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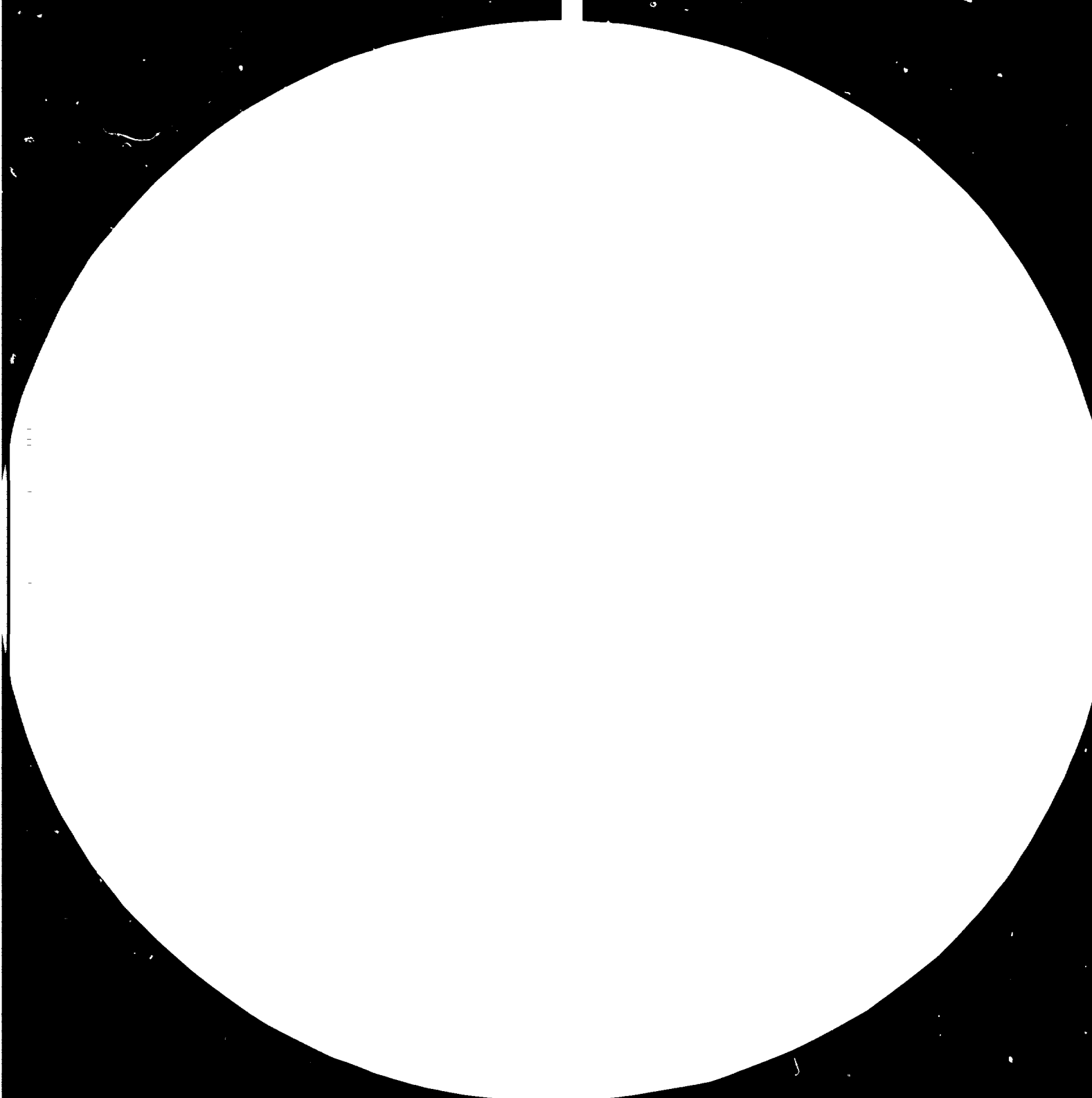

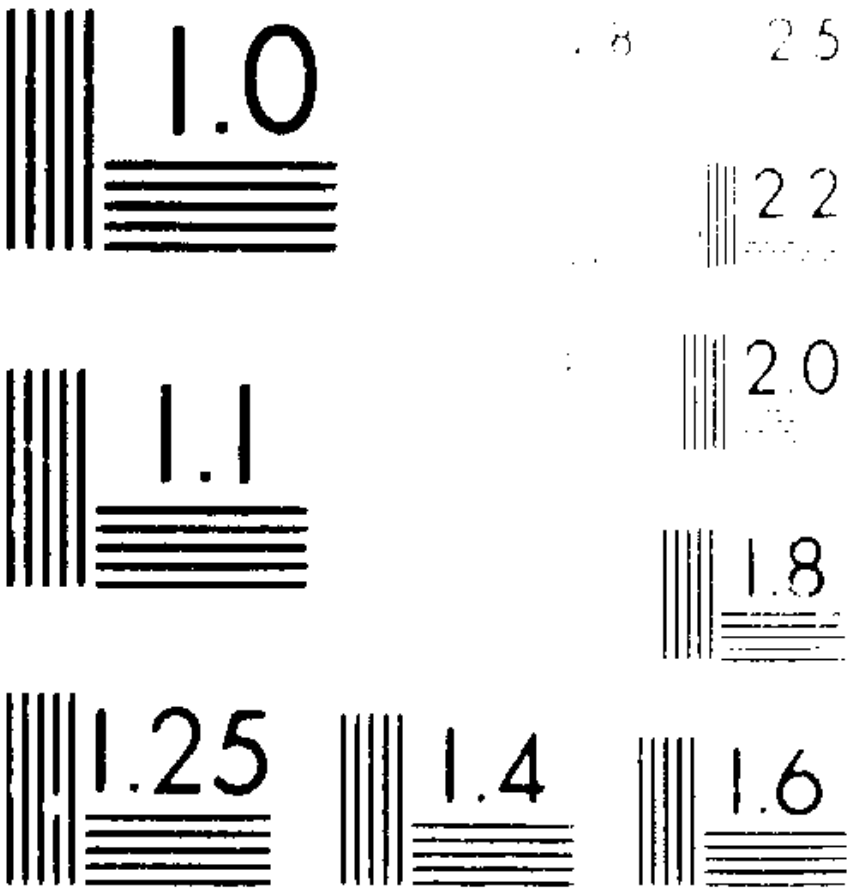
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7 August 1981
English

Zambia.

ASSISTANCE IN THE ESTABLISHMENT OF AN INTRAVENOUS FLUIDS PLANT

DP/ZAM/74/002

ZAMBIA

Terminal report*

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

Based on the work of B. Sarin,
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United Nations Industrial Development Organization
Vienna

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C O N T E N T S

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Sometime in the beginning of seventies the Government of Zambia decided to develop a pharmaceutical manufacturing Industry. Following the closure of Rhodesian border in 1973 this project became increasingly important. Zambia being a landlocked country, the long and expensive routes often proved to be unreliable, necessitating costly airfreighting of crucial supplies.

As a result of certain studies made under United Nations assistance during 1973 the Govt of Zambia undertook to establish a plant for the manufacture of Intravenous Fluids which could form a nucleus for further development of the pharmaceutical industry. It was also envisaged that the intravenous fluids plant should have a significant export potential to neighbouring countries. As such the plant was expected to fulfil the following objectives:-

(a) Self sufficiency in a crucial medical supply.
(b) A foundation for further development of the pharmaceutical industry.
(c) Export promotion.
(d) Conservation of foreign exchange by means of import substitution.

The Government therefore established a new subsidiary of the existing parastatal 'Industrial Development Corporation Limited (Indeco) of Zambia under the name of 'General Pharmaceuticals Ltd'.

A Swiss Company Vifor SA was awarded the contract to advise on the construction of the factory, supply of equipment and provision of knowhow. A five-year agreement was entered into whereby General Pharmaceuticals Limited were obliged to purchase their plastic containers from Vifor and in return Vifor permitted GPL to use their Trade Name 'Flex Flac for the Intravenous Fluids manufactured by GPL. The agreement would last upto November 1983.

1.2 INSTITUTIONAL FRAMEWORK

General Pharmaceuticals Ltd is a wholly owned subsidiary of INDECO Limited, itself a subsidiary holding company of Zambia Industrial and Mining Corporation Limited (Zimco). Zimco is wholly owned by the Government of Zambia.

The company was formed with an authorised share capital of one million Kwacha divided into one million ordinary shares of one Kwacha each. In April 1978 the capital structure of the company was:-

Share Capital 894,000 Kwacha issued to Indeco Limited.
Long term loans from the Government and Government Institutions 757,000 Kwacha.

In February 1981 the authorised share capital of the company was increased to 2 million Kwacha divided into 2 million shares of one Kwacha each. Issued share capital was increased to 1.216 million Kwacha by capitalising a part of the Govt. loans. It is further proposed to increase the issued share capital to 1.599 million. This is being done by capitalising the balance of Long term Govt. loans and hence obviating the incidence of interest in the outgoings of the company.

1.3 UNDP/UNIDO PARTICIPATION

UNDP/UNIDO were requested by the Government of Zambia to provide managerial and technical assistance for the early stages of the plants operations.

During 1978-1979 a sum of 145, 840 US $ was provided. Under this programme two experts one designated as 'Senior Technical Adviser/Team Leader' and the other as 'Quality Control Expert' were assigned to the project. They joined the duty station in the middle of December 1978 and middle of January 1979 respectively.

Subsequent to the project review carried out on 13 June 1979 Govt of Zambia requested extension of the UNDP/UNIDO assistance till December 1980 and asked for the provision of experts and some essential equipment and technical literature for upgrading GPL's Quality Control Department. A further sum of US $ 260,391 was provided to cover the cost of two experts, equipment, technical books and training during 1980.

As a result of Indepth review of the project during June 1980 followed by country programme review of the Industrial Sector by UNDP, the Zambian Government requested further extension of the project. On the basis of this request the project has now been extended till December 198. and the current budget is attached as annexure I. This brings the total UNDP/UNIDO input to US $ 558,631.

1.4 PROJECT AREA

Zambia is a landlocked country having an area of 752,614 sq km. It has a population of 5.8 million (mid 1980 estimates) out of which nearly 40% is settled in Urban areas.

There is a considerable emphasis in Zambia on the development of health services. Annexure II shows the (i) Annual Govt. health expenditure as a percent of national budget (ii) Per capital expenditure in Kwachas (iii) and annual health expenditure. The in-patient accommodation in the country rose from 16,300 at the beginning of 1972 to 19,800 in December, 1977. As per Third National Development Plan it is planned to increase in-patient accommodation in hospitals and health centres from 19,800 to 21,760 by 1983. This represents an increase of 9.9%.

To streamline the health care system and implement measures of social reform the Government decided in 1975 to take over private nursing homes.

Although considerable effort is being made in the provision and expansion of health facilities, (Third National Development Plan during 1979-83 envisages an investment in the Health Programme and Projects of 43,202,000K (52,977,000 US $) yet almost all drugs and pharmaceuticals requirements are being imported.

T.N.D.P. therefore, makes a special mention that'in line with the objective of encouraging local production of pharmaceuticals the Intravenous Fluids plant in Kabwe will be operational during the earlier part of the plan'.

1.5 MARKET

Health services being nationalised, most of the requirements of drugs and medicines needed for the country are purchased by the Govt. Medical Stores Ltd functioning under the Ministry of Health. A very small portion of drugs (approx. 10 - 15%) are purchased directly by the Mining companies for the hospitals and clinics operated by them for the benefit of their employees. There are two mining companies in the country i.e. NCCM and RCM. Purchases by other private organisations are negligibly small if any.

The Medical Stores Ltd. supplies these drugs to all the hospitals in the country (except those run by the mining companies) and recover their cost and operating expenses.

Another parastatal company National Import and Export Corporation (N.I.E.C.) imports a small amount of drugs and medicines and distributes them through a chain of Pharmacies managed by their subsidiary Company, National Drug Company Limited. These products also find their way to some of the Pharmacies run by private organisations. National Drug Company do also have some manufacturing facilities for tablets, capsules, and liquid orals but their output is insignificant.

1.6 PROJECT OBJECTIVES

As stated in the original project document dated 21.10.77 the immediate and long range objectives of the project are as follows:-

Immediate Objectives:

(a) To assist in the establishment of a modern industrial plant for intravenous fluids

(b) To advise and train Zambian counterpart personnel in all aspects of the plant's operation, in order to ensure full operating capability after the withdrawal of the United Nations team.

Long Range Objectives:

(a) The achievement of self sufficiency in critical pharmaceutical supplies.

(b) The establishment of a basis for further development of Zambia's pharmaceutical industry.

(c) Promotion of import substitution/foreign exchange saving.

(d) Export promotion.

2. PROJECT ACTIVITIES

2.1 PRODUCTION

The plant commenced commercial production on 6 February 1979 which continued un-interrupted till 27 March 1979. As the normal operating year of the company is from 1st April to 31st March actual production figures for the two years of operation i.e. April 79 - March 80 and April 80 to March 81 are given in Annexure III.

The problems experienced during 1979 - 80 were:-

i. Interruption in the supply of materials.
ii. Water condensation in steamlines due to the defective piping which had to be corrected.
iii. Waterstill compressor bearing getting worn out after a short run.
iv. Pyrogen testing at the Company's Quality Control Department in Kabwe being unreliable.

These were generally brought under control during 1980 - 81 when production improved considerably, and the plant was able to meet almost the entire demand of I.V.F. in the country except a few occasional delays in affecting supplies.

During 1980 - 81 the nagging problem was, the high incidence of rejects for leaks and particulate matter, due to poor quality of plastic containers received from Vifor.

The problem was fully gone into and during the visit of General Manager and UNIDO Chief Technical Adviser to Vifor, Geneva in July 1980 during which Vifor agreed to make good the losses incurred by the company due to these rejects by supplying an additional quantity of plastic bags equivalent to actual rejects plus 40% to cover the cost of chemicals and other losses.

Production also had to be curtailed during most part of the 3rd quarter of 1980 - 81 and partly during 4th quarter of 1980 - 81 because one of the sterilizers was put out of commission for want of certain spares which took a few months to procure.

2.2 PROBLEMS EXPERIENCED IN PRODUCTION

(a) Although General Pharmaceuticals Ltd is treated as a priority industry yet at times the delays in the release of foreign exchange by the Bank of Zambia seriously affect continuity in production. This situation unfortunately may not materially improve till either the foreign exchange availability in the country improves or the company earns reasonable foreign exchange through exports.

(b) The quality of plastic containers received from Vifor still results in very high rejects in some batches. Vifor have time and again assured that they would improve their supplies and have also suggested a reduction in the temperature of sterilisation which is not free from its own hazards. The rejection rate due to leaking bags and particulate matter is still a problem.

(c) The rejection due to non sterility and pyrogens is also high. Now that reasonable equipment and other aids for monitoring the autoclaves have been received it is expected that the incidence of non sterile batches would be eliminated. The incidence of pyrogenic rejection is not likely to be controlled till GPL fully implements the recommendations regarding (i) installation of proper change rooms (ii) Laundry, (iii) Air filtration unit and air-locks, (iv) Storage of Distilled Water at 80°C (v) Controlling bacterial count in post-sterilisation cooling water and (vi) Filtration of the raw water before it goes into the overhead storage tank. Some action is in hand towards implementing these. The progress unfortunately is extremely poor with the result that quality of the product suffers.

(d) The procedure adopted for sterilisation as amended by Vifor is 113°C for 1 hr. This does not comply with the officially recommended procedures. Vifor were requested to furnish experimental data to support their recommendation, unfortunately it has not yet been received. Recently tests carried out with attest indicators show that the procedure does not result in complete sterility. The production have therefore been advised to revert back to the earlier sterilisation procedure i.e. 116°C for 40 minutes. The attest indicators exposed with this procedure show that satisfactory sterilisation is being achieved.

2.3 QUALITY CONTROL

Production and Quality Control Adviser Mr R D Saracchi joined the duty station mid January, 1979. The quality control department was in existence at that time. It was equipped with certain basic equipment and an animal house. Two qualified chemists were in position as Assistant Quality Control Managers.

Mr R D Saracchi left in January 1980. Dr R A Khan joined the duty station as Quality Control Adviser in April 1980 and is due to stay till December 1981.

During the year 1979 all batches were tested at GPL but samples from each batch were also sent to Vifor and no batch was released for sale till clearance was received from Vifor.

The number of batches manufactured tested and rejected during the periods April 1979 - March 1980 and April 1980 - March 1981 are given in the Annexure IM.

During April 1979 - March 1980 the following problems were experienced in Quality Control Department

(i) The flame photometers and the pH meters did not function properly. These had to be sent to Vifor for repairs.

(ii) Pyrogen testing gave inconsistent and unreliable results. This was found to be due to poor handling, improper feeding and unkeep of rabbits. These problems were mostly resolved by early 1980 and the pyrogen testing has since been functioning well.

(iii) The laboratory was poorly equipped and a number of tests could not be performed locally. A request was therefore, made to UNIDO/UNDP at the end of 1979 to allocate funds and render assistance in providing laboratory equipment and technical books which were badly needed. During the year 1980 therefore, 55,000 US $ were budgeted for this purpose. A fair amount of equipment and technical books have been received since and the capabilities of the quality control department have materially improved.

(iv) Because of sending the batches for testing to Vifor and awaiting their results during 1979-80, there was a considerable time lag before a manufactured batch could be released for sale. This situation at one stage got completely out of hand because due to paucity of foreign exchange the testing fees could not be remitted to Vifor on time. On 31st March 1980 out of 206 batches manufactured during the year only 100 batches had been cleared and as much as 106 batches were under test. This resulted in very high inventories of finished products.

During April 1980 - March 1981 there has been a consistent improvement and strengthening of the Quality Control Department.

(i) In the later part of 1979 the two Assistant Quality Control Managers were sent on UNIDO fellowship training to Vifor for a period of five weeks each.

(ii) The animal house and pyrogen testing were put in order by early 1980.

(iii) During the visit of the General Manager and the UNIDO Chief Technical Adviser to Geneva in July 1980, it was agreed that the number of samples to be sent for final clearance to Vifor should be considerably reduced as the results obtained in Kabwe for pyrogens on all solutions and chemicals assay for simple solutions like Sodium Chloride and Dextrose were reliable.

This reduced the burden on the company of paying testing fees to Vifor. Further it was agreed that the testing procedures at Vifor and analytical limits for various tests performed at Kabwe should be brought in line with those at Vifor. In this connection a visit to Vifor Geneva was also made by Dr P.A. Khan the Quality Control Adviser in the beginning of 1981.

(iv) To date the position is that samples of only a few solutions i.e. Ringers Lactate and Darrows are sent to Vifor for chemical assay. As soon as the testing of these solutions on Flame Photometer is standardised this would be stopped. Vifor have the facility of testing Sodium and Potassium on Atomic Absorption.

(v) The backlog of undertest batches has been cleared. On 31st March 1981 there were only 5 batches under test.

(vi) As would be noticed from the Reasons of Rejection for the two years in Annexure IM the rejection due to Non-Sterility and Pyrogen is very high. Such a high rejection in the finished batches clearly shows that the environmental conditions and other salient provisions as listed in the draft of Good Manufacturing Practices though accepted by the management are not being effectively implemented.

(vii) These results also show that terminal sterilisation and testing of a few samples of the finished batch cannot guarantee complete safety with regard to the final product. The concept of total quality control by enforcing the provisions of GMP is absolutely necessary. The management has been made aware of this need through a series of discussions. The main problem is that initially while laying the factory these factors were ignored.

2.4 SALES

To start with, in the beginning of 1979 there was a stiff resistance from the Govt. Medical Stores Ltd and the Mining companies to the purchase of Intravenous Fluids manufactured by GPL. The main reason advanced was that the GPL prices were much higher than those of the imported fluids.

By end February 1979 GPL reduced its prices by about 40% and these were approved by the Ministry of Health. It took quite sometime before these prices could be approved by the Central Supply and Tender Board. Sales therefore, during the months of February and March 1979 were very low.

Sales figures for the years April 1979 - March 1980 and April 1980 - March 1981 are given in Annexure V.

During the year 79 - 80 the sales were low partly because it took a long time for Central Supply and Tender Board to approve company's prices and partly because certain quantities of imported intravenous fluids which had been earlier ordered were in the pipeline.

Besides poor sales during 1979 - 1980 the prices of intravenous fluids marketed were so low that the company incurred a loss of 460,000Z (563,040 US $) at the close of the year.

During 1980 - 81 the following corrective measures were taken:-

(i) Ministry of Commerce and Industry were approached and they issued a directive to the two Mining companies RCM and NCCM that their Intravenous Fluids requirements should with immediate effect be obtained from General Pharmaceuticals Ltd. As per this directive the Ministry of Commerce and Industry will not forthwith issue import licences to the two Mining companies for importation of Intravenous Fluids unless applications for such import licences are supported by a certificate from GPL that GPL is unable to supply the two Mining Companies a given range of I.V.F.

(ii) An upward revision in prices for the I.V.F. was pressed for. Increase in prices was finally approved by the Zimco and Central Supply and Tender Board with effect from 1st April 1980.

Average price per unit pack during 79 - 80 is 1.663K Average price per unit pack during 79 - 80 is 2.365K	an increase of 42%

(iii) Other steps taken towards improving financial performance which could not have a significant impact during 1980-81 but would go a long way in improving 1981 - 82 results are.-

(a) A 20% reduction in the prices of plastic containers supplied by Vifor has been negotiated with effect from 1st January 1981. Plastic container's cost constitutes approximately 40% of the total cost.

(b) Other raw materials are also being obtained from much cheaper sources in South Africa which also results in a considerable saving in the freight.

(c) Cost of sending samples to Vifor and paying them testing fees have been considerably reduced as the analytical facilities at Kabwe have been upgraded.

(d) Steps have been taken to capitalise most of the long term loans to obviate the incidence of interest.

(e) Another area where economies are to be affected is the high cost of direct and indirect labour. For the year 1980 - 81 the actual cost of direct and indirect labour is 21.3% of the total turnover. This has been discussed with the management and a programme of re-organisation has been suggested whereby considerable economies could be achieved. Certain measures have already been initiated by the management in this area.

2.5 EXPORTS

The rated capacity of the plant is 1 million units per year. This appears to have been computed on the basis of filling 4000 bags of 1 litre solution each per day, for 250 working days a year. In actual practice mostly bags of smaller volume i.e. 150ml, 500mls are filled along with the 1 litre bags and the production goes above 5000 units per day. With the current experience and with the existing product mix the plant can achieve a production of 1.2 million units per year.

During the year 1980 - 81 actual sales were 663,000 units. In case a 15% increase in sales during the year 81-82 is taken as real, the figure would go upto 770,000 approx. The budget forecast for 81-82 is 850,000 units. In any case the plant if run in full capacity could still manufacture upto approx. 400,000 bags for exports.

Export survey have been conducted during the last two years in the neighbouring countries i.e. Malawi, Tanzania, Kenya, Zaire and Zimbabwe. Sizeable potentials for exports have been identified particularly in Malawi, Tanzania, Zaire and Zimbabwe.

Trade enquiries have been received from the first three countries and Zimbabwe has asked GPL to get their products approved by the Zimbabwe Drug Registration Authority before they could direct their trade enquires to the company.

The prospects of exports to the neighbouring countries have further improved because:-

(a) It has been negotiated with Vifor that they would give GPL non-exclusive rights to export Intravenous Fluids under Vifors' Name and Trade Mark of 'Flex Flac' to these neighbouring countries.

(b) Vifor have also been requested that they should in future forward to GPL such enquiries for exports from African countries where Vifor feel that GPL could have advantages of freight being nearer the buyer country.

It has been suggested to GPL management that in order to tap this export potential they should:-

(i) Prepare an informative and attractive catalogue for the company's products and make it freely available to the potential customers.

(ii) Market company's I.V.F. along with administration sets.

(iii) Initiate a concerted export drive and develop strategies to displace the existing suppliers through competitive pricing, ensuring continuity of supplies and establishing an export market cell which could liaise and actively follow up with the buying organisations in these countries.

2.6 TRAINING

(i) During the very first year of plant's commercial production i.e. 1979 four technicians two from production and two from Quality Control were identified and sponsored for training overseas at Vifor plant in Geneva under UNIDO auspices. The training programme and training contents were discussed in detail and were finalised with the Vifor representatives who visited Zambia in July 1979. The training period in each case varied between 5 - 8 weeks.

Out of these trained technicians one from production has left the company, the other three are on their jobs.

(ii) Besides this training operation-manuals in the form of training handouts were prepared for each of the operating areas such as Water treatment, Solution Preparation and Bag Filling, and Inspection. These are being updated from time to time and are still in use.

(iii) During 1980 a short training programme as a refresher was prepared and the staff in the Water treatment section and Sterilisation areas were exposed to it.

(iv) In 1981 it is planned that the Quality Control Manager would go to Chelsea England for a post graduate degree in Analytical Chemistry.

(v) One area where specialised training needs to be imparted is the plant maintenance. This has not been possible so far as the management could not identify the engineering staff who could be given training. People in this department have unfortunately been changing their jobs. Now that things appear to be getting a bit more stabilised training needs would in due course be identified. It is proposed to send to Vifor one engineer for a short attachment course in plant maintenance under UNIDO auspices before the end of 1981.

(vi) Now that a GMP guide for the plant has been drafted and it has been accepted by the management, it would be reasonable to conduct training programme to ensure its proper implementation throughout the plant.

2.7 DIVERSIFICATION

A number of essential facilities at GPL such as (i) Steam Generation, (ii) Water Treatment (iii) Laboratory Equipment and even production of Intravenous Fluids are under utilised.

In order to improve this situation and achieve better recovery of fixed overheads it was felt necessary to examine such diversification plans which would not only utilise some of the existing facilities but also satisfy the long range objectives of the project i.e.

(i) Achieve self sufficiency in critical pharmaceutical supplies.

and(ii) Achieve further import substitution and savings in foreign exchange.

Keeping these factors in view, the following proposals were examined:

(i) Manufacture of Anticoagulant solution for whole blood in PVC bags.

(ii) Manufacture of water for injection in PVC bags (30 - 50ml) for multidose purposes.

(iii) Manufacture of Oral Rehydration Salts.

(iv) Manufacture of parenteral drugs filled in ampoules and vials.

(i) Manufacture of Anticoagulant Solution for Whole Blood in PVC bags

There is a ready demand for this preparation and the annual requirements are estimated between 50,000 - 80,000 bags.

The product could be manufactured with the existing staff and facilities. Additional equipment needed is:-

1. One Filling machine to fill by volume. Quotations were received in January 1981 from a British Firm. The equipment would cost approx. 5,500K CIF Lusaka.

2. One solution making tank 1000 lit. capacity. Stainless steel and a stirrer. Approx. cost 5,000K. Total investment required = 10,500K. Annual increase in turnover = 120,000K approx. Details have already been submitted to the management.

(ii) Manufacture of Water for injection in PVC bags 30-50mls

Difficulty is experienced in the manufacture of this product as most of the conventional safe bacteriostats used tend to get absorbed or deposited at PVC surface.

(iii) Manufacture of Oral Rehydration Salts

Detailed proposals have been worked out for this project and these have been submitted to the management. Annexure VI

During the middle of 1980, General Pharmaceutical Ltd. had a discussion with the Representative of WHO and UNICEF based in Lusaka on the subject of developing facilities for the manufacture of oral rehydration salts.

Both WHO and UNICEF representatives showed great interest in the product and stated that their organizations would be interested in promoting the establishment of a plant for the manufacture of oral rehydration salts which could satisfy the regional needs of Central Africa. Subsequent to these discussions GPL had requested WHO and UNICEF to indicate their estimated annual offtakes and the form of assistance which their organizations would be able to provide for setting up ORS manufacturing facilities. It appears these queries were referred to WHO and UNICEF regional office.

During the recent debriefing discussions with the SIDFA in Lusaka, reference was made to the export survey report dated 12.9.1980 on Zimbabwe. The Chief Pharmacist to the Ministry of Health, Zimbabwe, had shown a great interest in ORS.

The SIDFA therefore proposed that it would be in the fitness of things if details are worked out for a much larger scale project on ORS so that the needs of Zambia and Zimbabwe or the entire region of Central Africa are met.

The scope and size of such a project would have to be entirely different from the one proposed under Annexure VI of the Terminal Report.

Scope:

Stage I, to develop facilities to manufacture oral rehydration salts to satisfy the needs of Zambia and Zimbabwe

Stage II, to expand these facilities so as to increase production of ORS to also satisfy the needs of other countries such as Malawi, Mozambique, Tanzania, Angola and Lesotho etc. through WHO and UNICEF.

Production Capacity: The capacity of the unit should be in the range of 2 M. packets or sachets a year on the basis of a single shift operation for 250 working days a year. Further it should be possible to double the capacity either by two shift working or by installing another set of equipment.

Space Requirements:

1.	Storage of raw materials	48 m2
2.	Drying and sifting	48 m2
3.	Weighing and mixing	48 m2
4.	Forming, filling and sealing of sachets	48 m2
5.	Quarantine and storage of finished products	24 m2
6.	Quality control laboratory	Existing facilities which are already being expanded would suffice.
7.	Lockers and changing rooms, 2 areas one for male and one for female workers	2x9 = 18 m2
		234 m2

The ceiling height of areas nos. 1 to 5 should be 5 m, while the others should be 3 m.

There should not be any drains in areas 1 to 5. Routine cleaning of areas and machines should be carried out by an industrial type vacuum cleaner. The absence of drains elminates common source of contamination.

Areas 1 to 7 to be airconditioned and humidity in areas 1 to 5 is to be controlled below 50.

Equipment

		Stage I	Stage II
1.	Manesty mill	one unit	one unit addition
2.	Aeromatic dryer 60 kg	two "	one " "
3.	Blender Moritz type V50	two "	one " "

			Stage I	Stage II
4.	Form, fill and seal unit Easy pack type from Dott. Bonapace, Milano or Transwrap Germany.		one unit	one additional
5.	Weighing scale dial type 100 kg	)	two "	
	Weighing scale 100 kg	)	two "	
	Weighing scale 20 kg	) Avery	two "	
	Weighing scale 100 gms	)	two "	
6.	Vacuum cleaner industrial type		two "	
7.	Stainless aluminium or polythene drums 30 lit capacity with hermatically sealing lids.		20	10 additional units
8.	Sundries such as hand shovels, bowles of different sizes.			
9.	Veheratory Russel type sifter		two units	
10.	Imprinter for batch no. and mfg. date		one	one additional unit

Approximate cost of the project

To develop a working and functional area of 234 m2 , area to be constructed approximately 350 m2

Cost 400 US$ per m2	350 x 400	140,000 US$
Cost of equipment		300,000
Cost of installation		50,000
Services		100,000
		590,00
Escalation 10%		60
		650,000

UNIDO/UNDP contribution for such a project could be:

Basic imported equipment	250,000 US$
Technical and management personnel for 18 months (one engineer and one team leader)	105,000
Training	45,000
	400,000

Government input 400,000 US$ plus working capital

The unit should be in production within 6 months after the building and services are provided.

As already mentioned in the terminal report page 14 under 3.3 (v), GPL has nearly 3600 m2 of open site on its premises available for development. So, a project of this kind and magnitude could be easily developed there with a number of advantages to the existing activities.

(iv) Manufacture of parenteral drugs filled in ampoules and vials.

Detailed proposals for this project have also been submitted to the management.
Annexure VI.

(v) Manufacture of IVF in polypropylene bottles.

It has already been pointed out to the GPL management that the existing range of activities of the plant are vulnerable on two grounds:

(a) For their entire requirement of plastic containers GPL are totally dependant on Vifor of Geneva. Though the existing agreement between GPL and Vifor lasts until November 1983 GPL will be obliged to seek extensions of the agreement so long as they continue to use PVC bags for filling IVF.

(b) There is a degree of resistance being built up against the acceptance of PVC as an ideal plastic for IVF. The resistance is on two counts, one is the leaching of the plastizisers and the other is due to evaporation losses through the bags particularly during storage in the tropics.

It would therefore be highly desirable that GPL should explore the possibility of switching over to alternate technologies. One is to use polypropylene bottles with the existing sterilisation facilities. The other is to use polyethylene bags with gas sterilisation.

The existing sterilization facilities and after some modifications the filling facilities can be used if GPL undertakes to fill IVF in polypropylene bottles. They will however need to install a suitable blow moulding unit for the manufacture of polypropylene bottles. UNIDO could, therefore, render assistance in providing a suitable blow moulding plant and train local personnel in operating such a plant. UNIDO/UNDP input would be in the region of half a million dollars which would also cover the training cost.

3. FINDINGS AND RECOMMENDATIONS

3.1 PRODUCTION FACILITIES

The production of Intravenous Fluids by General Pharmaceuticals Ltd at Kabwe fulfils an essential need in Zambia. The plant is manned by Zambian staff who are capable to produce the present range of products. It is rather unfortunate that there is still a lot to be done before it could be claimed that the production facilities at GPL meet the accepted international standards.

The things that need to be done have been identified, details worked out and accepted by the management. Even action has been initiated in certain areas. The pace of implementation needs to be speeded up as the plant is already in full production. It is an accepted fact that provision of certain requirements would have been much easier if these had been taken into account when the plant was installed. At the present stage when the plant is in operation and the entire energy and resources are directed towards maintaining a certain level of production the management is finding it hard to give priority to the implementation of these recommedations. In view of the high incidence of rejection due to Pyrogen and the risk involved in marketing a product where one cannot be absolutely sure of its quality it is strongly recommended that the management must make the hard option and implement the agreed improvements in the production facilities without any further delay.

The present production activity is highly vulnerable because of its sole dependance on the supply of PVC plastic containers from Vifor, Switzerland. It is, therefore, considered advisable to gradually change over the production of IVF to polypropylene bottles. Assistance for such a change could be sought from UNIDO/UNDP.

3.2 COST CONTROL

As has been mentioned earlier the cost of direct and indirect labour for the year 80-81 has worked out to be 21.3% of the turnover. The rejection due to non sterility, Pyrogens and the finished product not meeting the chemical and other specifications is as high as 6.8%. While the first figure could be brought down to 15% by rationalising the management structure, the second figure should normally be zero if and when the G.M.P. recommendations are effectively implemented The scheme for rationalisation of the management structure has been fully discussed with the General Manager and he has already initiated some action.

Other areas where economies could be effected are:-

1. Warehousing cost of the finished goods and reduction of inventories. The company has all along been maintaining two or more rented warehouses which means the additional cost of hire, movement of goods and security arrangements. Recently the number of rented warehouses has been reduced to one. Now that the time lag for testing the batches has been reduced efforts could be made to plan production in close consultation with Govt Medical Stores, so that there is no holding up of the finished stocks in the company's warehouses. Production plans could be based on a quarterly discussions with Govt Medical Stores the main customer with regard to their more precise requirements for the following quarter.

An adjustment of 10 to 20% could be provided for in these estimates. The ordering of raw materials could of course be continued on the present basis i e. the annual budget based on the annual estimates received from the Govt. Medical Stores and the Mining Companies.

3.3 DIVERSIFICATION

Besides there being a need in Zambia for extending the range of essential drugs to be manufactured, GPL has a number of manufacturing facilities which are under utilised. These are mainly:-

i. Steam Generation - Present usage is [illegible] of the generation capacity available.

ii. Water Distillation - One water still with a capacity of 200L per hour is still lying idle awaiting to be installed.

iii. Quality Control facilities : Though the quality control department needs more space for properly installing the equipment recently received through UNIDO and some of which is still on order yet with the equipment now available the department can undertake a lot more work.

iv. Production and sterilisation of liquid filled PVC bags ; With the present equipment and staff the set up can increase their output by 70 to 80% in a single shift operation.

v. Space : Besides there being 3600 M^2 of site being available for extension of building one floor can be constructed over the existing factory building thereby yeilding an addional floor space of over 1100M^2

The company can therefore both improve its viability and achieve more self sufficiency in essential drugs for Zambia by extending its existing range and undertaking the manufacture of Oral Rehydration Salts and Parenteral products in form of ampoules and vials.

Further, a suggestion has been made in the report to set up an oral rehydration unit which could serve the sub region of Zambia and Zimbabwe to begin with and the enitre region of Central Africa at a later stage. Such a project could also enlist support from WHO and UNICEF.

3.4 EXPORTS

The neighbouring markets and their potential for exports have already been identified. These markets though close to Zambia are already procuring their requirements either from Europe or South Africa. The buying authorities in these neighbouring countries have shown a keen interest in the Intravenous Fluids manufactured by GPL. It is now entirely upto GPL to break into these markets by offering them competitive prices and assuring them of continuity in supplies. Once GPL are able to export their products they would not only improve the utilisation of their existing manufacturing facilities but also would obviate their problems with regard to foreign exchange.

3.5 TRAINING

Manufacture of Intravenous Fluids and for that matter any pharmaceutical preparations calls for the staff being all the time made aware of the meticulous care needed in all its operations. The best means to achieve this is through refresher training programmes for the trained staff and structured training programmes for the new staff. The existing operating manuals form a good basic material for the structured training where as the refresher training programmes could be prepared by the Department Heads keeping in view the needs from time to time. It is suggested that the emphasis on training be maintained.

3.6 G.M.P.

A draft G.M.P. has been prepared and has been accepted by all departments. This document would need to be implemented implicitly. In addition to this it must be updated from time to time as the experience within the organisation grows richer.

4. ACKNOWLEDGEMENTS

I am indeed grateful for the help and guidance received from the following persons and organisations during my assignment:-

i. Director General, National Commission of Development Planning, Zambia
ii. Managing Director, Indeco Limited, Lusaka
iii. Board of Directors, General Pharmaceuticals Ltd.
iv. Mr M C Msensema, General Manager, General Pharmaceuticals Ltd, Zabwe.
v. Dr J M Masonde, Permanent Secretary, Ministry of Health, Lusaka.
vi. Mr K J Moore, Chief Pharmacist, Ministry of Health, Lusaka.
vii. Mr A Leach, Ministry of Health, Lusaka.
viii. Mr J Mufti, Resident Representative, UNDP, Lusaka.
ix. Mr K C Sen, SIDFA, UNDP, Lusaka
x. Dr B S Sehgal, WHO. Lusaka
xi. Messrs Vifor SA, Geneva, Switzerland.

Annexure I

PROJECT BUDGET/REVISION

3 COUNTRY	4 PROJECT NUMBER AND AMEND.	5 SPECIFIC ACTIVITY
	DP/ZAM/74/002/G/01/37	32.1.D

10 PROJECT TITLE

INTRAVENOUS FLUIDS PLANT

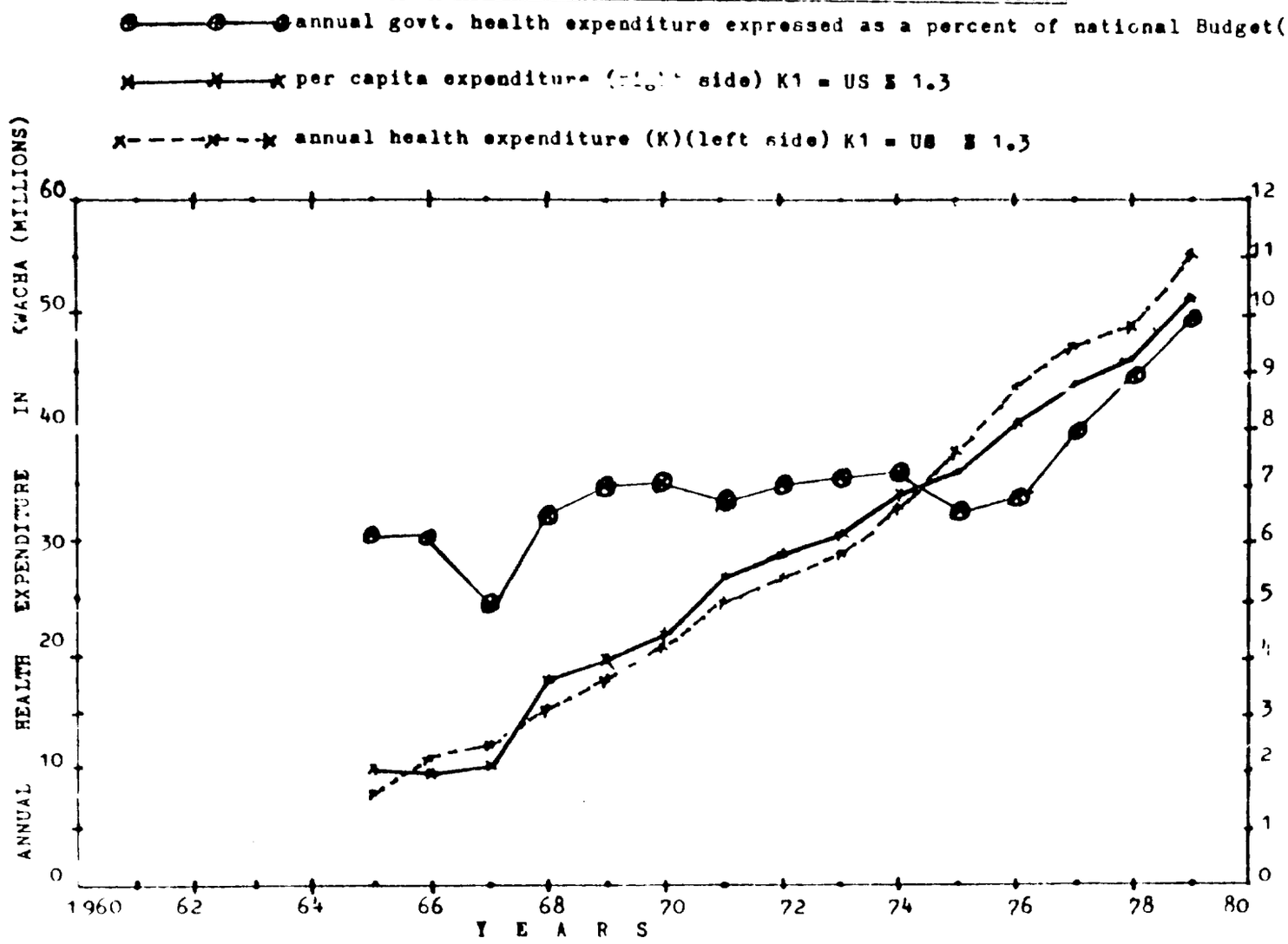
15 / 10 / 11 PROJECT PERSONNEL — EXPERTS: Post title	16. TOTAL m/m	16. TOTAL $	17. 1978 m/m	17. 1978 $	18. 1979 m/m	18. 1979 $	19. 1980 m/m	19. 1980 $	20 1981 m/m	20 1981 $
1101 Chief Technical Adviser	30.6	159,206	0.6	2,460	12.0	57,146	12.0	64,800	6	34,800
02 Production Expert	12.0	52,965			11.5	50,265	0.5	2,700		
03 Quality Control Adviser	21.0	118,200					9.0	48,600	12	69,600
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
1199 SUBTOTAL:	63.6	330,371	0.6	2,460	23.5	107,411	21.5	116,100	18.0	104,400

21 REMARKS

PROJECT BUDGET/REVISION

DP/ZAM/74/002/G/01/37	16 TOTAL m/m	16 TOTAL $	17 1978 m/m	17 1978 $	18 1979 m/m	18 1979 $	19 1980 m/m	19 1980 $	1981 m/m	1981 $
15 [illegible]		14,710				5,386		9,324		
17 [illegible]		2,000						2,000		
19 [illegible]										
19 [illegible]										
19 [illegible]	63.6	347,081	0.6	2,460	23.5	112,797	21.5	127,424	18.0	104,400
20 SUBCONTRACTS										
29 Total Subcontracts Component										
30 TRAINING										
31 Fellowships		82,700				20,925		13,775		48,000
32 Study Tours, UNDP G. Trainee Meetings										
33 In-Service Training										
34 Group Training (non UNDP)										
35 Meetings/Consultations (non-UNDP)										
39 Total Training Component		82,700				20,925		13,775		48,000
40 EQUIPMENT										
49 Total Equipment Component		122,100				7,200		114,900		
50 MISCELLANEOUS										
51 Operations -- Maintenance		1,500				682		818		
52 Reports		3,250						3,250		
53 Sundries		2,000				1,776		224		
54 Hospitality (non-UNDP)										
59 Total Miscellaneous Component		6,750				2,458		4,292		
GRAND TOTAL:	63.6	558,631	0.6	2,460	23.5	143,380	21.5	260,391	18.0	200,400

TRENDS IN GOVERNMENT ANNUAL HEALTH EXPENDITURE



ANNEXURE III

PRODUCTION OF INTRAVENOUS FLUIDS BAGS (UNITS) AT GPL APRIL 1979 - MARCH 80 AND APRIL 80 - MARCH 81

PERIOD	NO. OF BAGS FILLED (UNITS)	REJECTS	REMARKS	PERIOD	NO OF BAGS FILLED	REJECTS	REMARKS
1st Quarter 79 - 80 Apr 79 - June 79	11,694	79 (0.7%)	Budget for the year was one million units	1st Quarter 80 - 81 Mar - June 80	209,621	14,091 (6.72%)	Budget for the year was 965,653 units
2nd Quarter 79-80 Jul 79-Sept 79	166,613	3,352 (2.01%)	Production got interrupted due to 1. Delays in the receipt of raw materials during the 1st and 3rd quarters. 2. Problem with the waterstill. 3. Problem with pyrogen testing at GPL.	2nd Quarter 80 July 80-Sept80	233,987	27,936 (11.93%)	Production was more regulated though some problems were experienced due to (a) one of the sterilizers needing certain replacement of parts. (b) the poor quality of plastic containers received from Vifor.
3rd Quarter 79-80 Oct 79-Dec 79	78,942	3,887 (4.9%)		3rd Quarter 80-81 Oct 80 - Dec 80	114,384	3,570 (3.1%)	
4th Quarter 79-80 Jan 80-Mar 80	240,332	16,936 (7.05%)		4th Quarter 80-81 Jan 81-Mar 81	182,394	11,225 (6.15%)	
Total for the year Apr 79 - Mar 80	497,580	23,234 (4.7%)	Out of 206 batches produced during the year only 100 could be tested, the rest i.e. 106 batches were under test by the end of the year.	Total for the year Apr 80-Mar 81	740,376	56,812 (7.67%)	

ANNEXURE IV

The following table shows the batches produced and tested over 1979 - 80 and 1980 - 81 on a quarterly basis and also number of batches rejected :-

PERIOD	TESTED	REJECTED	REASONS FOR REJECTION
May 79 (no production in April and June 79)	7	-	-
1.7.79 to 30.9.79	88	2	Low dextrose
1.10.79 to 31.12.79 (no production in N November 1979	40	1	Clarity unsatisfactory
1.1.80 to 31.3.80	94	10	2 non-sterile and pyrogenic, 8 chemically unsatisfactory
Total for 1979 - 80	**206**	**13**	**6.2%**
1.4.80 to 30.6.80	78	6	5 non-sterile, 1 pyrogenic
1.7.80 to 30.9.80	67	3	1 non-sterile, 2 chemically unsatisfactory. A few trolleys from 4 batches rejected for non-sterility.
1.10.80 to 31.12.80	69	6	*6 Pyrogenic. One trolley from one batch over heated.
1.1.81 to 31.3.81	125	8	4 Pyrogenic, 3 chemically unsatisfactory, 1 contaminated.
Total for 1980-81	**339**	**23**	**6.8%**

ANNEXURE V

SALES FIGURES IN UNITS AND VALUE FOR I.V.F. MANUFACTURED BY GPL FOR THE YEARS APRIL 79 - MARCH 80 AND APRIL 80 - MARCH 80

APRIL 79 - MARCH 80				APRIL 80 - MARCH 81			
PERIOD	NO OF BAGS SOLD UNITS	VALUE IN KWACHA	VALUE IN US $ (1K= 1.224 $)	PERIOD	NO OF BAGS SOLD UNITS	VALUE IN KWACHA	VALUE IN US $ (1K= 1.224 $)
1st Quarter Apr 79 - June 79	56,455	94,757	115,983	1st Quarter Apr 80 - June 80	163,980	401,555	491,503
2nd Quarter July 79 - Sept 79	120,052	216,009	264,395	2nd Quarter July 80 - Sept 80	138,367	325,816	398,798
3rd Quarter Oct 79 - Dec 79	90,147	151,387	185,298	3rd Quarter Oct 80 - Dec 80	211,285	467,993	572,823
4th Quarter Jan 80 - Mar 80	70,929	99,280	121,519	4th Quarter Jan 81 - Mar 81	154,715	385,090	471,350
Year April 79 - March 80	337,583	561,433	687,194	Year April 80 March 81	668,347	1,580,454	1,934,474

PROPOSAL FOR THE MANUFACTURE OF ORAL REHYDRATION SALTS (ORS)

INTRODUCTION

In many developing countries such as Zambia acute diarrhoea diseases are one of the main causes of infant mortality. The death is caused by dehydration. Such cases can be treated effectively in all age groups by giving patients by mouth a dextrose-electrolyte solution. The solution can be easily prepared as needed by dessolving a prepacked mixture of ORS in an appropriate volume of drinking water.

ORS packets of pharmaceutical quality can be used as a non prescription drug even in remote areas where proper medical assistance is not readily available. These can be easily transported and have a long shelf life.

Composition:

The recommended ingredients in ORS packet for making one litre of solution are:

Dextrose anhydrous	20.0g
Sodium Chloride	3.5g
Sodium Bicarbonate	2.5g
Potassium Chloride	1.5g

According to a WHO and U.N.I.C.E.F. document this formulation has been used successfully to treat dehydration due to acute diarrhoes including cholera in all age groups.

On dissolution in water it yields the following concentrations:-

Dextrose	111 m mol/L
Na^+	90 m mol/L
cl^-	80 m mol/L
HCO_3^-	30 m mol/L
K^+	20 m mol/L

PACKAGE SIZE

For simplicity of production and economy to the end user it is proposed to manufacture only a packet size to yield on litre of ORS solution. Later on if need arises more expensive packs for making up volumes of solutions such as 200 mls or 500 mls can be introduced.

PRODUCTION CAPACITY

For a semi-automatic packing unit the most economic plant would have a production capacity of 2500 packs per day. This is based on a production rate of 6 packets per minute and 7 hours of actual work.

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Annual production may however be varied to virtually accommodate any requirement based on:-

1. decrease by operating fewer days.
2. increase by working more than one shift or by adding more machines.

SPACE REQUIREMENT

The following areas need to be provided

1. Storage of raw materials	Existing stores after the proposed quarantine goods received area is developed, should suffice.
2. Drying and Sifting	24 M^2 floor space
3. Weighing and Mixing	24 M^2 floor space
4. Filling sealing and packing	24 M^2 floor space
5. Quarantine and storage of finished products	Existing storage facilities could be used.
6. Quality Control Laboratory	Existing facilities could be used.
7. Lockers and change rooms for workers	Existing facilities could be used.
	72 M^2

Ceiling height in all the production areas should be 3M.

There should not be any water or drains in the rooms 1 - 5. Routine cleaning of the areas and machines is by vacuum cleaner. The absence of drains eliminates common source of contamination.

The rooms 1 - 5 need to be air conditioned for control of humidity and temperature.

EQUIPMENT

For a semi automatic operation and for the production capacity indicated the following equipment is proposed.

	Approx. Price
1. Oscillating granulator Manesty England or Multimill All S.S. Construction Gansons Ltd, India	K5,000/-
2. Dryer Tray type Mitchel	K15,000

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3. (a) Weighing Scales Dial type upto 100 kgs (b) upto 20 kgs (c) 100 gms needed for process control	AVERY	K4000
4. Mixer blender Drum type		K4000
5. Drums S.S. or Aluminium or Polythene with herimetically sealing lid 10 Numbers		K1800
6. Vacuum Cleaner		K500
7. Dosing Equipment Semi automatic		K 8000
8. Sealer		K 1000
9. Imprinter for batch No. and Mnfg date		K 1500
10. Sundries, Hand Shovels 2kgs 10, hand shovels 250g 10, Polypropylene bowls 10,		K 400
		K27,200
11. Cost of Installation		K 5,000
Total cost		K32,200 rounded off to K35,000

Cost of the project

Equipment and Installation Approx.	K35,000
Building 72 M^2 floor space @ K500 per M^2	K36,000
Facilities such as air conditioning, piping etc.	K 5,000
Total	K76,000

LABOUR REQUIREMENT

Granulation Drying & Weighing Filling & Packing	1 Operator 1 Operator 4 Operators	K600/month
Supervisor	1	K200/month
		K800/month

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COST OF PRODUCTION

Per batch of 2500 packets

Materials

Glucose Anhyd	50kg @ K2,0/kg	K100
Sod. Chloride	8.75kg @ K1,4/kg	K 12,25
Sod. Bicarb.	6.25kg @ K1.5/kg	K 9.4
Pot. Chloride	3.75kg @ K2.0/kg	K 7.5
Aerosil (recommended to keep the powder in free flowing state)	0.01375kg @ K6/kg	K0.08
	68.76375 kg	K129,23
Working losses 5%		6,4615
		or K135,7

Direct Labour (monthly cost K800 divided by 20 working days)	K	40,00
Overheads same as direct labour	K	40,00
Total cost for 2500 packets exclusive of the sachet & packing	K	215,7
Cost per packet exclusive of sachet and packing		K0,086
	or	9N
Cost of Aluminium Sachet printed on both sides	=	2N
Cost of outer carton for 100 packets	=	50N
Cost per packet	=	0,5
Total cost per packet	=	11,5N

JUSTIFICATION

a) Annual Consumption and prices:

Regarding consumption and price of ORS (one litre make up solution packets). Mr A Leach Buying Officer, Ministry of Health has indicated that:-

1. Based on the reported cases of severe diarrhoes in Zambia the consumption could be up 1,2 million packets a year.

   Mr Moore the Chief Pharmacist Ministry of Health indicated that the immediate need in Zambia would be of the order of 5-600,000 packets a year. This could grow to 1,2 million during the next three years when their plans regarding primary health services could become fully operative.

5/....

2. Mr Leach indicated that a price of 25 - 30n per packet would be reasonable.

3. At present ORS are marketed in Zambia by Searle Laboratories under the trade name of Rehydrate. Their one litre make up pack sells at the chemiss shop for 95n. The product has a lime and lemon flavour.

(b) Capital Outlay:

The total capital cost as shown earlier is	K76,000
+ 10% for escalation and exigencies	7,600
	K83,600 to rounded of to K84,000

(c) Return and Profitability

Basing the price to be 30n per packet the net generation of money from the sale of 500,000 units per year would be

$$\frac{(30-11.5)\ 500,000}{100} = K92,500$$

Adjusting K17,000 towards return of capital (basing total recovery within five year) and K25,000 contribution to the indirect and fixed overheads of the company the project would yield a minimum profit of K50,000 per year.

(d) Other advantages

It has been known for sometime that WHO and UNICEF are planning to assist the development of a regional project for Central Africa for the manufacture of ORS. By establishing a plant for the local consumption GPL would not only fulfil Zambia's need for an essential medical preparation but would also qualify for assistance from WHO and UNICEF for developing their ORS plant to satisfy the regional needs through these organisations.