in June 1982, and when the local agent, IR Technology, New Delhi, wanted to install it in April 1984, two of the PCBs were found to be wrong. Replacements were requested from the manufacturer and fitted into the data processor in October 1984. The equipment works satisfactorily.

Liquid chromatograph HPLC (Du-Pont)

This device consists of the following units:

Gradient controller 8800
Display unit
Column oven
Absorbance detector 860
Chromatographic pumps
Refractive index detector
Recorder
Variable wavelength IR detector
Solvent containers

It arrived on site in June 1982, and when IR Technology, New Delhi, tried to install it in May 1984 it was found that the PCBs for the display-patterns was wrong. During the second attempt in October 1984 it turned out that the replacement PCB sent by the manufacturer was not suitable. Moreover, the pumps give no continuous pressure, without which the equipment is not usable. In January 1985 an engineer of the local agent adjusted the pumps and the chromatograph can now be used, however, without display unit. As soon as the proper PCB will be available, the local agent will proceed with the installation.

Gas chromatograph Sigma 2B (Perkin-Elmer)

The gas chromatograph was received in April 1982. During its installation by Labindia Instruments Ltd, Bombay, in July 1984 one of the PCBs was found to be out of order. A replacement was fitted in September 1984 and since then the equipment has been working satisfactorily.

Atomic absorption spectrophotometer SP9 (Pye-Unicam)

It arrived in June 1982 and was installed in April 1984 by the local agent, Philips Service, New Delhi. Since its installation there were only minor problems.

IR spectrophotometer SP 2000 (Pye-Unicam)

That apparatus was received in June 1982 with the following main accessories:

SP 2040 Infrared sample changer
SP 2060 Air dryer
Press for sample tablets

Philips Service installed it in April 1984, but one week later the equipment was out of order.

This spectrophotometer uses a so-called Nernst-source to generate the infrared light, which is working at 1350°C. All metal parts of the source expand at that temperature and contract when the equipment is switched off. Therefore, every on/off cycle causes a great mechanical shock to the source, thereby decreasing its life-time. This is the reason why the manufacturer recommends a 24-hour operation, which is difficult to implement because it requires a regular electric power supply, which is not the case at the Research and Development Centre.

During a detailed check carried out in October 1984 the Nernst-source was found to be at fault; after replacing it, it became clear that there was a problem with its circuit as well. Due to the lack of a service manual, it was not possible to rectify the defected circuit. In January 1985, when an engineer from the local agent came to repair it and learned that two diodes had been put into the circuit to protect the source, he removed them. Since that time the equipment has been working satisfactorily.

To increase the life-time of the Nernst-source, the samples to be analysed should be collected to ensure a continuous use and to avoid frequent switching on and off.

For easier reference, the expert prepared a list showing the present status of instruments and equipment.

At the beginning of the reporting period the following instruments had been or were being installed:

Instrument	Installed by	Status
1. UV-VIS spectrophotometer 559	Local agent	Operating except dye
2. Gas chromatograph Sigma 2B	Local agent	Operating
3. Atomic absorption spectrophotometer SP9	Local agent	Operating
4. Micron photosizer	Local agent	Operating
5. HPLC	Local agent	One PCB and pump faulty
6. Thermal analyser	Local agent	Two PCBs faulty
7. IR spectrophotometer SP2000	Local agent	Nernst-source faulty

During the reporting period the following instruments were installed or were under installation:

Instrument	Installed by	Status
1. Thermal analyser	Local agent	Operating
2. IR spectrophotometer SP2000	Local agent	Operating
3. HPLC	Local agent	Pump repaired, display faulty
4. Autofraction collectors	Project	Operating after repair
5. Electrophoresis equipment	Project	Operating after repair
6. Spectronic 20 spectrophotometer	Project	Operating after repair
7. Dissolved oxygenmeter	Project	Operating after repair
8. Aerosol generator	Project	Operating after adjustment
9. Airborne dust sampler	Project	Needs accessories
10. Shaking apparatus	Project	Operating after adjustment
11. Various balances	Project	Operating after repair and adjustment
12. Rotavapor evaporators	Project	Operating after adjustment
13. Audio-visual projector	Project	Operating after adjustment
14. Selective 5000 ion analyser	Project	Needs proper electrodes, otherwise operating
15. Surface tensiometers	Project	Operating
16. Redwood viscometer	Project	Operating after adjustment
17. Homogenizer	Project	Operating
18. Deep-freeze cabinets	Project	One operating, second wrong relay and circuit
19. Autoliners	Project	Operating after adjustment
20. Freeze drier GT-1	Project	Partly repaired, accessories missing
21. Polarograph	Project	Operating after repair
22. Centrifuge CRU 5000	Project	Partly repaired, wrong PCB
23. Moisture determination balance	Project	Operating after adjustment

Instrument	Installed by	Status
24. Refractometer	Project	Operating after modification
25. Automatic KF titrimeter	Project	Operating after repair
26. Incubator INC-700	Project	Operating
27. Incubator INF-600	Project	Operating
28. Powder characteristics tester	Project	Operating
29. Potentiometric titrator	Local agent	Display wrong

B. Accessories, fittings and spare parts

To ensure a continuous operation of the scientific instruments, it is obvious that certain accessories, fittings and spare parts have to be at hand. Some of these are available on the local market, but there are others which have to be procured from the manufacturer. In some instances the quantity of spares originally ordered is insufficient, e.g.:

(a) Only one pack of thermographic paper for the SP 4100 computing integrator which carries a special optical mark on each sheet which triggers the movement of the driver. Such paper is not available in India;

(b) Only one pair of cells (cuvettes) for the UV-VIS spectrophotometer;

(c) Only 18 pieces of septa for the gas chromatograph;

(d) Disposable filters with refills for the HPLC.

As the individual ordering of such items takes a lot of time the expert was advised to have them bought by a Field Purchase Order. To that end he prepared lists of all required spares, taking into account the importance of the instruments concerned for the operation of the Centre.

C. Equipment of pilot plant

The equipment of the pilot plant was installed mainly by the national staff and most of the generally slight problems they had could be solved immediately. The expert frequently advised on the matter of safety (see also chapter II "Conclusions and recommendations").

D. Premises

The Research and Development Centre has been erected on a field and constructed in such a way that during dust-storms the dust can easily enter the buildings. While this is considered detrimental for the instruments, good ventilation is, on the other hand, essential for the safety of staff dealing with poisonous materials in a chemical laboratory.

Since the buildings cannot be re-designed, the expert proposed the following slight modifications:

(a) The exhaust ventilators in the chemical laboratories should be equipped with lattice shutters (blinds) to prevent the penetration of dust. The blinds have been delivered and will soon be assembled;

(b) Partitions consisting of a wooden frame and sandwiched transparent PVC-foil should be erected in the instruments laboratory. That way, each of the sensitive instruments can be placed into a "cell" of its own thus protecting the samples to be analysed against pollution stemming from the outlet of other equipment and at the same time shielding the instrument somewhat against dust and the rapid fluctuation of the ambient temperature caused by air-conditioners;

(c) The central bench in the instrument laboratory should be protected by a construction similar to a tent, and made of the same materials as the partitions. Sliding parts (windows) should enable the access to the instruments.

The layout of the proposed modifications in the instruments laboratory is given in the figure on the following page.

The importance of having fire-extinguishers, a proper safety earthing, and an anti-static mesh around the plastic bags of the milling machines as a protection against the danger of static electricity which can cause explosion of the pesticide raw material has been pointed out many times.

The main switchboard in the building of the instruments laboratory was the subject of several theoretical explanations and practical demonstrations. The connection of the neutral wire is wrong and dangerous because it causes electrical shocks. Moreover, although in September 1984 it was demonstrated to workers and senior staff members how to assemble the electrical sockets on the benches, they are still not properly put together. It seems that the overall attitude of the national staff is characterized by the "it cannot happen to me" syndrome, although the expert tried many times to convince them that Murphy's law ("if anything can go wrong, it assuredly will") is valid.

E. Maintenance

All indispensible hand-tools for maintenance were purchased from the local market. The expert prepared a list of further necessary tools and devices which are available in India which is reproduced in annex V. To select a suitable institution for co-operation in the area of maintenance, different institutes and universities were visited.

F. Training

Everyday on-the-job training was given to Miss Mani and to Mr. Soni who are permanently dealing with instrumentation at the Research and Development Centre. Especially when the sophisticated instruments (e.g. HPLC, thermo analyser etc.) were installed, they were instructed how to handle and maintain the instruments. Mr. R. Gururajan who has some background in chemistry but who is interested in instruments was very helpful when the instruments of the technology laboratory were installed, and was later trained how to repair the Systronics spectro calorimeter.

Two formal courses were given, both on the subject of basic maintenance. A third one on microprocessor-controlled instrumentation was planned.

A list showing the status of implementation of the abroad training programme is given in annex VI.

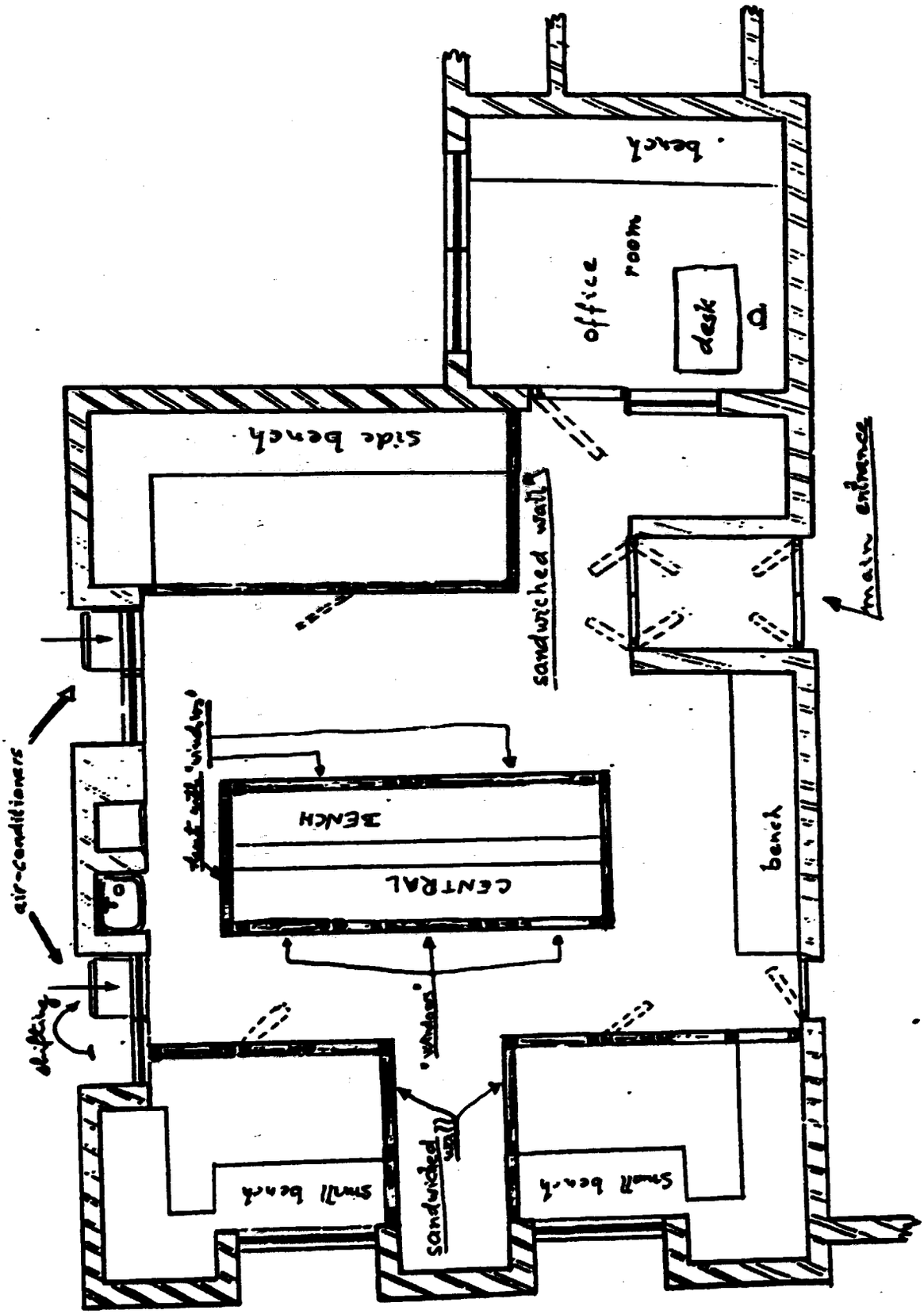

Figure. Layout of proposed modifications in the instruments laboratory

II. CONCLUSIONS AND RECOMMENDATIONS

To meet the objectives of the project, effective corrective measures need to be taken. Some of the recommendations concerning instrumentation were mentioned in the preceding chapter and are repeated here together with new proposals.

A. Laboratory environment

The designers of modern analytical instruments normally do not give specifications for the environment in which the instrument should operate, as it is assumed that the instrument will be placed in a "laboratory environment". To establish such an environment, the conditions below should be met.

Electrical supply

The voltage should be stabilized to about ± 2 per cent. To that end it is recommended to use a locally-made electro-mechanical voltage stabilizer, because other types can cause faulty signals in microprocessor-controlled instruments. The existence of a 24-hour electrical supply is assumed (e.g., the IR-source of SP 2000 needs a round-the-clock electrical supply).

Temperature

Two operating temperatures are recognized and recommended for laboratories, with defined limits of variation around a specific operating temperature. For research laboratories it is 20°C (68°F) with a ± 0.1°C limit of variation around a specific operating temperature at the measuring point, and ± 0.3°C for the room. For other laboratories it is 23°C (73.4°F) with a ±1 to 1.5°C limit of variation for the room.

The ambient temperature plays an important role in the efficient use of many instruments, but the rate at which changes of temperature occur during a measurement period is also important. Changes in temperature are usually due to the cyclic operation of an air-conditioner. Recommendations for the rate of change of temperature range from 0.5 to 1.5°C per hour.

Relative humidity

A relative humidity of 35 to 55 per cent is acceptable. Many infrared devices have windows made of NaCl and they can be seriously damaged by humidity. It would be reasonable to use air conditioners with low humidity for rooms where such devices are placed. If this is not possible, humidity-sensitive devices should be kept during the monsoon season in an air-tight wooden box containing a proper amount of dry silica gel.

Lighting

An illumination of 100 foot-candles (1.067 lm/m^2) at the bench-level is recommended. Other factors such as maximum ratios of brightness between the task-area and surrounding areas, and between different surfaces in the room are also important.

Dust particles

For analytical measurements there is a need for a "clean" room. Generally, the number of dust particles of 5 micron and above should not

exceed 10^4 to 10^5 per cubic foot of volume of room, with no particles greater than 50 microns. The amount of particles of 1 micron and above should not exceed 10^5 to 10^6 per cubic foot of room volume.

Acoustic noise and vibrations

Acoustic noise in the range of 20 to 9600 Hz should be less than 35 decibel. The tolerable extent of vibration for a recorder is a maximum acceleration of 0.001 g or maximum displacement of 1µ inch (25.4 µm) at the instrument-base for vibration frequencies of less than 200 Hz.

The location chosen for the new DG-set (emergency generator) is such that disturbance in the laboratories by the noise and vibrations caused by it will be kept as low as possible.

Recommendations

The afore-mentioned proposal to install partitions in the instruments laboratory can be realized without any great capital outlay, as was explained to the civil engineer of HIL. It needs mainly carpenter-work, wood and transparent PVC-sheets and will help to achieve a laboratory environment. Further improvements to that end would be the following:

(a) Reduce the gaps at the windows and doors (also a carpenter-work);

(b) Install proper filters in the air-conditioners;

(c) Assemble lattice-blinds for the ventilators;

(d) Clean the laboratories with a vacuum cleaner.

B. New building

The optimal solution would be to design the fourth building of the Research and Development Centre, the construction of which has not started yet, in such a way as to achieve the ideal laboratory environment, including a central air-conditioner. The argument, that the present design is dictated by budgetary limitations, is short-sighted. The loss, caused by a cheaper construction, in terms of service-life and failure rate of the very expensive instruments is uncomparably larger than the money saved momentarily. It is therefore worth while to modify the original plan for the Research and Development Centre, because in a well-designed building the research and development units will be safe and operate effectively, like in other research and development institutions of New Delhi. The new building should also be "rodent-proof". In the existing laboratories there are definite traces of rats, and one of the expensive apparatuses, the CRU 5000 centrifuge, has been damaged by them.

C. Organization of the Research and Development Centre

In the organizational structure of the Pesticide Development Programme in India (see annex IV), instrumentation is placed under the Department of Centralised Facilities and Activities. This set-up was reasonable as long as only paperwork was done - although that situation led to tremendous problems caused by the fact that at the planning stage the instrumentation aspect had been neglected. However, now that the project is beginning with the real work, it needs an effective Instrumentation Department.

The Instrumentation Department will be responsible for the following:

(a) Selection of new instruments and equipment to be purchased. The choice should be based on (i) anticipated needs over the next two years and (ii) reliability under existing working conditions. The Centre now intends to purchase some very sophisticated equipment, but the necessity for it has not been established, and the existing buildings are not suitable for it. It is a wrong strategy to purchase analytical equipment and then keep it stored in a shed for several years, because (i) some electronic components like electrolyte condensers, batteries etc. deteriorate during prolonged storage, as was the case with the instruments installed by the expert; and (ii) it is uneconomical because such equipment is generally redesigned every two years and one can get the improved model for the same price or even cheaper. E.g. the infrared spectrophotometer SP 2000 was redesigned and available in 1983 with a Pyrex-source which increases its reliability in places with frequent power-cuts and it was offered at a cheaper price than the model purchased by the project in 1982;

(b) Negotiations with local agents to seek their opinion and advice regarding the equipment selected, recommended spare parts, accessories and fittings, installation, guarantee, and to obtain all necessary documentation (installation, operating and maintenance instructions);

(c) Assistance and supervision of the installation, the adjustment and the putting into operation of new or repaired equipment;

(d) Regular maintenance to ensure the operational fitness of equipment. To be able to fulfill that function, the Instrumentation Department should have a properly staffed Maintenance Workshop, equipped with the necessary instruments and tools. The minimum equipment in terms of tools and instruments which are available in India is listed in annex V together with approximate prices. Maintenance should not be narrowly defined, but viewed as including the acquisition of an instrument, its storage and transportation, as well as ensuring its proper operation and repair. To perform that task well, skilled technicians or engineers are required (it seems that two of the local staff would be suitable) who have both, enthusiasm and aptitude for maintenance, features which often are more important than certificates;

(e) Giving technical advice with regard to the measurement of data and instrumentation at all levels.

The Head of the Instrumentation Department should have higher education, a high level of motivation and interest in instrumentation, a sharp mind, be able to cope with technical problems not only within the area of his formal education, but possess an interdisciplinary knowledge in the field of technology, be self-confident based on his technical expertise and experience, and prepared to maintain his theoretical knowledge and skills at a consistently high level. He should further possess social skills allowing him to deal easily with the staff, local agents and colleagues.

It may be difficult to find all those traits in one person, but further training of the individual chosen for that position should be envisaged to ensure a proper performance.

D. Co-operation with other institutions

Until an Instrumentation Department as described above will exist, the only way to overcome some of the afore-mentioned problems is to co-operate

with other institutions. To evaluate the possibilities existing at New Delhi, various institutes and universities were visited. Considering such factors as the level of manpower, available tools and measuring instruments, and willingness, it became evident that the most fruitful co-operation could be established with the Services and Instrumentation Centre of the University of New Delhi.

E. Instrumentation library

The instrumentation library should be a small, technical library, which is independant of the Library of the Research and Development Centre, and where all manuals and instruction handbooks for the instruments and equipment employed in the Research and Development Centre are available, as well as leaflets and prospectuses of well-known manufacturers of analytical instruments (like Perkin-Elmer, Hewlett-Packard, Pye-Unicam etc.) and laboratory equipment (like Fisher, Heraeus etc.).

The library should also keep a register of all instruments. Such a register will have to be prepared by the instrumentation staff. Models of register-sheets, containing all basic information, especially with regard to the safety of the operator and the instrument, are given in annex VII.

In addition, documents and reports on events which influence the output of the Research and Development Centre should be collected there (e.g. detailed inspection reports, installation reports, failure reports, maintenance reports and test reports).

The library should also be responsible for the updating and correcting of manuals, if so required. There are, for instance, some instruments with German labels on their panels, while the relevant English manuals contain different labels. Such corrections have already been made in the manual for the deep-freeze dryer, the aerosol generator and the autofraction collector.

The books and leaflets which were given to the national counterpart of the expert, and which are listed in annex VIII, will constitute the nucleus of that library. The Technical Manual, which was prepared by the expert, deals with a variety of technical problems and information related to the maintenance and repair of electronic equipment. The issues are approached from a practical point of view, and the book contains such data and information which cannot be found in text books of a general nature. That way the special knowledge, gathered by the staff who received on-the-job training, is secured for others who did not participate in the work of the Instruments Laboratory. The Trouble-shooting Guide presents practical examples of how to locate a fault related to GC problems, while the book on Gaschromatographic Analysis of Pesticides is a valuable help in planning GC tests. The other leaflets all relate to GC or HPLC technique, mainly in the field of pesticides. The last book, a study prepared by a research-scientist at Nehézvegyipari Kutató Intézet, Veszprém, Hungary, deals with the trends in the world market of pesticides. Although it is written in Hungarian, the gist of it can be understood by a technically educated man, especially as there is a list of translated key-words.

F. Safety

The most important recommendations regarding safety are summarized below:

(a) The wrong power-breakers of the main switchboard should be replaced;

(b) Each laboratory should receive its own main power switch, which should be easily accessible, preferably near the main entrance. In an emergency the whole laboratory can be switched off in an instant, which may save lives;

(c) The safety wiring in the pilot plant should be properly assembled. Welded joints should be inserted between the metal strips because the existing screwed joints are not safe;

(d) Around the large plastic bags at the milling machines in the pilot plant metal grids should be provided as a protection against the charges of static electricity which can cause dangerous explosions of the pesticides raw-material dust;

(e) All laboratories should be equipped with fire-extinguishers and blankets to combat accidental fire;

(f) All work benches where pesticides raw-materials are handled should have suitable fume-hoods. The design of the Sigma 2B gas chromatograph, for instance, definitely requires one;

(g) The laboratory workers who deal with poisonous chemicals should protect themselves with rubber gloves and other safety devices and antidotes should be available.

G. Scientific and professional contacts

The addresses of scientists who, according to previous dealings with them, are willing to be in scientific and professional contact with the scientific personnel of the Project are given in annex IX.

Annex I

JOB DESCRIPTION
DP/IND/80/037/11-54/32.1.G

Post title: Expert in instrumentation/electronic equipment.

Duration: Four months.

Date required: September 1984.

Duty station: Central Research and Development Complex, Pesticide Development Programme in India, Dundahera, Gurgaon (India).

Purpose of project: To assist the Government in the establishment of a pesticide formulation Research and Development and training centre and in the establishment of scientific and professional contact with other national and international organizations in this field.

Duties: The expert is expected to advise on specifications and assist in the installation, testing and operation of analytical instrumentation like infrared and ultraviolet spectrophotometers, atomic absorption spectrophotometer, gas chromatograph, high-pressure liquid chromatograph, electrophoresis equipment etc. of the chemical pesticides laboratories. He shall also assist in putting in operation and adjusting the electronic and microprocessor-controlled devices of the instrumentation laboratory. To the extent feasible the expert may be requested to advise on the functioning of other electronic office equipment including computerized data collection, processing and communication facilities. The expert would also be required to train local scientific staff for the proper operation and maintenance/repair of the above equipment.

Annex II

WORK-SCHEDULE

Until 15 October 1984:	Prepare an interim report about the present situation of the project (findings, actions).
31 October 1984:	Prepare a corrected inventory list of UNDP-property instruments, equipment, simultaneously marking them with the insignia of UNDP.
15 November 1984:	Prepare lists reflecting the state and condition of instruments and equipment. Make proposals on how to improve the laboratory environment.
20 January 1985:	Assist in the installation, testing and operation of instruments and equipment. Train the national staff.
On a continuous basis:	Act as a trouble-shooter regarding problems arising with instruments and equipment. Make proposals about maintenance and repair of instruments and equipment.

Annex III

INVENTORY LIST OF INSTRUMENTS AND EQUIPMENT SUPPLIED BY UNIDO*

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NON-EXPENDABLE PROPERTY CONTROL RECORD

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Project Title PESTICIDE DEVELOPMENT PROGRAMME Period ending

HQ Req. Ref.	Item No.	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received Qty.	Received M	Received Y	Condition	Qty. on hand	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
81/-	4	2	EA	Auto Fraction Collector "LINEARII" (with test tube racks, test tubes, timer, and control unit) Reichert Chemie Technik, FRG	6,534	15-1-01283		6	82	G/B		One unit without accessories
	10	1	EA	Corrosion Testing C inet "KS-300" Gebr. Liebisch, FRG	1,968	-do-	1	6	82	G		
	11	1	EA	Electrophoresis Equipment Mod.065 Vetter GmbH, FRG	4,169	-do-	1	6	82	G/B		
81/-	12	1	EA	Mechanical Micro Balance Mod.2405 Sartorius, FRG	5,397	15-1-01284	1	3	82	G		
	5	4	EA	Rotavapor Evaporator "RE-120/A" Buchi, FRG	3,483	-do-	4	3	82	G		
	21	1	EA	Audio Visual Projector "AV-1002" (with Philips tape-recorder) KINDERMANN, FRG	844	-do-	1	3	82	G		
81/1	12	1	EA	Selective 5000 Ion Analyser "PM 123509" Beckman, U.S.	3,790	15-1-01281	1	6	82	B		Electrodes not available
81/-	18	1	EA	UV-VIS Spectrophotometer Mod.559 Perkin-Elmer, U.K.	17,947	15-1-01286	1	6	82	G		Paint of cover peeled off

*Not formally edited.

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HQ Req. Ref.	Item No.	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received			Condition	Qty. on hand	Remarks
							Qty.	M	Y			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
82/2	2	1	EA	"Spectronic 20" Spectrophotometer Bausch and Lomb, U.S.	1,033	15-1-01495	1	7	82	G		
	3	2	EA	Surface Tensiometer "0482-010" Kruss, FRG	2,101	-do-	1	7	82	G		
	5	1	EA	Dissolved Oxygen Meter "OXI/57" Wissenschaftliche Technische Werkstatte, FRG	457	-do-	1	7	82	B		
	9	1	EA	Aerosol Generator Sartorius, FRG	4,293	-do-	1	7	82	G		
	12	1	EA	Colloid Mill "1 CM" (with Cooling element, and gas inlet) Alpine AnG, FRG.	2,496	-do-	1	7	82	G		
	19	1	EA	Lab. Grinding Mill "LS10K" Condux, U.S.	1,243	-do-	1	7	82	G		
	20	1	EA	Lab.Grinding Mill "LV15K" Condux, U.S.	1,315	-do-	1	7	82	G		
	21	1	EA	Lab. Blast Mill "CGM100" Condux, U.S.	4,239	-do-	1	7	82	G		
	22	1	EA	Hammer Mill "LHM 20/16" Condux,U.S.	2,907	-do-	1	7	82	G		

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HQ Req. Ref.	Item No.	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received Qty.	Received M	Received Y	Condition	Qty. on hand	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
81/2	1	1	EA	Airborne Microorganism and Dust Sampler "ND2" Sartorius, FRG.	2,622	15-1-01495	1	8	82	G		needs accessories
	15	1	EA	Cone Crusher (with sample divider) Siebtechnik, FRG.	7,814	-do-	1	8	82	G		
	17	1	EA	Universal Lab. Mixer Mod.NTHK G.Papenmayer GmbH, FRG.	10,812	-do-	1	8	82	G		
	13	1	EA	Shaking Apparatus (with shaking rod and adapter) Vetter K.G.	676	-do-				G		
	16	2	EA	High Efficiency Lab. Kneader Mod. HKD (duplex 2,5 VHV) IKA-Werk, FRG	12,116	-do-				G		
	23	1	EA	Lab. Ball Mill "1226C" Guwina-Hofman, FRG	2,114	-do-				G		
	24	1	EA	Ball Mill (with frame, porcelain drums, and balls) Guwina Hofman, FRG	5,125	-do-				G		
81/2	6	2	EA	Redwood Viscometer Karl Kolb, FRG	648	15-1-01496	2	5	82	G		
	18	1	EA	Homogenizer SCHOTT, FRG	1,582	-do-	1	5	82	G		

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HQ Req. Ref.	Item No	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received Qty.	Received M	Received Y	Condition	Qty. on hand	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	14	2	EA	Lab. Grinding Mill(bench model) vibratory disk type T250 Siebtechnik, FRG	3,830	15-1-01496	2	5	82	G		
		2	EA	Continuous - Flow - Grinding Barrel (made of hardened chromium-steel) Siebtechnik, FRG	2,696	-do-	2	5	82	G		
31/1	8	2	EA	Deep Freeze Cabinet Mod, VL 180 Heraeus - Votsch, FRG	11,496	15-1-01282	2	6	82	B		one has wrong relay and circuit failure
31/1	16	1	EA	Gas Chromatograph "Sigma 2" (complete with accessories) Perkin - Elmer, U.K.	22,854	15-1-01285	1	7	82	G		
	1	2	EA	Analytical Balance Mod. 2434 Sartorius, FRG	3,037	-do-	2	8	82	G		
	3	2	EA	Top Loading Balance Mod, PT15/4T Bosch, FRG	984	-do-	2	8	82	G		
31/1	6	2	EA	Autoliner Desaga, FRG	5,172	15-1-01285	2	8	82	G		
	13	1	EA	Gas Analyser Strohlein, FRG	1,028	-do-	1	8	82	G		
	20	1	EA	Freez Drier Plant Model "GT-1" Leybold Heraeus, FRG	16,946	-do-	1	8	82	B		missed and wrong parts

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NON-EXPENDABLE PROPERTY CONTROL RECORD

HQ Req. Ref.	Item No.	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received Qty.	Received M	Received Y	Condition	Qty. on hand	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
81/1	9	1	EA	Polarograph DC Recorder Mod.3001 Sargent-Welch, USA	3,450	15-1-01287	1	5	82	G		
81/1	19	1	EA	Thermal Analyser "1090" (with Data Analyser, 910 Differential Scanning Calorimeter, and accessories) Du-Pont, USA	61,369	15-1-01306	1	6	82	G		
	17	1	EA	Liquid Chromatograph, System 8800 (with 4 solvent pumps, optional items) Du-Pont, USA	50,859	-do-	1	6	82	B		
81/1	15	1	EA	IR Spectrophotometer "SP 2000" Pye-Unicam, UK	36,328	15-1-01327	1	6	82	G		
	14	1	EA	Atomic Absorption Spectrophotometer "SP9" Pye-Unicam, UK	17,658	-do-	1	6	82	G		
		1		Centrifuge (refrigerated) "CRU 5000" (with accessories) DAMON ICE DIV., USA IEC	5,728	15-1-01450	1	8	82	B		PCB faulty
	8	1		Moisture Determination Balance Mod. No.6010H(10g capacity) Ohaus Scale Corp. US	785	-do-	1	8	82	G		
		1		Refractometer Abbe "3L" (with prism - set) Bausch and Lomb, US	2,848	-do-	1	8	82	G		
		1		Automatic K-F Titrimeter Mod.392 Fischer Sci.Co. USA	3,969	-do-	1	10	82	G		

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NON – EXPENDABLE PROPERTY CONTROL RECORD

HQ Req. Ref.	Item No.	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received			Condition	Qty. on hand	Remarks
							Qty.	M	Y			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
81/2		1		Incubator "INC - 700" Gallenkamp, UK	1,141	15-1-01451	1	6	82	G		
81/2		1		Cooled Incubator "INF-600" Gallenkamp, UK.	1,500	-do-	1	6	82	G		
81/1	6	1		Micronizer 4"(top discharge model) (with vibrating feeder) Sturtevant Mill Co. US	8,400	15-2-00798	1	3	83	G		
82/2	2	1		Air Compressor & Drier Hankinson Gardner, US	10,600	-do-	1	3	83	G		
82/2	5	1		Potentiometric Titrator Mod.DL40RC (with accessories) Mettler, CH	6,962	15-2-01004	1	1	83	B		display wrong
82/2	3	1		Micron Photosizer Mod. SKN-1000 Seishin Ltd., Japan	8.850	15-2-01010	1	1	83	G		
82/2	5	1		Universal Lab. Mixer Mod.NTHK 15 (with mixing vessel, agitator) G.Papenmeyer GmbH, FRG	11,988	15-2-01046	1	2	83	G		
				Mixer for Batch Operation "FM50/12" (with speed regulator, jacketted mixing drum) Lodige, FRG	11,696	15-2-00769	1	2	83	G		
82/2	4	1		Powder Characteristics Tester "82IIPT-4" Hosokawa Iron Works Ltd., Japan	4,542	15-2-01157	1	2	83	G		

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HQ Req. Ref.	Item No.	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received			Condition	Qty. on hand	Remarks
							Qty.	M	Y			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
82/-	4	1	EA	Ultraplex Universal Mill 'B 160 UPZ' (with console, installation - platform motor) Alpine A.G., FRG	20,679	15-2-00926	1	5	83	G		
82/1			EA	Reaction Vessels (for pressure and vacuum)								
	9.7	1	EA	2 ltr/25 bar	1,256	15-2-00766	1	4	83	G		
	9.8	1		5 ltr/15 bar	2,090	-do-	1	4	83	G		
	9.9	1		10 ltr/10 bar	2,367	-do-	1	4	83	G		
	9.10	1		50 ltr/4 bar K.K.Juchheim, FRG	3,006	-do-		4	83	G		
	9.11	1		Agitator for Reaction Vessel Heynau, FRG	765	-do-	1	4	83	G		
82/1		1		Micro-Jet Mill Mod. 8" MJ (with JOC-F4S-Jet-O clone collector porteblex table, ductwork) Fluid Energy Proc. and Equipment Co. U.S.	17,760	15-2-00780	1	4	83	G		
82/1		1		Air Compressor Champion, U.S.	5,746	15-2-00780	1	4	83	G		
82/2	1	1		Tri-Homo Colloid Mill Mod. 6 LA (with mechanical seal assemblies) Sonic, U.S.	12,875	15-2-1162	1	5	83	G		
82/2	2	1		Laboratory Tumble Mixer "529/0" NETZSCH G,bH, FRG	1,279	15-2-01147	1	7	83	G		

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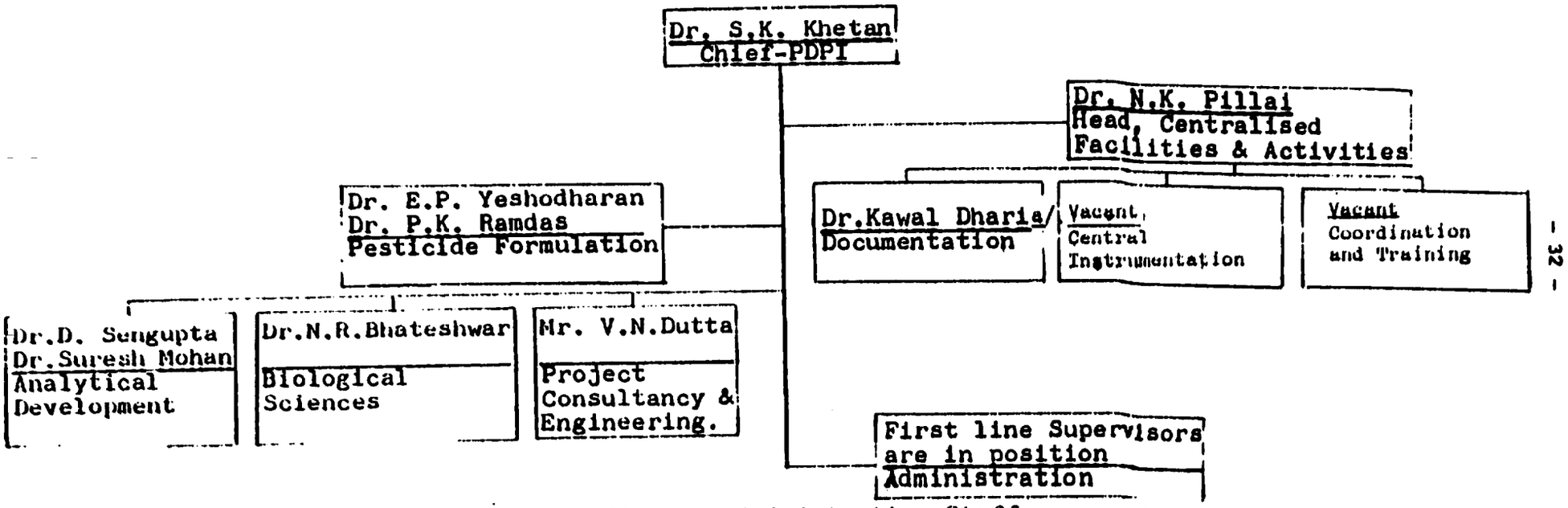
NON-EXPENDABLE PROPERTY CONTROL RECORD

HQ Req. Ref.	Item No.	Qty.	Unit	Description	US Dollar Equivalent	P.O./Shipping Advice Ref.	Received Qty.	Received M	Received Y	Condition	Qty. on hand	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
82/2	6	1		Filling Machine (air operated) "A-J-232" Nat. Instr.Co. U.S.	3,790	15-2-01159	1	4	83	G		
82/1	3	1		Ribbon Blender "N-205" (with SS 316) S.Moves, U.S.	10,160	15-2-01478	1	7	83	G		
82/1	2	1		Ultrafine Mill "V.5" (with main motor, control cabinet) Society Ultrafine, France	29,315	15-2-00770	1	6	83	G		
82/1	8	1		Extruded Type Granul tor Mod.EXK-1 (with motor for main drive, jacket for water cooling or heating) Fudji Paudal, Japan.	7,083	15-2-01477	1	7	83	G		
83/1		1		Xerox 1035 Copier(with accessories) Rank Xerox, US		15-4-B0405	1	6	84	B		Accessories damaged during transit
83/1		1		Xerox 620 Electronic Typewriter Rank Xerox, US		-do-	1	6	84	G		

Annex IV

ORGANIZATIONAL STRUCTURE OF PESTICIDES DEVELOPMENT PROGRAMME IN INDIA



Other Scientific and Administrative Staff attached to PDPI

1. Mr. K.L. Soni
2. Mr. S.N. Gupta
3. Mr. M. Mukherjee
4. Mr. S.M. Bonik
5. Miss Mani
6. Mr. R.M. Sarin
7. Mr. R. Gururajan
8. Mr. M. Ram.
9. Mr. Ramanishankar
10. Mr. D.N. Kumra
11. Mrs. C.K. Ahluwalia
12. Mr. K.V. George
13. Mr. Trilok Singh
14. Mr. R.R. Pillai
15. Mr. Y.P. Mehto

a/ Presently on training abroad in documentation under PDPI.

Annex V

HAND-TOOLS REQUIRED FOR MAINTENANCE WORK

		Price (rupees)
1.	Multimeter for basic measurements (e.g. made in India)	2 000
2.	General purpose oscilloscope (e.g. small Philips)	12 000
3.	Magnifier lens, min.10x	250
4.	Stainless steel tweezers	300
5.	Dental mirror, plain, with rotating head	220
6.	Needle files (standard set of six different files)	500
7.	Screwdriver kit, normal	300
8.	Screwdriver kit, Philips heads	300
9.	Screwdrivers, magnetic	300
10.	Jeweler's screwdriver set	250
11.	Assembly pliers, 140 mm long, snipe nose	300
12.	Assembly pliers, 140 mm long, round nose	300
13.	Assembly pliers, 140 mm long, flat nose	300
14.	Drill, manually-operated	2 500
15.	Drill bits from 1.0 mm to 10 mm, increment 0.1 mm	400
16.	Knife system (e.g. X-Acto knife)	150
17.	Small vice (80 mm x 40 mm)	200
18.	Sandpaper (sets)	100
19.	Wire bristle brush	100
20.	Small-size end-cutter pliers	250
21.	Medium-size end-cutter pliers	250
22.	Soldering iron (e.g. Weller TCP-1)	1 000
23.	Transformer for above mentioned item	500
24.	Vacuum-cleaner	5 000
25.	Stopwatch	1 000

26.	Pressure gauge kit (0 - 100 psig)	700
27.	Bubble flow meter (10 ccm) with magnetic clamps	600
28.	Glass tubing cutter with spare cutting wheels	600
29.	Tubing cutter with spare wheels ("Imp" type)	350
30.	Tubing reamer	400
31.	Teflon tape with tape dispenser	250
32.	Kit for drilling ferrules (0.41 - 1.19 drills)	1 000
	Total	37 720

Annex VI

CANDIDATES NOMINATED FOR TRAINING ABROAD

Name of candidate	Field of training	Nominated in	Training started	Training completed
1. P. K. Ramadas	Pesticide technology	1981	October 1983	March 1984
2. V. N. Dutta	Chemical engineering	June 1982	May 1983	June 1983
3. D. R. Sharma	Pesticide technology	June 1982	September 1983	February 1984
4. Suresh Mohan	Pesticide analysis	June 1982	September 1983	March 1984
5. V. Kurian John	Effluent treatment and pollution prevention	June 1982	May 1983	December 1983
6. G. Chandrasekhar	Techno-economic evaluation	August 1982	January 1983	April 1983
7. S. Kumar	Chemical engineering	April 1983	Being arranged	
8. I. S. Shan	Pesticide technology	April 1983	November 1984	
9. M. K. Warriar	Mechanical engineering	April 1983	Not yet finalized	
10. S. C. Maryal	Pesticide analysis	April 1983	May 1984	November 1984
11. P. K. Ghoshal	Pesticide marketing	April 1983	Deferred	

continued

Annex VI (continued)

Name of candidate	Field of training	Nominated in	Training started	Training completed
12. Rawal Dhari	Documentation	April 1983	May 1984	November 1984
13. N. V. S. Prasad	Techno-economic evaluation	April 1983	January 1985	
14. S. N. Deshmukh	Product development	April 1983	November 1984	
15. B. R. Murthy	Pesticide marketing	August 1983	Not yet finalized	
16. B. N. Dabas	Effluent treatment and pollution prevention	August 1983	Dropped	
17. R. P. Luthra	Chemical engineering	Dec. 1983	November 1984	
18. N. R. Bhateshwar	Product development	Dec. 1983	January 1985	
19. D. Sengupta	Effluent treatment and pollution control	Dec. 1983	September 1984	February 1985
20. C. B. Mann	Documentation	Dec. 1983	Deferred	
21. K. V. G. Rao	Techno-economic evaluation	Dec. 1983	January 1985	
22. S. Bandopadhya	Pesticide marketing	Dec. 1983	Left the organization	

Annex VII

MODEL REGISTER SHEETS FOR SELECTED INSTRUMENTS

Analytical balance (Sartorius)

Type	2434	
No.	3202075	
Received	1982	Installed 1984

Special considerations

Wires of connecting plug: blue = N; red = L; green = earth.

Protect the balance from heavy shocks.

Take care of the spirit-level.

Maintenance

No special regular maintenance required if balance is always protected from dust by means of plastic dust-hood.

Recommended spare parts:

Bulbs
Ordering No. of bulbs (package of 6): 69/0315.

Incubator IMC-700 (Gallenkamp)

Cat. No.	IMC 700 010 Q	
App. No.	OC 4516 H	
Received	1982	Installed 1984

Special considerations

Wires of connecting plug: blue = N; brown = L; green-yellow = earth.

This apparatus must be earthed.

For normal operation it needs a mercury-thermometer 10^{o} to $60^{o}C$ in $1^{o}C$.

Maintenance

Routine maintenance as described in the manual. Motor maintenance should, according to the manual, be performed every six months.

Recommended spare parts

2 load lamps
1 safety thermostat
1 thermistor-assembly
1 Compenstat-PCB

Information for the ordering of spares can be found in the manual.

Cooled incubator INF-600 (Gallenkamp)

Cat.No.	INF 600 010 R	
App. No.	1C 2928	
Received	1982	Installed 1984

Special considerations

Wires of connecting plug: blue = N; brown = L; green-yellow = earth.

This apparatus must be earthed.

The apparatus is not suitable for high-humidity applications (see manual, section 9.1 "Reduction of frosting"). It requires regular weekly defrosting, especially in the monsoon-season; the defrosting procedure is described in the manual on page 7. The minimum attainable temperature is about +5°C.

Maintenance

Regular lubrication of both motors according to the manual every three months (see manual page 8).

Recommended spare parts:

2 switch-lamp units
4 indicator-lamps

Information for the ordering of spares is given on page 11 of the manual.

UV-VIS spectrophotometer, model 559 (Perkin-Elmer)

Received 1982 Installed 1984

Power requirements: 230 V ± 10% 50/60 Hz ± 2 Hz 560 VA

Special considerations

The instrument is very sensitive to dust because of optical paths.

Use the dust-hood.

Never clean the optical parts by wiping. The maintenance/service company for Perkin-Elmer should do the proper cleaning.

Recommended spare parts

Light sources: Tungsten lamp (ordering No. C 055 - 0500)
Deuterium lamp (ordering No. C 055 - 0505)

Remember that these sources have a limited storage life and become "hard" after 2-3 years under prevailing climatic conditions.

Detector: Single-window photomultiplier (wavelength range to 900 nm) to be ordered as an electron-device from

Hamamatsu, Japan type R 446

or RCA, United States type 1 P 28 A

Fuses: 2 amp, 3 AG Slow (ord. No. CP 11851 0)

Cells: 1 pair of silica UV-VIS (ord. No. C 030 - 0300)
1 pair of pyrex VIS (ord. No. C 030 - 0310)

Window-kit: (set of 4) (ord. No. C 550 - 0107)

Dust-hood: (ord. No. CP 31807 0)

Annex VIII

BOOKS, LEAFLETS AND CATALOGUES FOR THE INSTRUMENTATION LIBRARY

Title	Author
Technical Manual: A Guide to Instrument Components	S. Déri, UNIDO expert
Trouble-shooting Guide: How to Locate GC Problems	Supelco
Gaschromatographic Analysis of Pesticides	Varian
Guide to leak-free connections with columns	Supelco
Eliminate column pretreatment to pesticide analysis	Supelco
New EPA procedures	Supelco
GC septa	Supelco
Consistent GC column dimensions	Supelco
Capillary column butt connector	Supelco
Purification of carrier gas	Supelco
Cleaning flame ionization detectors	Supelco
Column switching in capillary gas chromatography	Siemens
Disposable 2 cm HPLC guard columns	Supelco
Deactivated columns simplify HPLC analysis	Supelco
Guidelines for formulating mobile phases	Supelco
Reference chemicals	Supelco
General catalog	Supelco
Leaflet about "clean room"	Xerox-copy
Leaflet about "clean water"	Xerox-copy
Trends in the World Market of Pesticides	NEVIKI

Annex IX

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