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ASSISTANCE IN START-UP OF PESTICIDE FORMULATION PLANT AT MOSHI

SI/URT/93/802

TANZANIA

Technical report: Findings and recommendations*

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

Based on the work of Klaus Ziller,
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* This document has not been edited.

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TABLE OF CONTENTS

TABLE OF CONTENTS (contd)

LIST OF CONTACTS

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LIST OF ABBREVIATIONS & ACRONYMS

CIPAC	Collaborative International Pesticides Analytical Council Limited
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practice
GIFAP	International Group of National Associations of Manufacturers of Agrochemical Products
GLP	Good Laboratory Practice
IPM	Integrated Pest Management
MOA	Ministry of Agriculture
NCI	National Chemical Industries
NDC	National Development Corporation
TISCO	Tanzania Industrial Studies and Consulting Organization
TPRI	Tropical Pesticides Research Institute
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Programme
WHO	World Health Organization

MEASURES:

cbm	cubic meters
sqm	square meters
dC	degrees centigrade

CURRENCY:

TSH = Tanzanian Shilling (May 1995: 1 USD app. 550 TSH)
USD = U.S. Dollar
ECU = European Currency Unit

PREFACE

Background and history of the project

The economy of Tanzania is largely based on the productivity and efficiency of its agricultural sector producing for local consumption as well as providing export revenues. Use of agrochemicals, including plant protection products, together with modern farm management practices play an increasing role in crop production and provide a steady and even increasing market for pesticides in Tanzania. Upon recommendation of a fact finding mission in 1976 the Government of Tanzania has given priority to the establishment of a pesticides manufacturing and formulation plant in the country.

A feasibility study based on a market evaluation was prepared for the project as early as 1979/80 by two experts from UNIDO following a request by the Government of Tanzania. The feasibility study recommended the establishment of a pesticide complex for manufacturing copper oyxchloride 3000 t/year as well as formulating the following types of pesticides:

wettable powders	3000 t/year
granules	2000 t/year
flowables	1500 t/year

The type of pesticides to be formulated as wettable powders and granules was recommended to be insecticides while that of flowables to be herbicides.

The estimated cost for the project at that time (1980) was TSH 127,0 million of which TSH 60,3 million should have been in foreign currency (equivalent to 7,5 million USD with 1 USD = 8,04 TSH). An investment proposal based on the study was approved by the National Development Corporation Board for implementation. The location of the plant was originally suggested to be in Arusha area and later decided to be in Moshi.

Substantial delays occurred in securing financing from abroad while in 1984 the Italian Government offered to extend o soft loan to the Tanzanian Government for the project. Due to the delays, however, the study was already outdated. Therefore, TISCO, a local consulting company was given the task of updating the feasibility study in order to obtain realistic cost estimates. The updating confirmed the feasibility and resulted in a new cost estimate of TSH 567,6 including 123,5 working capital and equivalent of 354,3 in foreign currency.

Soon after the appraisal, tenders were invited for the supply of machinery, know-how and services. Technimont of Italy were selected and a contract was concluded between them and NCI at a contract price of USD 12,38 million. Negotiations with the Italian Government to increase the original grant by additional 4,9 million USD in order to match the contract became successful in 1985. The Financing Convention was signed in March 1986 with 20% down payment for the contractor effected in August the same year. By this time, however, prices fixed in the 1984 contract already expired by 5 months and accordingly a 22% price increase was requested by Technimont. As a solution, conversion of the original USD price into ECU was agreed in 1987 as an amendment for the contract.

The implementation of the project started in 1986/87 with the erection of houses to accommodate engineers coming for the construction of the plant and was followed by the erection of the workshop buildings. In early 1990 already 80 % of the civil works were completed and 90% of the machinery and equipment already delivered at the site. In the meantime it was agreed that the formulation of the granules will be canceled from the products designed for formulation originally. The rest of the complex has been erected by Technimont in 1990/92.

The installation of the Moshi Pesticides Project caused great concern amongst the people of Moshi about the safety of the plant and the problems of environmental contamination related to its operation. This has been used by the local Green Party as a political tool with clear distortion of the real facts and supported by non scientific argumentation. Finally this resulted in a close down of all activities for a period of two years before start-up activities and performance tests could continue

to be carried out. Meanwhile several efforts were undertaken by NCI and the Government to satisfy the local public that safety has been given utmost importance in the operation of the plant and that no significant environmental pollution is produced under normal conditions.

A high court decision of 1994 enabled NCI to resume activities in 1995. Accordingly Technimont returned to the site and is presently going on with pre-commissioning and commissioning operations.

EXECUTIVE SUMMARY

Objectives of the Mission

The pesticide manufacturing and formulation plant in Moshi was about to be commissioned after a delay of almost three years and an interruption of all activities by a court order due to great environmental and safety concern raised by the public.

The objectives of the mission were to assess the present situation in the quality control laboratory and to assist the counterparts, in consultation with the formulation technology specialist, in the proper organization of the laboratory and the work as well as to extend further training to the staff.

Findings of the Mission

1. At the beginning of the mission, the laboratory was not operational yet as equipment had just been unpacked, but not installed. Likewise the plant was not ready for start-up and commissioning as extended servicing and maintenance became necessary due to the more than two years of interruption period.

2. Basic necessary external services such as water and gas supply were not available at the required specifications within the period of the mission.

3. Some basic equipment or parts of equipment as well as chemicals are still missing, partly due to non conclusive specifications, ordering and delivery.

4. Stocks of chemicals are incomplete or insufficient. Special consideration should have been given to the fact, that most specialized chemicals and reference standards are not available locally and need to be ordered from abroad.

5. The quality control manual, being an important part of the know-how documents supposed to be supplied by Technimont (TCM), was not available during the period of the mission.

6. The safety of the laboratory operation is presently not guaranteed. Hydrogen and oxygen lines as well as nitrogen lines in the laboratory are leaking, the emergency exit cannot be opened from inside, there is neither an emergency shower nor an eye washing station in the laboratory and no fire extinguishers are available. Blankets and first aid equipment are likewise not available.

7. Important calibration procedures cannot be performed as there are no cooling devices available. All glassware is designed to be calibrated at 20 degrees centigrade.

8. Sampling equipment had not been specified or delivered. Likewise the laboratory does not have suitable bottles or containers for storing samples.

9. Some equipment necessary for environmental monitoring and safety checks is not available.

10. Presently the plant does not avail of any incinerator. The special toxic waste collection pond of 26 cbm has no drain and is expected to overflow in less than two months of operation.

11. The training and experience of the staff is not sufficient to carry out all required testing and to accept the responsibility for proper operation of the plant and the release of its products.

12. Additional training on the job is required for an estimated period of not less than 6 months. This would include further organization of operational procedures and implementation of Good Laboratory Practice.

13. The Research & Development activities originally planned to be located at TPRI in Arusha have not started. Although TPRI has sufficient space, there is no equipment and no experience available.

14. Pesticide registration for the products intended for sale has not been started yet. Registration with TPRI according to present rules and regulation is tedious, lengthy and costly and requires comprehensive dossiers

for each of the products. This question was obviously never thought of earlier and consequently these dossiers are not available.

15. It is expected that the plant will have to be shut down again after start-up and test runs, as there are only enough raw materials to cover approximately ten days of operation and NCI having used up their operating capital due to the severe delays and additional expenses encountered.

Proposals and Recommendations of the Mission

16. All safety issues should to be dealt with immediately before the start-up of the plant. Laboratory safety devices have to be supplied and installed and modification made to the emergency exit. The central gas supply has to be thoroughly inspected and used only according to written instructions.

17. All Know-how documents according to the contract should be supplied by Technimont (TCM) well before the start-up of the plant. These documents, especially the Quality Control Manual, should be used in, and as part of the training on the job.

18. Additional equipment and chemicals needed for the operation of the plant within the present portfolio should be delivered by TCM before the final commissioning of the plant.

19. The plant's waste management facilities and procedures should be completed before the start-up of the factory.

20. Research & Development activities which originally were supposed to be carried out by TPRI in Arusha, should be shifted to the plant in Moshi as almost all facilities needed for that purpose are available there within the compound of the plant. TPRI should still cooperate in that field with emphasis on identifying the needs for new formulations according to plant protection requirements in the country and on organizing respective field tests.

21. The issue of pesticide registration should be dealt with and clarified immediately in order to obtain approval to use the production from the start-up and commissioning of the pesticide plant in the country.

22. A medium term intensive training programme should be worked out to cover all aspects of operation, quality control and safety in the plant. As far as quality control and safety aspects are concerned, TPRI should be included. Such a programme could be incorporated in the possible UNIDO project that was under discussion for Research & Development activities.

23. A firm committment from the Tanzanian Government with new financial inputs should be given in order to avoid another shut-down of the plant, which would mean considerable losses on the investment.

24. Additional missions are recommended and should be granted for the final commissioning of the plant along with an instant training on the job for both, Quality Control and Formulation Technology.

INTRODUCTION

BACKGROUND OF THE MISSION

The relatively long history of the project has already been described in the preface of this report. UNIDO, in the past, provided technical advise regarding technology transfer and the type of formulations to be produced in the plant. NCI has also adopted UNIDO's Brussels "Integrated Safety Guidelines for Pesticides Formulatio in Developing Countries". After satisfying the local public that safety has been given utmost importance in the operation of the plant, NCI was allowed to continue its project.

For the commissioning and start of operation of the plant, UNIDO was committed to support NCI, along with the Italian subcontractor, by sending a formulation specialist and a quality control expert to provide the necessary technical inputs for starting and regular operation of the plant.

OBJECTIVES OF THE MISSION

The mission's original objective was to assist the counterparts in the proper organization of the analytical laboratory, its support to production control and the carrying out of analysis according to international standards. In addition to that the consultant was asked by the Tanzanian partner upon arrival to the site to assist also in the assessment of the contractor's performance and fulfillment of the relevant contract in view of the forthcoming commissioning of the plant.

APPROACH AND PROGRAMME OF THE MISSION

At the of arrival of the consultant the laboratory was not operational yet. Equipment had just been taken from it's

boxes and placed into position. Installation was still to be carried out.

In order to proceed faster and make full use of the time, the consultant, together with the two chemists and the environmental engineer, took over some of the installation work keeping in mind to instruct the staff at the same time in the handling and maintenance of that equipment.

The laboratory layout and set-up was inspected and assessed and several instruments and equipment were subjected to performance tests.

In the second week a laboratory specialist from Technimont (TCM) arrived and took over further installation work and also some training of the staff in wet chemical analysis.

Upon request of the environmental engineer some time was also spent on environmental issues and monitoring programmes.

One week of the mission was used to give a special training for Gas Chromatography and the principles of Good Laboratory Practice.

The last two weeks of the mission the consultant worked closely together with the formulation specialist seconded by UNIDO for one month.

During the mission a visit to the Tropical Pesticides Research Institute (TPRI) in Arusha was planned in order to discuss pesticide registration issues as well as Research & Development activities planned for the future.

The laboratory head and the project manager were continuously briefed on the progress of the work and by the end of the mission a summary of the findings was handed to them with one copy send to UNIDO in Dar-es-Salaam and Vienna. This report had to be completed after return to base.

The consultant was contracted for one month starting 23rd of April 1995. The job description is attached in annex [1]. A plan of site of the factory is given in annex [2]

INVENTORY OF EXISTING SITUATION

1. Present status of the plant

The court case raised against NCI in 1992 and the consequent court order to stop all related activities has caused considerable problems to the project, mainly because

a) the plant could not be commissioned according to schedule

b) the working capital that was set aside by NCI has lost its foreign currency value and most of it is meanwhile has been spent already

c) the machinery has suffered during the more than two years of stand still period and has to be completely rechecked and partly overhauled

Technimont (TCM) has come back for that reason with a team of specialists starting last November to do the necessary service and repair work as well as to complete the installations and the pre-commissioning and commissioning of the plant. This work had not been completed yet when the consultant arrived and is also presently still going on.

According to the new preliminary schedule of TCM, the start-up for the chlorine and hydrochloric acid plant will be in week 23, followed by the copper oxychloride production in week 24 and atrazine formulation in week 25.

2. Present status of the Quality Control Laboratory

The building of the Quality Control Laboratory (QC-Lab) has been established in 1992 along with the other buildings of the plant. Equipment, however, which was delivered at that time, was only unpacked in April 1995. Installation had not started yet at the time the consultant arrived.

2.1 Laboratory building

All operations for the quality control within the plant are housed in one building which is located at one end of the compound with easy access to the different parts of the factory.

2.2 Laboratory layout

The laboratory had been designed as a single hall without any subdivision. There is no separate instrument room and also no separate weighing room. Temperature control for the laboratory has not been provided. Only one fumehood is available for both, inorganic and organic chemicals handling and there is no active ventilation for the rest of the hall. For the analytical balance a special weighing table has been placed into the hall but no fume suction is available. Emergency shower and eye washing station are missing and the emergency exit door can only be opened from outside.

Chemical storage space both, inside and outside the laboratory is insufficient and inadequate. The only store room available is far away from the laboratory and adjacent to the social facilities of the plant. There is no special store to keep specimens of production batches or other samples.

2.3 Basic supplies and services

2.3.1 Electricity supplies

Moshi has experienced frequent power cuts and rationing in the past. Therefore the plant had been designed with its

own electrical substation supplied through a preferential high voltage power line at 33 kV. The nominal voltage for the plant is specified in the contract as 230 V +/- 5 % at 50 Hz. Electricity in Tanzania is generated from hydro power plants; throughout the year the demand is bigger than the supply resulting in rationning and frequent power cuts. The electricity company has presently committed themselves for a continous electricity supply over one month only.

In order to monitor the stability of the electricity and to identify spikes and surges a special monitoring device was connected over several days of laboratory operation. The graphs (see annex [3]) obtained from the temporary power connection and a weekend without plant operation show, that the voltage fluctuated between 202 V and 249 V. After the permanent connection to the plant's own transformer recordings show a basically stable voltage around 230 V without load. When running some tests in parts of the plant, however, frequent spikes and surges were recorded (see annex[4]). The extend of interference is not clear at this point as there has been no major operation yet in the plant.

The examination of the electrical circuits in the laboratory revealed that there were not enough circuit breakers available and that an important 3 phase 380 Volts connection point for the water destillation unit was missing. Also the muffle furnace with its 2.8 kW power consumption should have a separate connection. Most electrical outlets were Italian standard with respective plugs needed for the installation of the equipment neither locally available nor provided by the contractor.

2.3.2 Water supplies

Throughout the period of the mission the laboratory had been connected to a temporary water supply from a storage tank located appr. 250 to 300 meters away. The water had very low pressure with temperatures of 26 to 30 degrees. No pre-cooled water is fed from the plant to the laboratory and laboratory chillers are not available. According to the plans the laboratory will be connected to the process water used in the factory.

Whilst the factory avails of a water demineralization unit, no demineralized water is fed to the laboratory. This should still be done by providing a suitable extension from the HCl plant.

In order to operate condensers, temperature baths and water jet vacuum pumps it is recommended to include a laboratory chiller with a recirculating system.

2.3.3 Gas supplies

The laboratory has been fitted with a central gas supply which includes delivery of

* propane
* nitrogen
* hydrogen
* compressed air
* helium

All cylinders are located outside the laboratory in a separate storage place which, however, is not well protected from the sun. Feed lines are of ordinary copper quality with pressure reducers fitted at the gas tanks as well as in the laboratory. No gas purification equipment has been installed or delivered.

Throughout the mission of the consultant the contractor was not able to commission the central gas supply; possibly wrong connections resulted in high pressure (200 bar) in the copper tubes and many leakage's from different fittings. After over tightening the fittings the contractor replaced some by brazing T-connectors to the lines. No instruction manual was available for the central gas supply. One gas tank (hydrogen) is leaking from the main valve. Furthermore one compressed air outlet was connected to the propane gas line.

The present situation is considered very unsafe and dangerous and the partner was advised not to use the central gas supply untill the manuals are available and till the contractor has corrected these problems.

2.3.4 Air-conditioning

Although Moshi has high temperatures throughout the year, no air-conditioning system has been foreseen for the laboratory. It has to be considered that the temperature in the laboratory may not only rise due to intensive sun radiation but also due to considerable power consumption within the lab such as by the water destiller, the muffle furnace or the gas chromatograph which alltogether consume already up to 10 kW during normal operation.

Furthermore it should be considered that many instruments, especially those which are microprocessor controlled, are quite sensitive to high humidity.

Another reason for control of temperature is that the glassware which is delivered is calibrated at 20 degrees centigrade.

2.3.5 Communication

The laboratory appears to have an intercom connection to the administration office; so far no intercom or telephone had been connected. Presently the plant has only one outside telephone line. The telephone system is generally not very reliable, especially not in the raining season. Communication, however, is considered very important, not necessarily only outside but also within the plant.

2.4 Instrumentation and Installation of Equipment

The equipment ordered and delivered by TCM is listed in the following table. Composition of equipment was found to be non conclusive in some cases. If not done so by TCM, instruments were installed and tested by the consultant. Test reports are attached in the annexes whenever appropriate and indicated in the remarks. Some of the equipment showed unsatisfactory performance which is described further in the test reports.

Table 1. Equipment delivered, installed and tested

Equipment	delivered	installed	tested	remarks
gas chromatograph	yes	yes	no	gas leaks. see report[5]
spectrophotometer	yes	yes	yes	performance ok
automatic water destillation	yes	yes	problem	see report [6]
water heating bath	yes	yes	ok	
constant temperature bath	yes	yes	problem	no cooling available
rotary vacuum evaporator	yes		problem	no cooling / vacuum
pH meter	yes	yes	no	buffer missing
drying oven	yes	yes	yes	ok
muffle furnace	yes	no	problem	special line needed
sieve shaker	yes			
wrist action shaker	yes			
tap density apparatus	yes	yes	yes	ok
centrifuge	yes	yes	yes	ok (5000 RPM)
vacuum pump	yes	no	problem	no safety device
microscope	yes			stolen
viscosimeter and bath	yes	yes	yes	no temperature contr.
analytical balance	yes	yes (TCM)	y (TCM)	
laboratory balance	yes	yes (TCM)	y (TCM)	
Wurzschmitt bomb	yes	no		
Orsat apparatus plus Hg lamp	yes	yes (TCM)	problem	lamp holder missing
Carbonate determination app	yes			
Carbaryl determination app	yes			
hotplate / magnetic stirrer	yes	yes	yes	ok
computer system	yes	yes	problem	see report [7]
refrigerator	yes	yes (TCM)	problem	see report [8]
laboratory furniture	yes	yes (TCM)	problem	gas conn. & sinks
fume hood	yes	yes (TCM)	yes	problem with exhaust

Notes: 1) Installation and testing by the consultant unless otherwise noted
2) status as of May 24, 1995 / footnotes refer to reports in annex

Some equipment had been delivered without electrical plugs and with no spare plugs provided by the contractor. Also

the power distribution panel lacks some special circuits and circuit breakers.

The additional equipment suggested by M.Gimeno (1992) has not been purchased and is therefore partly included in the table of additionally needed equipment below. The procurement of an HPLC system will mainly depend on the future portfolio of products formulated.

Table 2. Equipment not delivered but needed in present operation

EQUIPMENT	USE	REMARKS
laboratory chiller	for destillation sets	recirculating system
incubator oven	for CIPAC accelerated storage test	
bath circulator	for CIPAC EC/SC stability tests	with plexiglass bath
cooling bath	for calibration of volumes at 20 dC	range -10 to +95 dC
density meter	general laboratory use	electronic device
ultrasonic bath	general laboratory use	
pipette/glassw. dryer	general laboratory use	
COD apparatus	chemical oxygen demand	
BOD apparatus	biological oxygen demand	
sampling air pump	environmental control	with specific traps
solid sampling tools		
liq. sampling tool set		
Multimeter	service & maintenance	
Set of tools	service & maintenance	
Gas leak tester	central gas supply and GLC	
Toxic gas tracer	warning device for production area	specific to gases
solvent destillation set	purification & recycling of solvents	(additionally suggested)
melting/boiling point a.	quality control / raw materials	(additionally suggested)
new computer system	quality control / certificate	(additionally suggested)
wet sieve analysis set	R & D / CIPAC tests	40 um/diameter 6-9 cm
particle size analyser	R & D	laser spectrum analyser
ball mill incl. ball sets	for flowable (SC) formulation dev.	volume 1x 2 liters

Further equipment may be needed depending on the range of formulated products and kind of raw materials used. In budgeting additional supplies, up to 2000 USD should be kept for assorted auxiliary parts and accessories.

2.5 Glassware and Chemicals

The glassware and chemicals supplied by TCM are not sufficient to run the laboratory. Some important glassware is missing and/or had not been ordered. The same applies to some important chemicals and also to analytical reference standards.

There is no chemical supplier nor a supplier of specialized glassware in Moshi or the surrounding area. Needed items will have to be brought from Dar es Salaam or ordered from abroad.

A list of missing items is given in annex[9] for glassware and in annex[10] for chemicals. Sources for analytical reference standards are given in annex[11]

2.6 Spare parts and supplies

The laboratory has been provided with some spare parts and supplies by TCM, however not enough to guarantee continuous operation over a longer period of time. Moshi is basically a small and remote town which does not offer the necessary infrastructure to supply parts for high-tech equipment. Apart from the fact that there are no companies representing any of the manufacturers of the laboratory equipment used, even simple fuses of specific value (e.g. 0.5 A) could for instance not be readily found in town.

2.7 Service and maintenance

Local service and maintenance is practically not available for most, if not all of the equipment.

Presently the laboratory does not have any tools. A selection of tools including screwdrivers, allen keys and spanners will be required along with some basic measuring instruments.

In view of the difficult situation in Moshi it is recommended to employ an own service engineer. This person should have experience with analytical equipment and be able also to work in the lab along with other technicians.

As an alternative some cooperation with the electronic department of the National Vocational Training Center (NVTC), located next to the pesticide plant, may be achieved. NVTC may be interested to send some students from their chemistry department as trainees to the pesticide plant, especially to process control and the analytical laboratory.

2.8 Qualification & Training of staff

For quality and environmental control NCI has employed seven persons that are presently working in the laboratory. The following table gives some details of their background.

Table 3: qualification and training of staff

NAME	QUALIFICATION	PREVIOUS SPECIAL TRAINING'S
Mr. Zadock NTENGA (laboratory head)	BSc chemistry	1991 - inplant training by TCM, 2.5 m in Italy [a] 1994 - hazardous waste management, 1 m in Sweden
Mrs. Grace MASENGA	BSc chemistry	-
Ms. Margreth KIVUYO	laboratory technician	-
Mr. Philipo SALIMU	laboratory technician	-
Ms. Linda MLAKI	A level science	-
Ms. Amina SWEDI	O level science	-
Mr. Paul KIJAZI	environmental eng.	1992 - hazardous waste management, 2 m in Sweden

Notes: a) according to the trainee the programme was very problematic as the Italian trainers were not able to communicate in English

During the mission the training on the job for the laboratory staff was coordinated with the TCM specialist, who took care of most of the wet chemical analyses and also the spectrophotometrical analyses with the laboratory technicians and the auxiliary staff.

Continuous discussions were held with the chief chemist (Mr. NTENGA) on the organization and operation of the quality control laboratory.

For the two chemists and the environmental engineer a one week training course was held by the consultant as an introduction to GLC (gas liquid chromatography). Apart

from the theory only limited practical instruction could be given as the central gas supply was not operational during the mission.

Also basic principles of GLP (Good Laboratory Practice) were discussed along with data handling and documentation procedures.

It has to be stressed, however, that the little time available was certainly not sufficient to provide comprehensive training on the job. Additional training is badly needed, especially for

- general organization of the lab
- implementation of GLP
- sampling procedures
- performance monitoring
- wet chemical analytical procedures
- practical gas chromatography
- physico-chemical parameter testing
- environmental monitoring analysis
- logical trouble shooting
- service and maintenance of equipment

2.9 Operational procedures

2.9.1 Sampling procedures

So far the Quality Control Manual for the laboratory, supposed to be provided by TCM, was not available. Sampling procedures have not been established yet and the laboratory staff in the past did not receive any specific training in that respect.

According to the chief chemist the laboratory is lacking of special sampling devices, sampling containers and sample storage containers (see also report M. Gimeno, 1992, p.2). Also for the environmental monitoring sampling devices are not available.

For the hydrochloric acid plant an analysis schedule is given in the operating manual of the plant; references are made to specific sampling points which, however, are not marked within the plant.

2.9.2 Work flow

The laboratory is supposed to perform at various times and at different frequencies mainly the following types of analysis:

* verification of raw materials
* process control
* quality of final product
* waste water effluent
* environmental monitoring

It is therefore of utmost importance that sampling and the passage of a sample through the laboratory is carefully planned and controlled to avoid confusion and make best use of staff and equipment. The specific requirements for the work in the plant should be worked out and visualized in a kind of work flow diagram.

2.9.3 Sample receipt and handling

As mentioned earlier there are no sampling devices and containers available. Suitable glass bottles with caps will have to be purchased from abroad.

The introduction of a sample log book with all parameters needed was discussed along with other requirements of GLP.

2.9.4 Test procedures and documentation

There has been no systematic compilation of the QC documents required for the testing of formulation ingredients, finished products and packaging materials. The QC manual should specify this further.

2.9.5 Data recording and reporting

Data from the production will be recorded on special batch cards provided by TCM.

Special laboratory notebooks have been recommended for each of the staff in order to record all relevant test data. For major routine calculations special method and calculation sheets may be worked out.

For data recording, reporting and specifically also for statistical evaluation the computer supplied to the laboratory may be used after upgrading it to present standards. This would facilitate the timely preparation of the QC reports for the Production Manager.

2.9.6 Filing

According to GIFAP all QC reports should be filed under the product name and in batch or invoice order and kept for at least 5 years or for a longer period if local legislation requires it. Likewise laboratory notebooks and calculations sheets should be retained for a similar period, whereas the lab number would be the common reference for all of records. Again the existing computer could be used for indexing and faster access to all documents. Special storage facilities will still have to be provided for that purpose.

2.9.7 Sample storage

Laboratory samples should be retained after testing for a period of at least 2 years. As mentioned earlier already there is no special store room yet for that purpose.

2.10 Analytical procedures and methods

All analytical procedures and methods should be compiled in the QC manual provided by TCM. The manual, however, was not available till the end of the mission.

The analytical and physical test methods should specifically relate to the finished products, all ingredients and packaging materials as well as to the process control and environmental monitoring. Methods must be validated and kept up-to-date.

2.11 Hygiene and safety

According to the consultant's assessment the laboratory staff is not sufficiently aware of the hazards in the plant and the laboratory. They must be further trained and recognize the need for personal hygiene and the use of appropriate safety devices and procedures.

Laboratory coats and eye safety glasses were not available.

The emergency exit has to be modified in order to open from inside and without the need for a key. An emergency shower and an eye washing station will have to be provided along with first aid sets, blankets and fire extinguishers.

The staff should also be familiarized with the handling of special chemicals and the different waste disposal methods.

2.12 Laboratory waste

Presently all laboratory waste goes through the water drainage system to the special waste collection pond.

Special waste disposal procedures should be defined considering that the laboratory is also using toxic organic chemicals that should be separated from water soluble toxic waste and collected in specially marked containers.

3. Pesticide manufacturing and formulation

3.1 Range of products

The original range of products which was proposed in 1980 based on the market demand at that time was covering, apart from copper oxychloride, several insecticides and herbicides including products such as DDT, Dieldrin, Aldrine, BCH, Endosulfan, Carbaryl as well as Atrazine, Simazine, Ametryne, Terbutryn, Diquat and Paraquat. Some of these products have meanwhile been canceled in Tanzania. Some other products are still registered for use whilst some of them are already banned in many other countries and therefore may be banned also in Tanzania in the near future. Potential new products have not been thought of yet.

The raw materials presently available in the store are only for the formulation of copper oxychloride and atrazine and sufficient for an operation of appr. 10 days only. Due to the financial situation of the company after the problems and delays encountered, no additional raw materials could be bought. A list of raw materials in stock is given in annex[11]

3.2 Know-how transfer

A list of Know-how documents to be supplied by TCM is given in annex V of the original contract dated 1984. The list includes amongst others

 # 2: Process parameters showing effect of variation of all operational/process conditions on time, yield and quality of each stage, including Raw materials, Intermediate and Finished Product Specifications.

 # 6: Safety precautions including safe limits of exposures of chemicals involved and potential hazards connected with the handling or reactions, chemicals and EQUIPMENT.

 # 9: FIRST AID MANUAL

 # 10: QUALITY CONTROL MANUAL consisting of sampling and quality control procedures for all inputs, materials in process, intermediates and outputs of the plants including effluents.

 # 11: List of complete Laboratory facilities to check the quality control of all inputs, material in process, intermediates and output of PLANT.

As mentioned already earlier, some of these documents were not available during the period of the mission and also some equipment required to carry out some of the above analysis was not delivered.

3.3 Research & Development

Research and Development is an important task within the pesticide formulation plant in order to improve and maintain quality and also to stay flexible and replace products and/or formulations by others whenever needed. According to the first proposals made by G.K. Handa in his feasibility study in 1979 R & D work should have been carried out together with and in the premises of TPRI, the Tropical Pesticides Research Institute in Arusha. It should be noted, that at that time the pesticide plant was proposed to be located in Arusha, possibly near the TPRI.

As important as a good cooperation with TPRI may be, it is felt that R & D work would be impractical to be performed in Arusha, mainly for the following reasons:

- although TPRI has sufficient laboratory space, there is no trained personnel or expertise is that field
- TPRI has no special equipment to conduct formulation R & D activities
- with the final location in Moshi, the plant is appr. 100 Km away from TPRI which makes a close cooperation difficult and impractical

- some pilot scale formulation equipment has been installed in the wettable powder and flowables formulation plant

- formulation specialists operating the plant could also operate the pilot equipment for R & D and as such bring in their own experience

- the existing laboratory could handle some additional work necessary for R & D; possibly the laboratory could even be extended in the future.

It is therefore advisable to perform R & D work within the plant in Moshi. TPRI should still cooperate as far as possible; its main task would be to identify the needs for different formulations and applications based on plant protection problems in the country. Another role for TPRI would be to organize field tests with newly developed formulations. TPRI is also interested in a cooperation in the quality control of pesticides and common training programmes.

Further assistance in that field by UNDP/UNIDO would be much appreciated.

4. Waste and waste treatment

The controversy over the environmental pollution through the operation of the plant, along with many allegations raised by the people have prompted NCI and the National Environment Management Council to make an environmental evaluation (1991) and one year later an environmental impact assessment. Also UNIDO and SIDA were invited to study the matter and prepare reports as well as recommenations. At that time assurance was given that the measures incorporated in the plant for pollution control are adequate and that they were the latest applicable in the technical world.

According to its design the plant is expected to discharge mainly waste water. Additionally some solid waste as well as some emissions are expected. There will be hazardous and non hazardous waste which will have to be separated from each other.

Various pollution control measures have been incorporated into the plant in order to ensure that all effluents and emissions will be treated to meet internationally accepted standards. Theses measures followed detailed and lengthy consultations between NCI, TCM and various institutions such as the National Environmental Management Council, the Ministry of Labour's Factory inspection division, TPRI UNEP, GIFAP, UNIDO and others.

An environmental engineer has been assigned to the plant since August 1994 for the purpose of implementing and surveying pollution control measures.

4.1 Waste identification

After studying the plant's design and processes involved, the environmental engineer expects various solid and liquid waste as well as some emissions that have to be controlled and monitored. The following table shows the different waste materials expected:

Table 4: Different waste expected from the plant

SECTION	SOLID WASTE	LIQUID WASTE	EMISSIONS
hydrochloric acid	inorganic cakes/slurries containing carbonates and sodium chlorides	acidic waste water from washings and other activities in the plant	chlorine, hydrogen gas, and hydrochloric acid vapor from leakage's
copper oxychloride	particles from cleaning, packing materials	acidic liquids containing Cu II and Cu I ions / liquid waste from cleaning	dust emissions containing copper oxychloride particles
herbicides formulation	containers and packing materials with residues of active ingredients	liquid spills and washing solutions containing the products	dust emissions containing particles of the product
insecticides formulation	containers and packing materials with residues of active ingredients	liquid spills and washing solutions containing the products	dust emissions containing particles of the product
laboratory	containers and packing materials with residues of chemicals, samples	organic and inorganic liquid waste, samples	chemical fumes from solvents and from other analytical procedures
other parts of the plant		oil spills and used oil of different machinery	exhausts of boiler unit

4.2 Waste management

Solid wastes:

The hazardous solid waste such as herbicides/insecticides remains and spills as well as empty containers were supposed to be incinerated. Inorganic materials mainly composed of carbonates of calcium and magnesium and a slurry of sodium chloride is intended to be easily disposed on the roads.

Liquid wastes:

The hydrochloric acid and copper oxychloride manufacturing units have got their own waste water treatment facilities, whilst the rest of the plant does not avail of any such

facilities. Instead there are two waste water collection ponds for the following purpose:

Pond A: capacity of 810 cbm for collection of treated waste water from the hydrochloric acid and copper oxychloride treatment facilities

Pond B: capacity of 26 cbm for collection from the herbicides, insecticides and laboratory units. Waste water collected in this pond is supposed to be finally incinerated.

Emissions:

In the manufacturing of hydrochloric acid possible chlorine gas leakage's have been taken care of by a negative pressure in the pipes which collects the chlorine gas and feeds it into the sodium hypo chlorite production system.

Dusts and other particles from the process will be controlled by a system of filter bags at each point opening into the atmosphere.

4.3 Incineration equipment

Unfortunately the incineration equipment that was proposed by the environmental team of experts from different institutions involved in the investigation of the safety of the plant is not yet available. This incinerator was also considered crucial by the UNIDO expert mission of M. Gimeno in March 1992 as the end the effluent treatment and cleaning system of the plant.

A simple estimate based on a small discharge of waste water from the quality control laboratory showed that the respective collection pond, which has no outlet, would overflow after 2 months of laboratory operation not considering natural evaporation. In addition it has to be kept in mind that the flowable and wettable powder formulation units will also discharge their effluents to the same small pond. Therefore a solution to that problem has to come soon or otherwise the overflow would contaminate the environment.

4.4 Monitoring of treatment facilities and the environment

It is expected that the plant will have the capacity of treating the waste to the required levels as designed. However many of monitoring devices, that are necessary to verify and control the performance of the treatment facilities, are not yet available.

According to the plant's environmental engineer the following parameters should be analyzed:

Waste water:	pH	
	acidity/alkalinity	
	Ca++ and Mg++	
	Cl-	
	Cu+ and Cu++	
	COD and BOD	*equipment not available*
	DO	*equipment not available*
	colour	
	turbidity	
	suspended solids	
	organics	
Emissions:	chlorine gas	*equipment not available*
	hydrogen gas	*equipment not available*
	dusts	*equipment not available*

The missing equipment is marked above and includes also the necessary devices for sampling.

Before starting operation of the plant some of the environmental data obtained in previous studies should be updated. This could be done by the Q.C. laboratory provided the facilities and funds are available. The study should include an inventory of all pollution sources within a few kilometers around the factory. This may also be useful to counter any possible future attacks on, or complaints about the pesticide factory, considering that the neighborhood hosts pollution intensive industries such as the pulp and paper industry.

Also it should be noted that sampling points for monitoring purposed will have to be established inside and outside the plant.

5. Pesticide Registration

Pesticide Registration in Tanzania is governed by act of Parliament No. 18 of 1979 which also established the Tropical Pesticides Research Institute (TPRI) and provided it with a broad mandate of conducting research on all fundamental aspects of pesticide application and behaviour in relation to the control of tropical pests.

TPRI ensures that all pesticides in the country are registered and tested for their effectiveness against the pests or plant diseases they are meant to control and that they are safe to humans, livestock and the environment.

The pesticide registration procedure is quite tedious and costly and requires the following materials to be submitted to the registrar:

1. duly filled application forms
2. three copies of registration dossiers containing all technical information and data on the product, including toxicological, environmental and efficacy data obtained in different countries
3. a label specimen which is in accordance with the labeling requirements of the country
4. a sample for analysis and field test

The registration scheme provides for 4 categories of pesticide registration, namely

* Experimental Registration
* Provisional Registration
* Full Registration
* Restricted Registration

The costs of registration are splitted as follows:

- application forms	50 USD
- experimental registration fee	500 USD
- field testing fees	5000 USD

So far no application for pesticide registration of any of the products intended for manufacture and sale has been submitted. This subject, which could turn out to create some problems, has obviously not really been considered before.

As far as copper oxychloride is concerned, the required dossier may be obtained from the know-how supplier. NCI intends to address a special request to TPRI in order to obtain permission to sell their copper oxychloride on the basis that it would be manufactured with the same know-how and according to the same specifications as a product already registered by the Italian know-how supplier.

For other products supposed to be formulated in the plant this may be a serious problem, as no data will be readily available.

SUMMARY OF MAJOR PROBLEMS (checklist)

The visit to the Moshi Pesticide Plan has revealed a number of problems in connection with the quality control and environmental monitoring, that have to be addressed and solved prior to the commissioning and start-up of plant operation:

* emergency exit does not open
* no emergency shower and eye washing station
* no fire extinguishers
* no blankets
* no first aid equipment
* gas leakage's in central gas supply
* wrong connections in central gas supply
* no gas warning devices
* no shading for gas tanks
* no special chemical stores
* no active ventilation (except fume hood)
* no temperature/humidity control
* no sufficient circuits available (distiller & ovens)
* no exhaust for balance table
* sinks leaking
* quality control manual missing
* connection to process water incl. pressure gauge
* connection to demineralized water incl. press. gauge
* broken glassware
* additional equipment or accessories needed (s. annex)
* additional chemicals needed (see list in annex)
* no sampling tools and accessories
* sampling points in plant not marked
* no incinerator or alternative
* missing equipment for environmental monitoring
* no clarity regarding organic waste
* not sufficient training on the job
* not enough special literature
* Research & Development needs to be with the plant
* no registration yet for pesticide products
* working capital of project is used up

Missing glassware and chemicals are specified further in the detailed lists in the annexes. Equipment is listed in chapter 2.4 above.

CONCLUSIONS & RECOMMENDATIONS

This visit to the Moshi Pesticide Plant and the work done proved to be important and necessary in view of the forthcoming commissioning and start-up of the plant with regards to the safety and efficiency of the laboratory operations and the plant's waste management and environmental monitoring programme.

The many delays in the pre-commissioning and commissioning phase since December 1994 were due to intensive servicing and maintenance works that became necessary after the interruption of the work for more than two years following the court order of 1992.

The fears of the population, which were believed to have been fortified by the green party for political reasons, were not justified, as the plant with it's layout and proven technology is in accordance with international standards.

The delivery and installation of the incinerator, however, still has to be clarified and all safety devices for the laboratory will have to be fitted before the start-up of operation.

Some equipment as well as measuring instruments, chemicals and glassware still have to be purchased in order to complete the necessary outfit of the laboratory.

Problems that are in connection with contractual obligations will have to be solved between TECHNIMONT (TCM) and NCI before the final hand over of the plant.

The theoretical and practical Know-how transfer still has to be completed by TCM; all relevant documents must be available at the site of the plant and in the respective departments. The laboratory urgently needs the Q.C. manual with all specifications, test methods and other procedures in order to take up its duties.

It is strongly felt that much more training on the job is needed in plant operations, formulation techniques, quality control and environmental monitoring, in the implementation of Good Laboratory Practice, Good Manufacturing Practice as well as for general organization

and administration before all operations would run smoothly.

Whereas the factory has it's own workshop for the maintenance, service and repair of a wide range of machinery, the laboratory has been neglected in that respect. A minimum of tools and special measuring instruments are needed and still have to be supplied in order to perform basic service and maintenance functions. Employment of a service engineer and cooperation with the adjacent National Vocational Training Center is recommended.

Research & Development work for new formulation may be carried out together with TPRI, but the practical work should be shifted to the site of the plant, as most of the laboratory or pilot scale equipment is available there.

Registration of pesticide products for manufacturing, sale and use in the country has to be started immediately as the required procedures according to present rules and regulations are tedious, lengthy and costly and require comprehensive dossiers for each of the products.

The financial situation of the Moshi Pesticide Plant looks very gloomy and could jeopardize the further development of the project. Therefore a strong commitment form the Tanzanian Government with additional financial inputs appears to be necessary in order to prevent a shut-down of the plant and a big loss on the investments made.

JOB DESCRIPTION **ANNEX 1**

dr:B.Sugavanam

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

SI/URT/93/802/11-52

Post title:	Quality Control Specialist
Duration:	1 m/m
Date required:	As soon as possible
Duty station:	Moshi, Tanzania
Purpose of project:	To provide advisory assistance and supervise the start-up of the formulation plant.

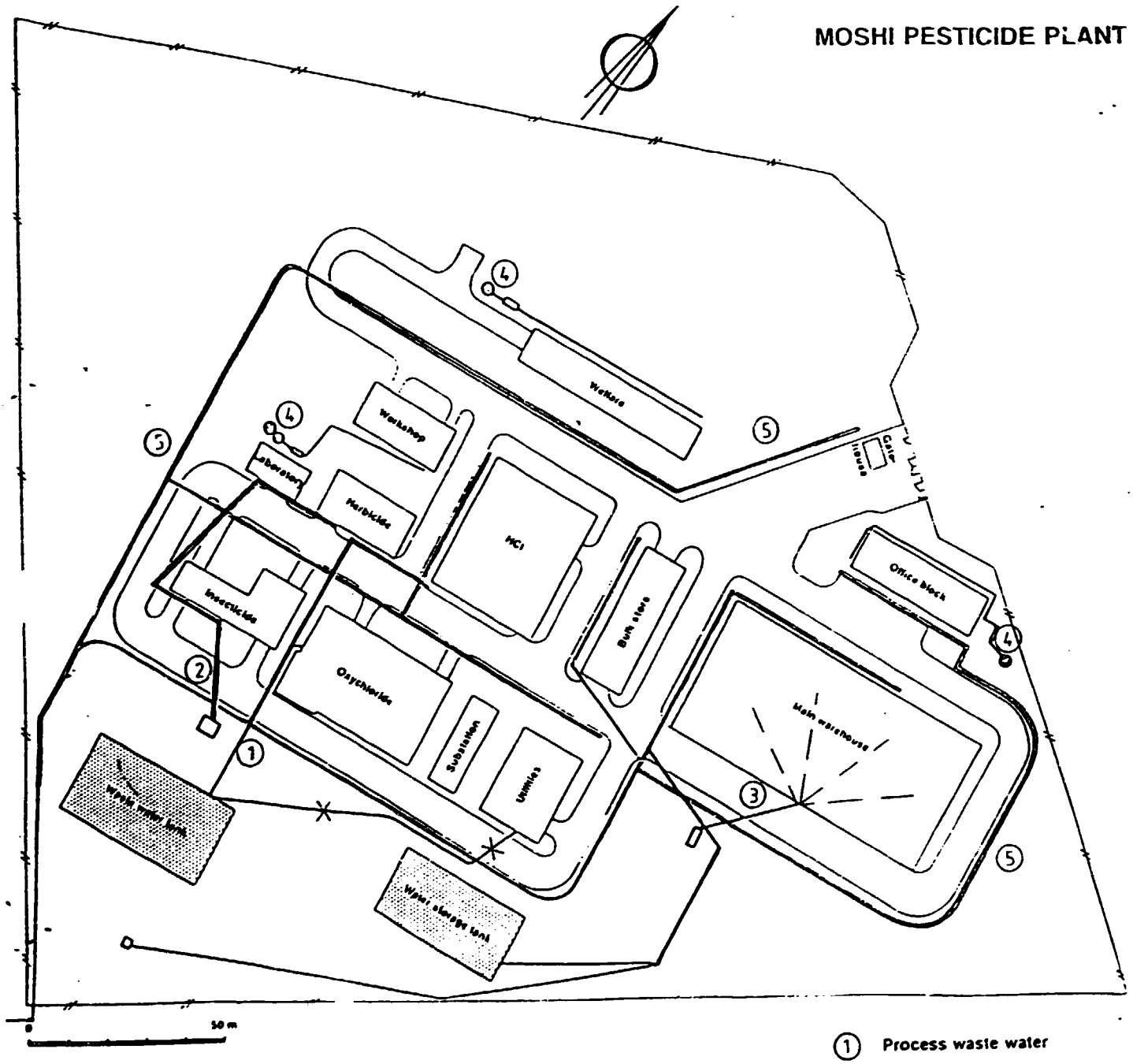
Duties:

The expert, in consultation with the Formulation Technology Specialist/counterparts, is expected to assist the counterparts in the proper organization of analytical laboratory, its support to production control ordering necessary standards, reagents, etc, carrying out analysis according to international norms.

The expert is expected to prepare a report .

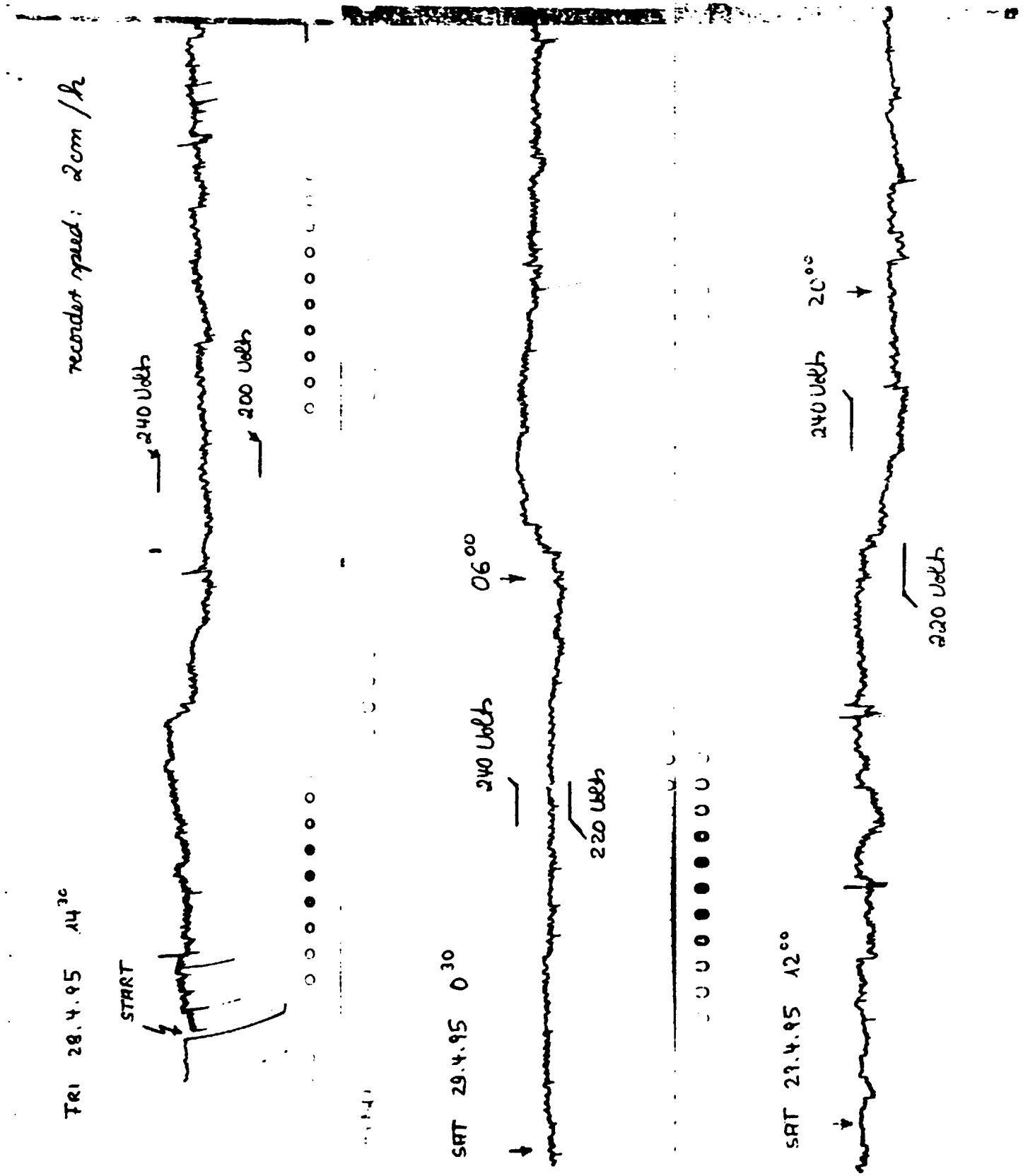
PLAN OF SITE

ANNEX 2



TEST REPORT: **ANNEX 3**

Electricity monitoring during weekends



TEST REPORT:

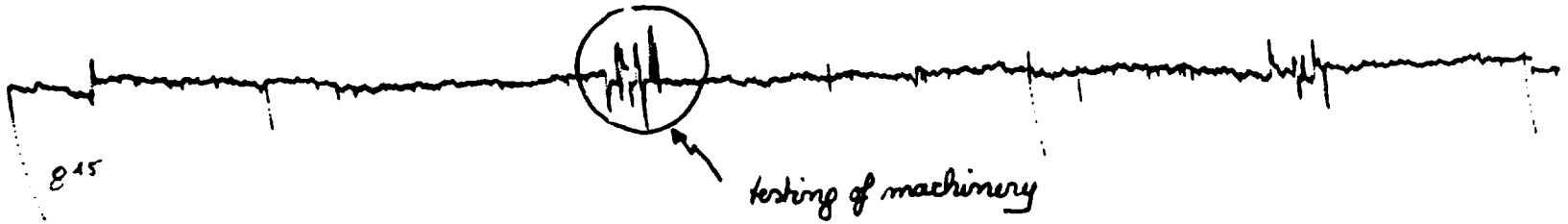
Electricity monitoring with limited factory load

ANNEX 4

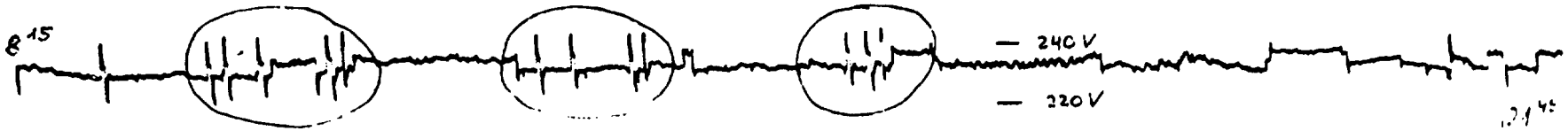
Q.C. Lab 8[illegible] - 1[illegible] Hoshi Pesticides Plant

15.5.95

18 MAY 1995 Q.C. Laboratory [illegible]



Q.C. Laboratory, Hoshi Voltage fluctuations caused by machinery within plant



19-05-95

INSTALLATION & TEST REPORT *ANNEX 5*

MOSEI Pesticides Plant / Q.C.- Laboratory

Instrument : Gas chromatograph

Manufacturer : CARLO ERBA

Model : GC 6000 VEGA Series 2

SN : 248717

Voltage identification tag: 220 Volts / 50 HZ

Steps performed:

1) Unpacking : 1 month ago by laboratory staff

2) Visual Inspection : no damage found

3) Modification of voltage setting:

   * internally modified to 240 Volts / 50 HZ
     according to instructions in manual

4) Inspection of all internal PC Boards:

   * no loose contacts
   * memory back-up battery of main board run down to
     0.67 Volts; needs replacement VARTA 3/V60R

5) Fitting of new electrometer board EL-680 and configuration of dip switches according to instructions on packing documents; the EPROM software on MB MPU-600 was not changed as instructions were not clear and as fitted version was of newer date

6) Installation and connection of one FID detector

7) Installation and connection of integrator DP 700 (CE Instruments); printing head does not function properly which may be due to the extended storage period

8) Plumbing connections: the supplied fittings did not match those of the gas armatures; special adapters were prepared with the help of the existing lathe machine and brazing work in NVTC. No filters.

9) Instrument start-up and tests: Only electronic functions could be tested as no gases were available from the central gas supply during the period of the mission. Staff has been instructed only in the basic handling of the instrument

INSTALLATION & TEST REPORT *ANNEX 6*

MOSHI PESTICIDES PLANT / Q.C.- Laboratory

Instrument : Automatic water destillation

Manufacturer : BICASA

Model : BE 119

SN :

Voltage identification tag: 220/380 Volts, 8/13 Amp.

Steps performed:

1) Unpacking : 1 month ago by laboratory staff

2) Visual Inspection : no damage found

3) Electrical connection: provisionally by TCM as no special 3 phase circuit and line had been provided to the location of the instrument

Remarks: 1) appropriate 3 phase line has to be provided to the final location of the destillation set
2) separate 3 phase circuit breaker has be provided

4) Performance test:

checking amount of distillate per minute

PARAMETERS	POS I	POS II	POS III
distillate	44 ml/min	77 ml/min	136 ml/min
ingoing water T	25 deg.C.	25 deg.C.	25 deg.C.
outgoing water T	38 deg.C.	54 deg.C.	64 deg.C.
distillate temp.	32 deg.C.	43 deg.C.	94 deg.C.

Remarks: 1) the existing static water pressure resulted from a water tank at a distance of appr.250 meters and a difference in level of appr. 2.5 meters and is too low to safely operate the equipment.

2) the water temperature of the cooling water is quite high, resulting in very high outgoing temperatures and lowered efficiency

INSTALLATION & TEST REPORT *ANNEX 7*

MOSHI Pesticides Plant / Q.C.- Laboratory

Instrument : Computer system

Manufacturer : IBM

Model : PS/2 model 30 (1988)

SN :

Voltage identification tag: 220 Volts / 50 HZ

Steps performed:

1) Unpacking : after transfer to laboratory

2) Visual Inspection : no damage found

3) Outfit & accessories:

* 640 kB RAM
* 720 kB Diskdrive
* 21 MB Harddisk

* IBM PS/2 color display
* IBM proprinter III

* Software: DOS 4.0
  DisplayWrite 4/2 (1988)

4) Provisional installation of system in laboratory

5) Performance test:

a) all components of the system have passed their functional tests
b) the printer is still lacking the original printing ribbon
c) software supplied could not be installed, as disks were missing

REMARKS: Alternative and newer software could not be installed as the system does not correspond to present standards. The storage memory capacity available is too low for the present standard software.

New system with HP510 inkjet printer is recommended.

INSTALLATION & TEST REPORT *ANNEX 8*

MOSHI Pesticides Plant / Q.C.- Laboratory

Instrument : Explosion Proof Refrigerator

Manufacturer : PRECISION SCIENTIFIC INC.

Model : Precision 814

Voltage identification tag: 115 Volts / 60 HZ

Steps performed:

1) Unpacking : prior to the mission by TCM

2) Visual Inspection : no damage found

3) Adaptation of voltage to local net: by TCM

   * the refrigerator had been connected to the local power through a down transformer

4) Performance test:

As the chief chemist complained of problems with the refrigerator, the performance according to specifications was checked with the with the following results:

PARAMETERS (pos.5)	SPECS FOR 32 d.C.	ACTUAL at 28 d.C.
Fresh Food comp.	1,5 to 4 deg.C.	12 to 16 deg.C.
Frozen Food comp.	-15 to -17 deg.C.	- 18 deg.C.
% Running Time	appr. 50 %	almost continuous

REMARKS: The performance of the refrigerator for the fresh food compartment is not acceptable.

5) Check-up of down transformer:

   * input : 230 Volts at 50 Hz

   * output: 108 Volts at 50 Hz (without load)
     97 Volts at 50 Hz (with load)
     76 Volts at 50 Hz (start with load, does not restart)

Note: The refrigerator is specified for 115 V at 60 Hz and therefore not suitable for operation in Tanzania; although the transformer reduces the voltage, it does not change the frequency from 60 to 50 Hz which results in bad performance and overload of the compressor.

LIST OF MISSING GLASSWARE & ACCESSORIES ANNEX 9

DESCRIPTION	QTY	FOR USE WITH / IN
Woulff bottles	5	vacuum systems
Water jet pumps	3	vacuum systems
Vacuum hose	10	vacuum systems
Vacuum filtration sets	2	filtration
Set of Buchner funnels	2	filtration
Gas washing bottles	3	general use
Assorted wide neck bottles	200	sampling
Assorted narrow neck bottles	100	general use
Assorted bottles with thread	500	sample storage
Assorted dropping bottles	10	indicators
Assorted reagent bottles	30	general use
Water bottles with faucet	5	destilled water
Assorted volumetric flasks	50	general use
Assorted graduated cylinders	30	general use
Graduated cyl.w.stoppers 100 ml	10	CIPAC tests
Graduated cyl.w.stoppers 250 ml	20	CIPAC tests
Burettes 10/25/50 ml. brown, each	2	replacement (broken)
Flow indicators	10	condensers
Set of dispensers	2	general use
Laboratory thermometer	2	range: -50 to + 100 dC
Glassware cleaning sets	2	general use
Glassware labeling set	1	general use
Glassware detergents		general use

NOTE: The above list may not be complete as more items could turn out to be missing when further analysis are carried out. After receipt of the Quality Control Manual a computerized inventory of all needed glassware and chemicals together with the minimum stock requirement should be prepared.

LIST OF MISSING CHEMICALS — *ANNEX 10*

POS	DESCRIPTION	FOR DETERMINATION OF
	A) *UNIT 600 - HYDROCHLORIC ACID PRODUCTION PLANT*	
1	Potassium Iodide	Ammonia in brine
2	Iodine	
3	Diethyl amine	Ca++ & Mg++ in brine
4	Hydroxyl naphtol blue	Ca++ & Mg++ in brine
5	Alizarin black	Ca++ & Mg++ in brine
6	Ammonium thiocyanite (iron free)	
7	Calceine TMF	Ca++ & Mg++ in brine
8	Puffertabletten MERCK (no specs!)	Ca++ & Mg++ in brine
10	Sodium arsenite	
11	Sodium hydroxide pellets	
12	Hydrochloric acid p.a.	
13	Iodine starch paper	
14	Mangan sulfate	
15	Silica gel with indicator	use in desiccators
16	Titriplex III (MERCK)	
17	Sodium thiosulfate	Bromides in brine
18	Nessler reagent	Ammonia in brine
19	Sodium dihydrogen orthophosphate	Bromides in brine
20	Sodium hypochlorite	Bromides in brine
21	Sodium formate	Bromides in brine
22	Phosphoric acid	Chromium in brine
23	Diphenylcarbazide	Chromium in brine
24	Sodium sulfite	Chromium in brine
25	Sodium citrate	Nickel in brine
26	Dimethylglyoxime (1%)	Nickel in brine
27	Nickel sulfate ($NiSO_4 \cdot 6H_2O$)	Nickel in brine
28	Potassium thiocyanate (iron free)	Iron in brine
29	Thioglycolic acid	Aluminum in brine
30	Potassium alum	
31	Sodium bicarbonate	
32	Mercury sulfate (p.a.)	COD
33	Eriochrome black	
	B) *UNIT 300 - FLOWABLE HERBICIDES FORMULATION PLANT*	
34	Carbon disulphide	
35	Benzene	
36	Sodium peroxide	
37	Mono ethylenglycol (chromatogr. grade)	
38	Di ethylenglycol (chromatogr. grade)	
39	Bromocresol green	
40	Dimethyl formamide	
41	Dioctylphthalate	
42	Di(2-ethylhexyl)phthalate	
xx)	Reference standards for raw materials and finished products for units 100/300/600 according to present portfolio, e.g. atrazine	

LIST OF SOURCES FOR REFERENCE STANDARDS ANNEX 11

The procurement and proper storage of reference material (standards) is crucial for most types of analysis as the results will depend on them. In several countries there are laboratories specialized on purifying chemical compounds and certifying them as analytical standards.

Such reference standards could obtained for instance from the following sources:

1) SUPELCO, INC.
Separation Technologies
Supleco Park
Bellefonte,
PA 16823-0048 USA

SUPELCO Germany
Postfach 2240
D-6380 Bad Homburg

FAX: 0049-6172-6305

2) Riedel de Haen AG
PESTANAL Products
Wunstorfer Str. 40
D-3016 Seelze 1
Fed. Rep. of Germany

TEL: 0049-5137-707-0
FAX: 0049-5137-707-123 or
0049-5137-919 79

3) Dr. Ehrenstorfer GmbH
Buergermeister Schlosser Str. 6a
D-86199 AUGSBURG
Fed. Rep. of Germany

TEL: 0049-821-906080
FAX: 0049-821-9060888

LIST OF RAW MATERIALS IN STOCK *ANNEX 12*

MOSHI PESTICIDES PLANT

Raw Materials in Stores

	No	Description	QTY	TYP	UNIT	TOTAL
	1	Calcium hydroxide	756	bags	25	18900
••	2	Calcium carbonate	814	bags	50	40700
	3	Sodium sulfit	4	bags	50	200
	4	Sodium carbonate	40	bags	50	2000
	5	Dicalite	45	bags	20	900
-••	6	Bretax	480	bags	25	12000
•	7	Atrazine	600	bags	25	15000
•	8	Attagel	40	bags	22.7	908
	9	Supragril WP	216	bags	20	4320
	10	Supragil RM 77	308	bags	25	7700
	11	Geropron T/36	6	bags	25	150
	12	Sodium hypochloride solution	23	bags	40	920
	13	Hydrochloric acid	25	drum	40	1000
•	14	Antischiuma AF	20	drum	50	1000
	15	Soprophor 46	10	drum	200	2000
	16	Soprophor FL	5	drum	200	1000
	17	Common salt	1505	bags	50	75250
	18	Copper wire	1767	rolls	25	44175
	19	Resins	5.5	bags	0	0
						228123 TOT KG

- partly damaged by water and repacked

• atrazine recipy component

•• copper oxychloride recipy component

UNIDO COMMENTS

The report gives in detail the status of the quality control laboratory attached to the formulation plant. While the implementation of the whole formulation plant took a long time due to various reasons it has affected the quality control laboratory set up. The report brings out various problems associated with the quality control laboratory and action to be taken to put it to acceptable standard. While some of the problems are typical of having such a set up in developing countries but the various findings of the expert clearly indicate that the laboratory does not have basic facilities and it is surprising that the sub-contractors have not provided all facilities according to the subcontract. Obviously many events that took place beyond the control of all parties concerned including the court injunction and a long gap between installation of the plant and the start-up. This is definitely a set back to the country which has committed a vast amount of resources but got nothing in return for more than five years.

Under such conditions the country needs all the help it could get to put the plant functional according to international standards to assure food security to the country.

The type of assistance needed should be an integrated one to complete the plant, improve registration procedure and follow 'cradle to grave' approach.

The human resource development should be given greater importance. The most important thing is to provide enough foreign exchange by the Government to purchase of enough raw materials.