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ESTABLISHMENT OF A PILOT PLANT FOR PESTICIDE FORMULATION

DP/MYA/80/011

UNION OF MYANMAR

Technical report: Findings and Recommendations

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

Based on the work of Brian Crozier
Consultant in pesticide quality control analysis

Backstopping officer: B. Sugavanam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

2/

* This document has not been edited.

V.91-21750

ABBREVIATIONS AND ACRONYMS USED

Local currency equivalent US$1=K5.62

ai	Active Ingredient
AOAC	Association of Official Analytical Chemists
CIPAC	Collaborative International Pesticides Analytical Council Ltd
EC	Emulsifiable Concentrate
ESCAP	Economic and Social Committee for Asia and the Pacific
FAO	Food and Agriculture Organization (of the United Nations)
GIFAP	International Group of National Associations of Agrochemical Manufacturers
GLC	Gas Liquid Chromatography
GLP	Good Laboratory Practice
HPLC	High Performance Liquid Chromatography
MAS	Myanmar Agricultural Service
MOA	Ministry of Agriculture
MPI	Myanma Pharmaceutical Industries
PPPF	Pilot Plant for Pesticide Production
QC	Quality Control
RENPAP	Regional Network for Pesticides in Asia and the Pacific
SK	Superior Kerosene
TLC	Thin Layer Chromatography
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization (of the United Nations)

ABSTRACT

Title:	Pesticide Quality Control Chemist
Number:	DP/MYA/80/011/11-56
Purpose:	To establish a liquid pesticide formulation plant in Myanmar
Duration:	Two month split mission :- 31 October 1990 to 30 November 1990 and
Conclusion:	The purpose-built laboratory for quality control of the formulations prepared by the plant has been well set-up and can adequately cope with all present demands,assuming there is no major equipment malfunction. The possible requirement for expansion of the range of pesticides has been investigated and the consequences of a move towards the use of locally available solvents and alternative sources of technical active ingredients and formulants discussed.
Recommendations:	Some additional instrumentation is considered necessary. Local purchase of some minor items would assist in the work of the laboratory. Further staff training is required Another consultancy would be of great benefit.

TABLE OF CONTENTS

INTRODUCTION

The Project is part of the Government of Myanmar's aim to maintain a relatively pest-free environment for the production of essential crops and to increase and intensify the cultivation of commodity crops including cotton, rice, pulses, vegetables and citrus for home consumption and export.

The Project is intended to supply the needs of the country for liquid insecticide formulations and then to begin to develop formulations based on locally available materials such as solvents, and to identify alternative, cheaper, sources of technical active ingredients and formulating agents. A further project is then intended to develop the capabilities of the plant to formulate granular products.

The PPPF has been installed and commissioned by SICPLANT (Italy) and is now fully operational. The Quality Control laboratory was purpose-built and essential instrumentation and other laboratory supplies have been provided through UNIDO, commencing in 1988.

This report has been written by Brian Crozier, Consultant in Pesticide Quality Control, based on the Job Description given in Annex I.

The mission, totalling two months, has been split and this report is based on the first month in November 1990; the follow-up month will be at a time to be arranged in 1991.

The basic objectives are the training of the laboratory chemists in current analytical techniques, to organize the work of the laboratory and to advise on equipment necessary to enable the laboratory to fulfill its duties in the foreseeable future.

Much of the basic training has been completed in the first part and future requirements have been identified, Further training will take place in the second part of the mission and installation and commissioning of any new equipment undertaken.

I. ARRANGEMENT OF THE QC LABORATORY AT PPPF

A. Accommodation

The building has been designed as a laboratory and the lay-out is as shown in Annex II.

The necessary rooms are well equipped with benches, albeit not chemically resistant, appropriate fume cupboards are provided and air-conditioning and de-humidification are installed where necessary. Rooms for storage of glassware and chemicals are well supplied with shelves.

A room has been designated as a medical room but any facilities within are negligible.

The balance room is equipped with appropriate stable benches and emergency showers are available on both floors.

Office and storage space are adequate.

B. Staff

The staff at present numbers five. There are two qualified and experienced members, the Laboratory Manager and his Deputy; and there are three qualified staff.

This complement is sufficient for the present and foreseen workload in terms of numbers, but some further training needs have been identified.

C. Equipment

Instrumentation is adequate at present, but needs strengthening as a back-up in the event of mechanical or electronic break-down, which will also provide for future needs.

Stocks of glassware and general chemicals are sufficient, but a number a number of special chemicals should be purchased.

Protective equipment is adequate, but some safety and medical supplies are needed.

The library needs some up-to-date standard texts and some minor items for the tool kit should be obtained.

D. Services

Failures in the electrical supply are frequent. A stand-by emergency generator has been provided by UNIDO but tenders for installation are still being received.

Only one refrigerator is available and this was out of action during most of November 1990; a second should be obtained and protected by a stabilised voltage supply.

II. ACTIVITIES

A. Theory

It was intended to carry out a programme of lectures on various topics in analytical chemistry and pesticide chemistry under the following scheme:

1. Safety in the Laboratory
   Basic First Aid
2. Chromatography
   2.1. General
   2.2. Paper
   2.3. TLC
   2.4. Column
   2.5. GLC and Capillary Column GC
   2.6 HPLC
   2.7. Other
3. Spectroscopy
   3.1. UV/Visible
   3.2. Infra-Red
   3.3. Mass Spectroscopy
   3.4. Other
4. Pesticides
   4.1. Formulation
   4.2. Specifications
   4.3. Registration
   4.4. Formulation Analysis
   4.5. Usage
   4.6. Residues
   4.7. Analytical Methods for Pesticide Residues
   4.8. New Trends
5. Determination of Physical Properties
   5.1. Physical Properties needed for Specification and Registration
6. Good Laboratory Practice
   6.1. Standard Operating Procedures
   6.2. GLP applied to Pesticide Analysis
7. International Organizations
   7.1. CIPAC
   7.2. AOAC
   7.3. FAO

7.4. WHO

7.5. UNIDO

7.6. GIFAP

7.7. RENPAP

7.8. ESCAP

8. Trouble-shooting and Maintenance of Equipment

This full programme has not been completely finished but a recap on topics covered and the remainder of the programme will be undertaken during the second half of the mission.

B. Practical

Activities in the practical area were concerned with aspects of GLC analysis and methods for physical properties required to characterise emulsifiable concentrate formulations, viz.:

1. GLC
   1.1. Injection system
   1.2. Detectors
   1.3. Preparation of column packing material
   1.4. Packing glass GC columns
   1.5. Conditioning new columns
   1.6. Trouble-shooting and maintenance
2. Physical Properties
   2.1. Acidity, alkalinity, pH
   2.2. Water content
   2.3. Stability to heat (and cold)
   2.4. Persistent foam
   2.5. Flash point
   2.6. Viscosity
   2.7. Emulsion Stability and Spontaneity of Dispersion
   2.8. Density

Again, not all of these topics have been fully covered during the first mission.

Emphasis in all cases has been made on the use of agreed, collaboratively tested methods such as those of CIPAC, and reference to FAO Specifications.

C. Job Description

The job description in Annex I mainly refers to QC in the laboratory, but reference is also made to discussion with the Ministry of Agriculture. This latter is discussed in Chapter III, together with a widening of the job description to cover pesticide formulation and testing for phytotoxicity and efficacy, at the request of the project personnel.

D. Visits

Visits were made to the Myanmar Agricultural Services, Plant Protection Project Headquarters and Laboratory.

III. FURTHER WORK, FORMULATION AND BIOLOGICAL TESTING

The Government and Project Authorities are anxious to increase the independance of the PPPF and to reduce the reliance on foreign companies for supplies which use valuable foreign exchange.

To this end the PPPF QC laboratory staff have been trying to develop new formulations, in the main based upon the use of locally produced solvents such as superior kerosene (SK), but also by the use of different emulsifier systems.

The PPPF is also hoping to extend the range of available insecticides by formulating deltamethrin and fenvalerate; and the range of formulations by building a plant to produce granular formulations.

There are several ramifications which need to be thoroughly explored and economically quantified if any or all of these actions take place. The Consultant is not qualified in all of these areas but has advised on the analytical aspects and gives some thoughts on the others.

A. Development of other active ingredients

Deltamethrin and fenvalerate are synthetic pyrethroids, as is cypermethrin which is already formulated at the PPPF. The individual members of this class of compounds all have several optical or diastereoisomers which can vary tremendously in their insecticidal efficacy.

Specifications for the purchase of technical material for formulating will have to cover this point and the QC laboratory must be able to verify the isomer ratio of both the incoming technical product and the outgoing formulation. The present analytical equipment capacity does not enable this to be done. There are two alternatives: Capillary Column GC or HPLC. The Perkin Elmer 8500 GC has a split/splitless capillary injection system fitted (but no instructions for use) and a capillary column is available. Capillary columns are very expensive and can be easily degraded and made ineffective if not treated carefully. The use of Capillary Column GC would increase the reliance on the one major piece of instrumentation and in the event of a breakdown would lead to long delays before a sevice engineer could repair it. Use of HPLC would avoid both these drawbacks and is the preferred option.

B Development of locally available solvents

To reduce the need for importing xylene, tests are being carried out to develop formulations using superior kerosene, which is produced in Myanmar, as a solvent. One batch of experimental formulation has been prepared and sent to MAS for phytotoxicity testing.

The refinery which produces SK cannot guarantee batch to batch conformity with the required specification for SK, but is prepared to produce the whole annual requirement, to the agreed specification, in one specially manufactured batch. There is not adequate storage capacity for this amount of SK at the PPPF.

Thus either enlarged storage capacity must be provided or phytotoxicity tests must be carried out on each batch of SK before formulation begins.

Phytotoxicity testing requires much time and will necessitate either continued input from MAS or the setting up of a unit at the PPPF to carry out the work. There are several Experimental Stations within MAS, eg., Lapotan, Hlegu and Shwe Na Ya, which can carry out phytotoxicity trials but the required timing cannot be guaranteed. A unit at the PPPF would require a prepared site for cultivation of at least four of the major crops necessitating the employment of a graduate in Agriculture together with two qualified assistants and a number of labourers. The trials would have to be statistically valid and, as a minimum, four replicates of the control and three varying concentrations of the recommended dose rate requires 16 plots. Spraying must be reproducible from plot to plot (boom sprayer) and adequate protection from drift to adjacent plots provided.

Advice from the MAS Technical Expert is that, so long as well-founded ai are used, efficacy testing is not essential.

C. Development of new emulsifier systems

To reduce reliance on a small number of suppliers of emulsifiers, both in the area of reducing the amount of emulsifier needed and offering the possibility of cheaper sources of supply, the staff at the PPPF QC laboratory have been asked to develop new formulations trying different emulsifiers. Most EC require the use of paired emulsifiers and expert advice is needed from a formulation chemist.

In all of this planning of future work the possible requirements of the proposed Pesticide Law should be borne in mind and that even more biological testing of new formulations may be required.

IV FINDINGS AND CONCLUSIONS

Based on the first month (November 1990) of a two month mission.

A. Accomodation

The laboratory is purpose-built and is satisfactory.

B. Staff

The two qualified and experienced staff, together with the three qualified staff, are sufficient for the present and foreseen workload.

C. Equipment

1. Instrumentation

There is one major analytical instrument, a Perkin Elmer 8500 Gas Chromatograph. It is now fully operational (after some maintenance) but in the event of its failure there is no alternative method of analysis for the active ingredient in the prepared formulation.

A significant part of the formulations prepared is based on synthetic pyrethroids; if alternative sources of the technical materials are sought (for economic reasons), confirmation of the isomer ratios is essential and can only be done satisfactorily by HPLC.

An HPLC isocratic system should be purchased.

This would provide a basis for alternative methods for the determination of the ai.

Other alternatives, a UV/Visible spectrphotometer and a basic TLC set-up, should also be provided.

Purified water for use in analysis is provided by a still. Distilled water can have a variable pH and a more suitable reagent is deionised water.

A simple mixed bed resin deionising column should be provided for the laboratory.

2. Glassware

Stocks are ample for the foreseeable future.

3. Chemicals

Stocks of general chemicals are sufficient but they do get consumed. In particular, if HPLC is installed the range and use of solvents will increase.

The annual budget for the replenishment of essential chemicals should be maintained.

The laboratory staff keep good records which will give an indication of annual consumption.

4. GC Accessories

Stocks are adequate, although some extra stationary phases need to be obtained. [Required spares for the NITROX generator and CHROMPACK filter are being investigated].

5. Pesticide standards and special chemicals

These have a definite shelf life and the expiry dates must be observed. Fresh certified analytical grade samples should be obtained from the manufacturers as necessary for use in calibrating technical material as secondary standards.

6. Protective equipment/safety equipment

Supplies of disposable gloves, rubber gloves, dust masks, goggles are adequate. However three eyewash bottles are needed, two for the general laboratory and one for the instrument room.

First Aid supplies in the 'Medical Room' are non-existent. A basic First Aid kit must be provided or assembled.

7. Literature

The library in the laboratory is equipped with only the basic CIPAC Handbooks and several other, by now quite old, textbooks. A selection of books from the list in Annex VI would form the nucleus of a reasonable library.

8. Tools

Whilst there are sufficient basic tools, a number of additional pieces would be useful Purchase of the tools listed in Annex VII can be made locally or from the usual laboratory supply houses.

D. Sampling

The procedure for taking samples from the formulation plant is satisfactory.

E. Organization

No changes are necessary.

E.Services

A stand-by emergency generator for automatic use in the event of a power failure has been supplied by UNIDO; it is still awaiting installation.

The process of evaluating tenders should be completed without further delay.

G. Facilities

Pesticide standards, both solid and in solution, should be stored in a refrigerator. The one refrigerator available was away for repair during most of my stay in November 1990.

A second refrigerator/freezer, together with appropriate voltage stabiliser would provide cover for another such occasion.

Many residues in volumetric flasks, beakers etc., can be removed only by thorough washing, preferably in hot water.

An over-sink wall-mounted water heater (if a suitable one can be identified) would provide instantaneous hot water.

H. Training

Training must be on-going.

The three inexperienced chemists should attend a suitable training course arranged by the RENPAP organization.

Participation in collaborative analyses gives valuable experience and allows results to be compared.

The laboratory should take part in suitable trials organised by CIPAC.

One or both of the experienced chemists should attend a suitable course of GC instrument maintenance.

This should preferably be with the Perkin Elmer organization nearest which can provide facilities.

[Alternatively, PE could be approached to organize a suitable course in Myanmar since the PPPF is not the only laboratory with PE equipment].

I. Consultancy

Part of the work of the laboratory is the development of new formulations using locally available solvents etc., and new sources of emulsifiers.

A consultant experienced in the area of formulation development could provide valuable advice during a one or two month mission.

V ACKNOWLEDGEMENTS

The Consultant would like to acknowledge the help and advice received from all those listed in Annexes III and IV. Both within and without the laboratory everyone has been more than willing to spend time and trouble on his behalf.

RECOMMENDATIONS

Priority	Ref to IV	Item	Action
1	3.1	HPLC Isocratic System	UNIDO
2	3.1	UV/VIS Spectrophotometer	UNIDO
3	3.1	TLC System	UNIDO
4	6	Installation of stand-by generator	MPI
5	8	Training in GC maintenance	UNIDO
6	8	Training in analytical techniques	UNIDO
7	3.7	Books for library	UNIDO
8	9	Consultancy in pesticide formulation	UNIDO
9	3.1	Mixed bed resin deionising column	UNIDO
10	7	Refrigerator/freezer	UNIDO/MPI
11	8	Collaborative analyses	PPPF
12	7	Hot water provision	UNIDO
13	3.6	Three eyewash bottles	MPI
14	3.6	First Aid kit	MPI
15	3.3	Budget for consumable chemicals	MPI
16	3.8	Tools for laboratory	MPI

ANNEX I

JOB DESCRIPTION

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

DP/BUR/80/011/11-56

Post title	Pesticide Quality Control Chemist
Duration	2 m/m (split mission if needed)
Date required	As soon as possible
Duty station	Yangon, Myanmar (with travel to project site)
Purpose of project	To establish a liquid pesticide formulation plant in Myanmar.
Duties	The consultant, in consultation with the project authorities, is expected to assist in completing the laboratory set-up, provide training to the analytical chemists in following standard operational practice and good laboratory practice. He is also expected to assist in getting various chemicals, equipment, spare parts and in organizing the laboratory according to plans already agreed. He must participate in discussions with the project authorities and also with the Ministry of Agriculture as to how they could co-ordinate activities so that the quality standards are maintained (mainly FAO specifications using CIPAC methodologies). Following his assignment, the expert will submit a report giving his findings and recommendations.
Qualifications	A chemist with extensive experience of analysis of pesticides either in an industrial or Governmental laboratories. Should have experience with regulatory authorities and also in the developing countries. He should be familiar with g.l.p., international standards and analytical methods accepted for pesticides as standard method.

Background Information

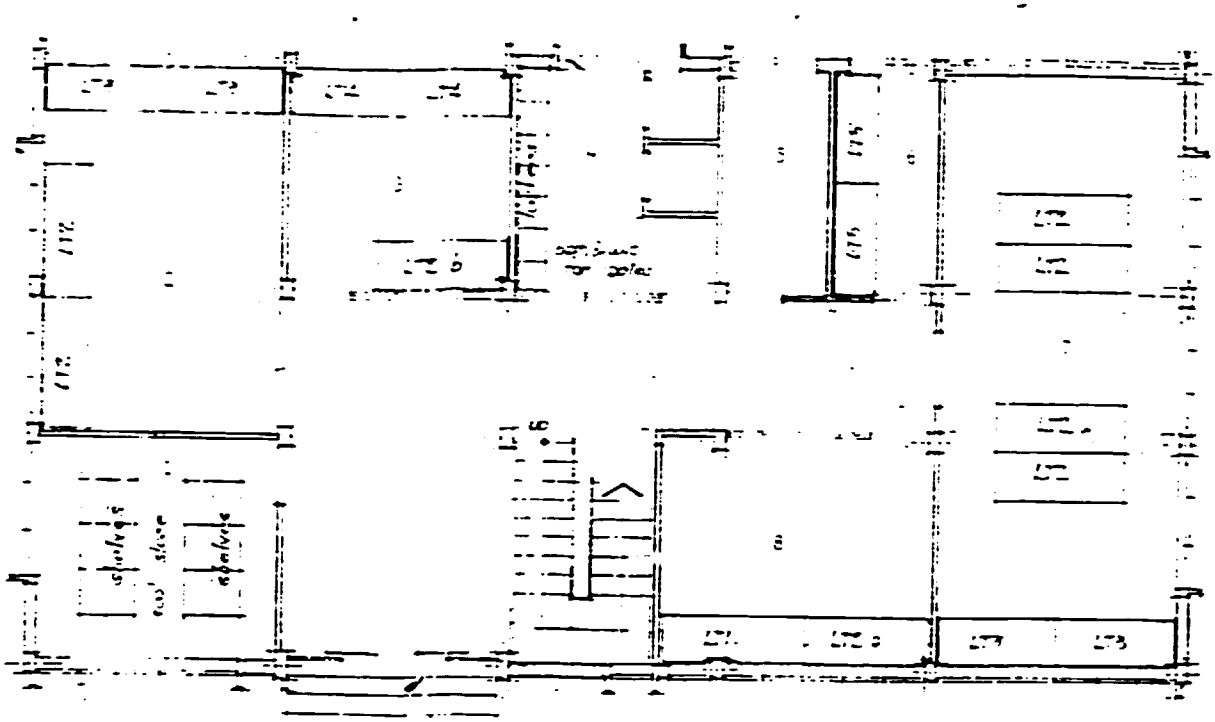
The backbone of Myanmar's economy is agriculture and the staple crops are rice, cotton and sugar cane. At one time Myanmar was a major exporter of rice but now, due to lack of fertilizers and pesticides, the productivity in agriculture has declined considerably. The country has to import all its pesticide requirements as finished products. Due to shortage of foreign exchange, supply of pesticides has been erratic and always below the requirements. Having realized the importance of proper supply of pesticides, the Government of Myanmar approached UNDP/UNIDO for technical assistance in the establishment of a pesticide formulation plant.

Based on various studies conducted by UNDP and UNIDO, it has been decided to set up a liquid formulation plant (F.C) making use of the locally available solvents as much as possible in combination with standard solvents such as xylene.

The project will be executed by UNIDO with the Pharmaceutical Industries Corporation (PIC) as the National Counterpart Agency. The plant will be established at 50 km north of Yangon, and a site is being made ready for the plant. The basic infrastructure is being created by providing all utility services, analytical laboratory, a small pilot plant, trained staff and the necessary safety precautions.

ANNEX II

LABORATORY PLAN



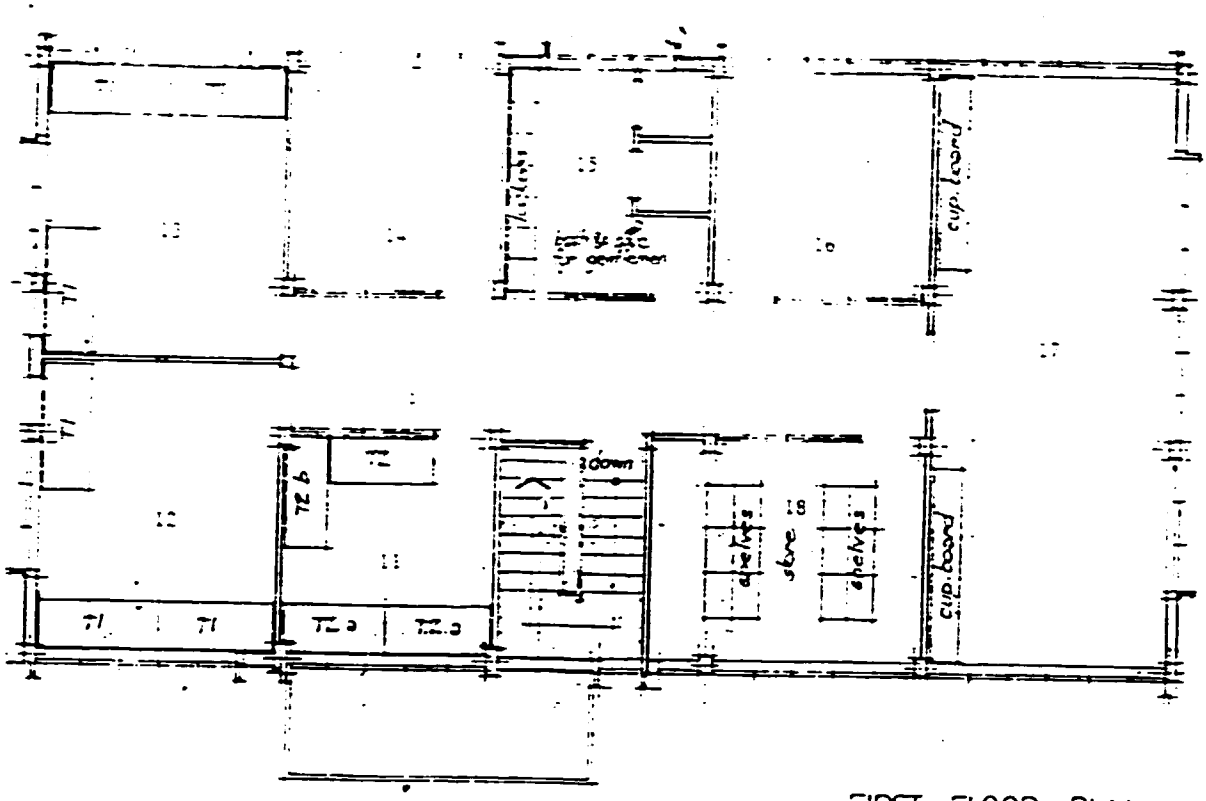
GROUND FLOOR PLAN

LEGEND

1. Cool Store for Solvents A/C
2. Medical Room A/C
3. Instrumentation Laboratory A/C and D/H
4. Toilet and Emergency Shower
5. Water Distillation
6. Photocopier
7. Lecture Room
8. Retained Sample Store

A/C = Air Conditioned

D/H = Dehumidified



FIRST FLOOR PLAN

LEGEND

11. Oven Room A/C
12. Office
13. Library
14. Office A/C
15. Toilet and Emergency Shower
16. Balance Room A/C and D/H
17. General Laboratory A/C X2
18. Equipment and Glassware Store

A/C = Air Conditioned

D/H = Dehumidified

ANNEX III

SENIOR COUNTERPART STAFF

Myanma Pharmaceutical Industries and Project Personnel

U Ban Yi	Planning Director
U Win Kyi	National Project Director
U Myint Swe	Project Manager
U Saw Moo Ler	Laboratory Manager
U Mon Tin Win	Assistant laboratory Manager
U Saw Win	Production Manager
U Nyo Lay	Maintenance Manager

ANNEX IV

INSTITUTIONS AND PERSONS CONTACTED

United Nations Personnel

U Htin Aung	Programme Officer
Dr Gaston Pierrard	Chief Technical Adviser, Pest and Pest Management FAO
Dr Arpad Ambrus	Pesticide Analyst FAO
Dr Visi Eva	Analytical Chemist FAO

Ministry of Agriculture

U Maung Maung Tin	Project Director, Plant Protection Project, Myanma Agricultural Service

ANNEX V

EQUIPMENT TO BE PROVIDED BY UNIDO/UNDP

All prices quoted in Pounds Sterling

1. HPLC System
   eg., Perkin Elmer
   Series 250 Pump, Isocratic (3600);
   Model 290 UV/VIS Detector (4300);
   7125 Injection Valve (890)
   R-100 Recorder (1680) or
   LCI-100 Integrator (2600)

2. UV/Visible Spectrophotometer
   eg., Perkin Elmer
   Lambda 2 (5000)

3. Basic TLC Equipment
   eg., Basic Starter Kit Alltech UK (also in Hong Kong)
   Cat. No. 7640 Price 105.00
   also requires solvents, spray reagents, UV lamp (198.00).

4. Mixed Bed Deionising Column
   eg., Permutit Company Ltd
   632/652 London Road
   Isleworth TW7 4EZ
   UK
   CD250 249.00, 2 replacement cartridges 69.00
   CD500 359.00, 4 replacement resin packs 149.00

5. Water Heater
   eg., Heatrae-Sadia
   through Electricity Company (Luton)
   price 59 to 105 (plus fitting).

ANNEX VI

BASIC REFERENCE TEXTS FOR PESTICIDE ANALYSIS

1. Manuals and Reference Books

1.1 Manual of Chemical Methods for Pesticides and Devices

US EPA. Published and distributed by the Association of Official Analytical Chemists, Washington DC, USA.

1.2 Official Methods of Analysis. 15th Edition, 1990

Editor W Horwitz

Association of Official Analytical Chemists, Washington DC, USA

ISBN 0 935584 42 0

1.3 The Pesticide Manual 8th Edition 1987

Editors Charles R Worthing and S Barrie Walker

British Crop Protection Council, England

ISBN 0 948404 01 9

1.4 Analytical Methods for Pesticides and Plant Growth Regulators Volumes I to date

Editors G Zweig and J Sherma.

Academic Press, New York, USA

ISBN 0 12 784314 0

1.5 The Agrochemicals Handbook 2nd Edition

The Royal Society of Chemistry, Nottingham England

ISBN 0 85186 416 3

1.6 Statistical Manual of the AOAC

[Statistical techniques for collaborative tests -W J Youden and

Planning and analysis of results of collaborative tests -E H Steiner]

AOAC, Washington, USA 1975

1.7 CRC Handbook of Chemistry and Physics 70th Edition 1989

Editor in Chief R C Weast

CRC Press Inc, Boca Raton, FLA, USA

ISBN 0 8493 0470

1.8 The Merck Index 11th Edition 1989

Editor S Budavari

Merck and Co Inc., Rahway, NJ,USA

ISBN 911910 28 X

2. Pesticide Formulation and Analysis

2.1 CIPAC Handbooks I(1970), IA(1980), IB(1983), IC(1985), D(1988)
Black Bear Press Ltd, Cambridge, England

2.2 CIPAC Proceedings Volumes I(1979), II(1980), III(1981)
Black Bear Press Ltd, Cambridge, England

2.3 Pesticide Formulation
Editor Wade van Valkenberg
Marcel Dekker Inc, New York, USA
ISBN 0 8247 1695 7

2.4 Formulation of Pesticides in Developing Countries
UNIDO, Vienna, Austria. 1983
UN Publication sales number E.83.II.B.3

2.5 Pesticides. Preparation and Mode of Action
R Cremlyn
John Wiley & Sons 1978
ISBN 0 471 99631 9

3. Pesticide Residues

3.1 Advances in Pesticide Science. Parts 1, 2 and 3
IUPAC, Editor H Geissbuhler
Pergamon Press, Oxford, England
ISBN 0 08 022349 4

3.2 FDA Pesticides Analytical Manual
Food and Drug Administration, Washington DC, USA

3.3 Manual on Analytical Methods for Pesticide Residues in Foods
Health Protection Branch, Health and Welfare Canada, Ottawa, Canada

3.4 Laboratory Manual for Pesticide Residues Analysis in Agricultural Products
Compiled by R B Maybury, Pesticide Laboratory, Food Production and Inspection Branch, Agriculture Canada, Ottawa, Canada

4. Gas Chromatography

4.1 Basic Chromatography

H McNair and E J Bonelli

Varian Inc., 1974

4.2 The Packed Column in Gas Chromatography

W Supina

Supelco Inc., Bellefonte, PA, USA, 1974

4.3 Gas Chromatographic Detectors

D J David

Wiley Interscience, New York, USA, 1974

4.4 Detectors in Gas Chromatography

Jiri Sevcik

Elsevier Scientific Publishing Co., 1975

ISBN 0 444 99857 8

4.5 Chromatographic Systems. Maintenance and Troubleshooting

John O Walker, Minor T Jackson Jr and James B Maynard

Academic Press Inc. 2nd Edition, 1977

ISBN 0 12 732052 0

4.6 Analytical Gas Chromatography

Walter Jennings

Academic Press Inc., 1987

ISBN 0 12 384355 3

4.7 Gas and Liquid Chromatography

Roger Smith

4.8 Modern Practice of Gas Chromatography

Editor Robert L Grob. 2nd Edition, 1985

ISBN 0 471 87157 5

5 High Performance Liquid Chromatography

5.1 High Pressure, High Resolution Liquid Chromatography and its Application to Pesticide Analysis and Biochemistry
D A Schooley and G B Quistad
In Progress in Drug Metabolism Volume 3 Editors J W Bridges and L F Chasseau
John Wiley and Sons Ltd , 1979
ISBN 0 471 99711 0

5.2 Introduction to High Performance Liquid Chromatography
R J Hamilton and P A Sewell
Chapman and Hall 1982
ISBN 0 412 23430 0

5.3 Maintaining and Troubleshooting HPLC Systems. A User's Guide
Dennis J Runser
John Wiley & Sons Ltd, 1981
ISBN 0 471 06479 3

5.4 High Performance Liquid Chromatography
M T Gilbert
Wright, Bristol, England 1987
ISBN 0 7236 0897 0

5.5 Introduction to Modern Liquid Chromatography
L R Snyder and J J Kirkland
John Wiley & Sons Ltd, New York, USA 2nd Edition 1979

5.6 Basic Liquid Chromatography
E L Johnson and R Stevenson
Varian, Palo Alta USA 1978

5.7 High Performance Liquid Chromatography
Editors P R Brown and R A Hardwick
John Wiley & Sons Ltd. 1989
ISBN 0 47184506 X

5.8 Pesticide HPLC Method Development
L R Snyder, J L Glajch and J J Kirkland
John Wiley & Sons Ltd 1988
ISBN 0 471 62782 8

5.9 Reversed-phase High Performance Liquid Chromatography
Ante M Krstulovic and Phyllis R Brown
John Wiley & Sons 1982
ISBN 0 471 05369 4

6 Pesticide Usage

6.1 Handbook on the Use of Pesticides in the Asia-Pacific Region
Asian Development Bank, Manila, Philipines 1987

ANNEX VII

LIST OF REQUIRED TOOLS

The following tools are required for laboratory maintenance and can be purchased from the local budget

1. Hand drill
2. Drill bits, 1 to 10mm
3. Knife, eg., X-Acto knife
4. Selection of pliers, flat-, round-, long-nosed
5. Jeweller's screwdriver kit
6. Sandpaper - various
7. Wire bristle brush
8. Dental mirror, plain with rotating head
9. Diamond knife for cutting glass tubing
10. Knife for cutting glass capillary columns

ANNEX VIII

PROPOSED TRAINING PROGRAMME

1. **Maintenance of GC (and HPLC) Instrumentation**

   The Laboratory Manager and Assistant Manager (one or both) to attend a suitable course organised by the Perkin Elmer Corporation at a convenient locality

   As an alternative, Perkin Elmer could be asked to organise such a course in Yangon since there are several laboratories with Perkin Elmer equipment and more staff would be able to attend.

2. **Training in modern Analytical Techniques**

   The three qualified, but inexperienced, staff of the QC laboratory to attend the next available course organised by the RENPAP. Courses have been held at the Agricultural Toxic Substances Division in Bangkok in the past.

ANNEX IX

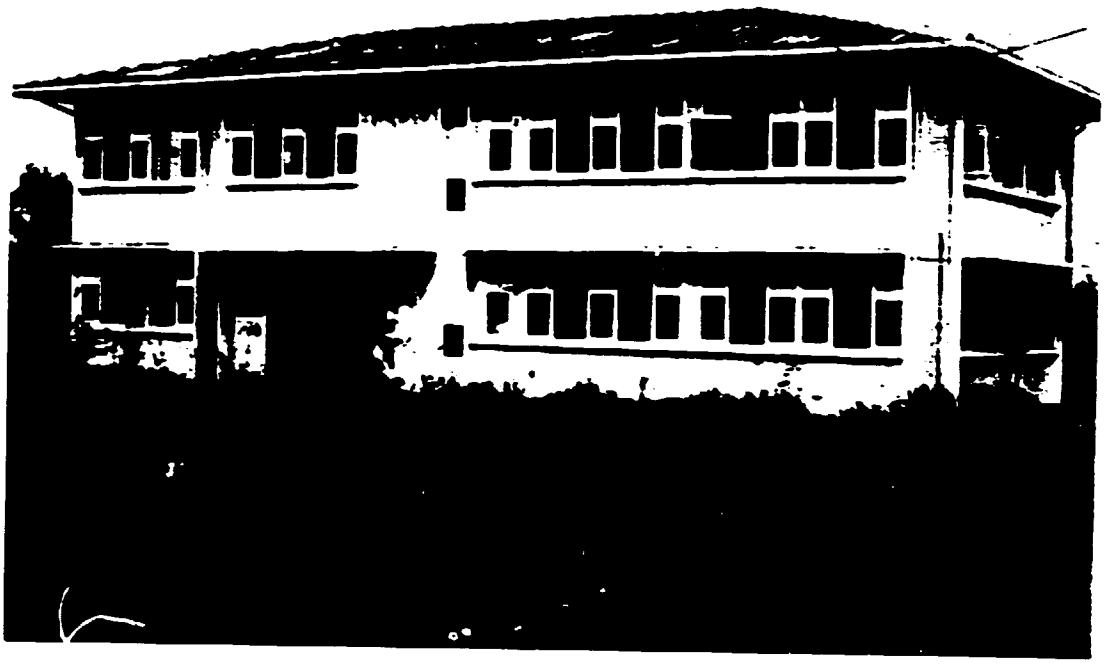
PHOTOGRAPHS

I The Laboratory

II General Laboratory, fume cupboards

III Instrumentation Laboratory, Perkin Elmer 8500 Gas Chromatograph

IV Instrumentation Laboratory, Nitrox air and nitrogen generator, hydrogen generator



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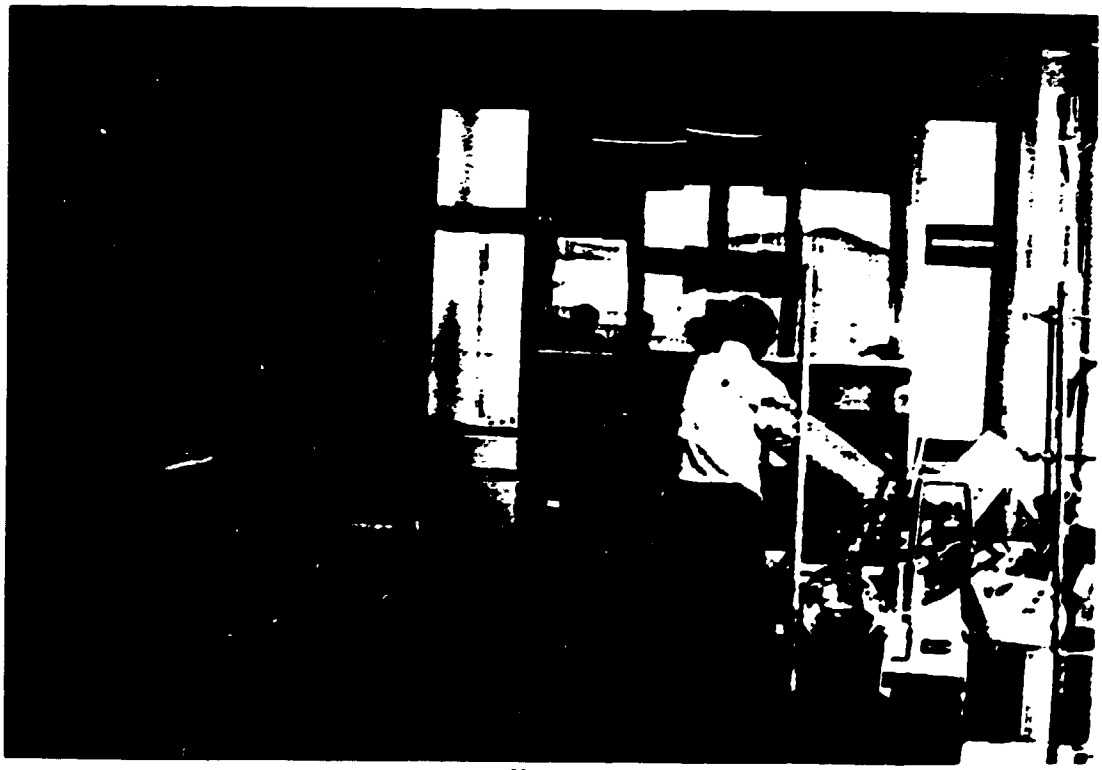

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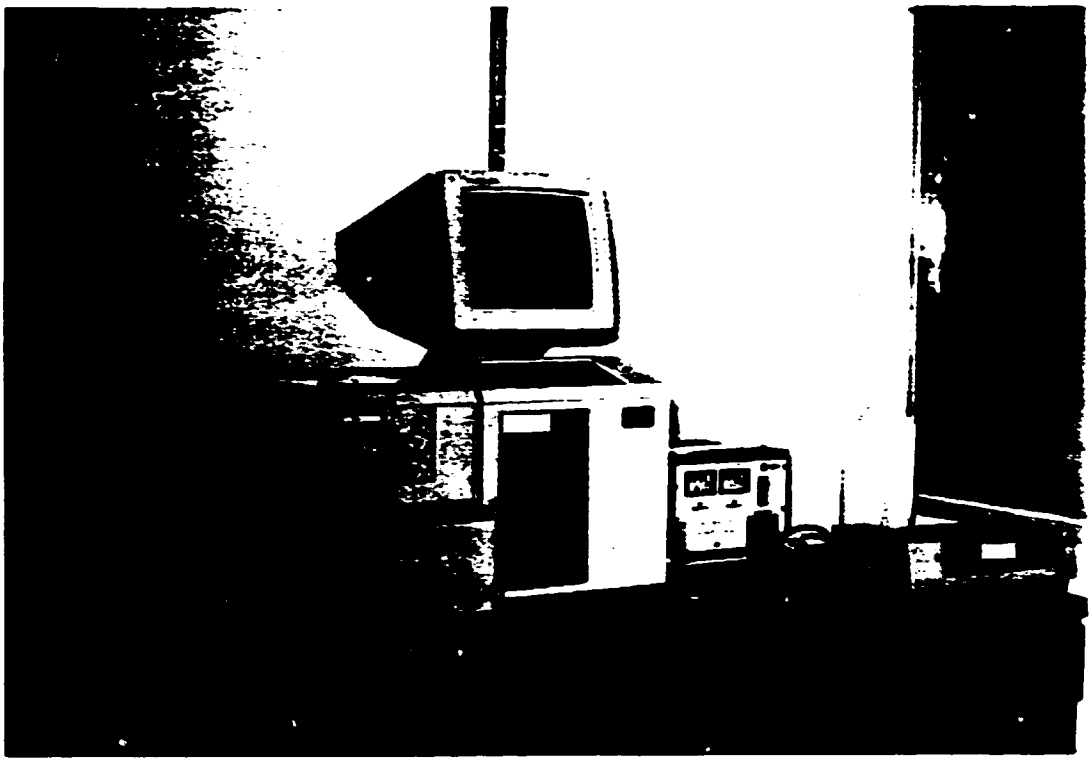

III

IV

UNIDO'S SUBSTANTIVE COMMENTS

DO/MYA/80/011

Establishment of a pilot plant for pesticide formulation

Technical report of Mr. Brian Crozier

Introduction

In order to establish a fully functional quality control laboratory, UNIDO assigned an expert to assist the project authorities to train an analyst in carrying out proper running of the laboratory following good laboratory practice (glp).

Comments

The expert has clearly given a very good training according to his terms of reference and has pointed out that many of the requirements for the laboratory are satisfactory but the laboratory is still far from the standards one would expect for a quality control laboratory. The supply facilities are still not fully functional and a few more items of equipment and books need to be provided.

The report is only an interim report and before the expert's second assignment, some of the essential equipment given in page 15 and annex VII should be ordered. The budget provision for all equipment including packaging provision is not sufficient and would need revision. This should be considered in the next tripartite review meeting.