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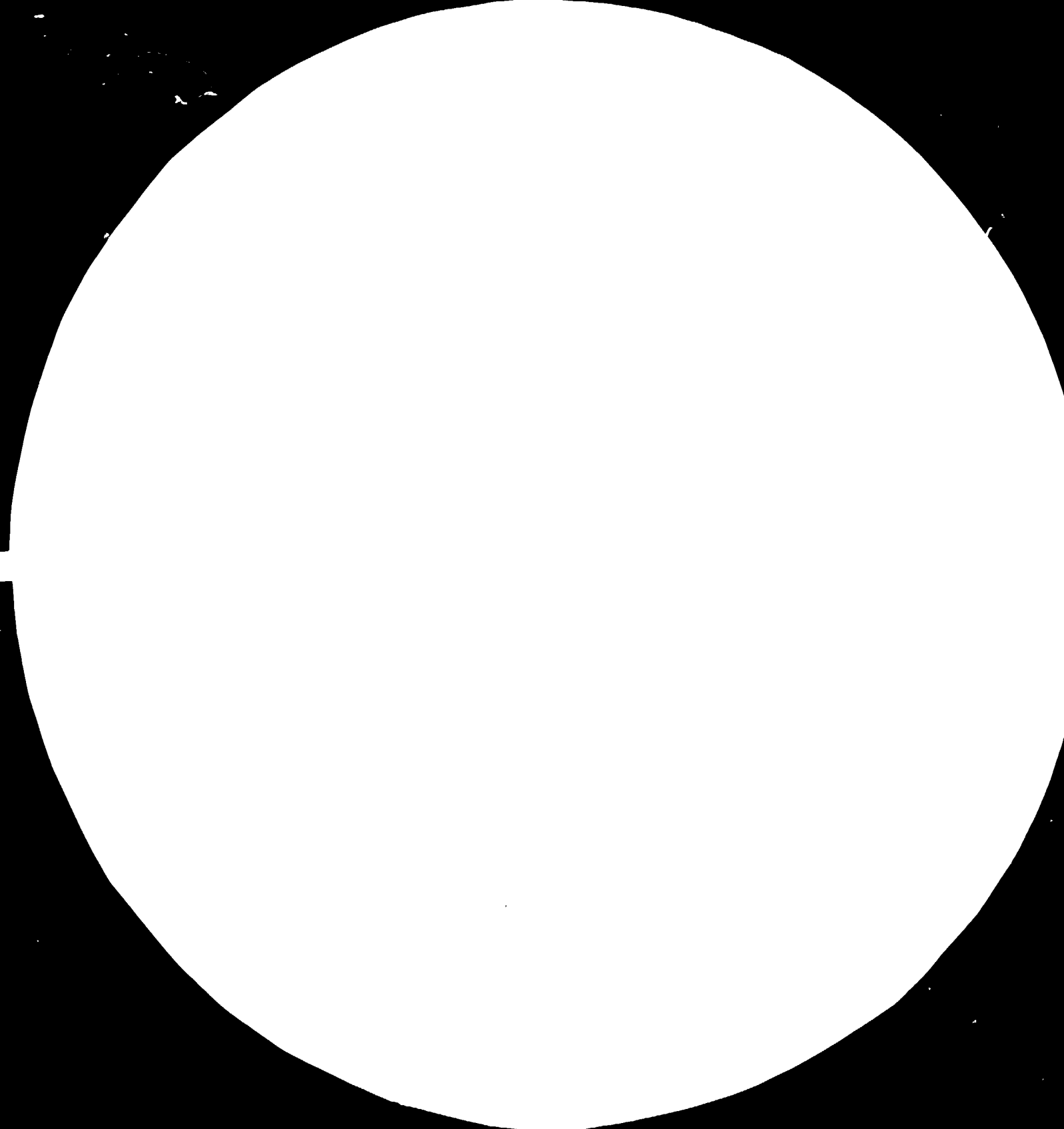
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Bhutan.

Production of High Density Polyethylene Pipes
for Potable Water Supply in Bhutan

A report for the Government of Bhutan

DP/BHU/83/025

by

A.D. Clarke
(Consultant)

of the United Nations Industrial Development Organization
acting as the Executing Agency for the
United Nations Development Programme

2376

This report has not been cleared with the United Nations Industrial Development Organization which does not therefore necessarily share the views expressed.

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1. SUMMARY

Following a series of intensive consultations with various Ministries and Departments of the Royal Government of Bhutan, four draft documents were prepared and, subject to editorial adjustment, were agreed upon during a final round-up meeting. The documents consisted of:

- i. Revised project document 'Establishment of a mini-plant for the production of high density polyethylene (HDPE) pipe' DP/BHU/83/025/C/01/37
- ii. Supplementary paper highlighting justifications for equipment and marketing
- iii. Terms of reference for the subcontractor
- iv. List of bidders to be invited to tender

Funding for the project has still to be finalised and as the project has been designated as time sensitive a decision will be required not later than end of July 1984.

Follow-up activities have been listed.

2. INTRODUCTION

This mission was undertaken in company with Mr. H. May, Deputy Director, Industrial Operations Division of UNIDO. The mission was undertaken to finalize the draft project document 'Establishment of a mini-plant for the production of high density polyethylene (HDPE) pipes' and to prepare terms of reference for a turnkey subcontract and list of bidders.

The mission arrived in Bombay on 15th May and undertook discussions with Petrochemical Industries Ltd. (PILS). The mission left Bombay on 16 May and arrived New Delhi the same day. After consultations with UNICEF and discussions at UNDP office the mission left New Delhi on 18 May and flew to Bagdogra and thence by car to Gayleghug (Bhutan) arriving the same day. The mission then travelled by car on 20 May to Puntsholing (overnight) and then to Thimphu on 21 May. The mission left Thimphu for Paro on 25 May and flew to Calcutta and on to Bombay arriving that evening. On 26 May a further meeting was held with PILS and the consultant left Bombay on 27 May, 1984.

3. FINDINGS

A. Petrochemical Industries Ltd. (PIL) , Bombay

Discussions took place with Mr. B.C. Gosalia, Vice-President, and Mr. A.R. Laddha, Marketing, and also with Dr. Dhuldhoya, Managing Director.

PIL is an international company in which Hoechst of the Federal Republic of Germany hold 30% share interest, and NOCIL 30% with the remainder in Indian hands. NOCIL are an international company in which Snell International have a 30% share holding. NOCIL operate a petrochemical cracker and supply ethylene to PILS which polymerises this to high density polyethylene using Hoechst process and technology.

PIL is divided into three divisions:

Polymer Division, Processing Division and Chemicals Division.

The polymer division produces high density polyethylene (HDPE) polymer on a plant with a rated capacity of 35,000 tons but currently operating at only 25,000 tons/year. The processing division now located at Akola produces pipes, and also blow mouldings of containers up to 200 litre capacity using HDPE as raw material. The output of pipes was stated to be 3,000 tons/year. The chemicals division produces chemicals required in rubber processing and is a business it acquired from Monsanto Chemicals.

PIL processing division has had a long association with Deki Polythene Ltd. of Caylegphug, Bhutan, over a period of seven years as it supplied them with HDPE. It was explained that Deki Polythene Ltd (DPL) had an extruder which was old and of outdated design when purchased. As DPL wanted to produce HDPE pipes for the piped drinking water supply programme being undertaken in Bhutan by UNICEF, PIL offered their technical assistance to modify the Neptune extruder which was accepted. Essentially the extruder was underpowered so the screw diameter was reduced to 65 mm. size, with an appropriate barrel. This had only recently been completed.

As part of their technical assistance PIL trained three persons from DPL (two process operators and one production manager, Mr. Geden Dorjee) by on the job training in PIL Processing Division and this also included training in testing. In addition, PIL supplied DPL with test equipment to enable DPL to test to specification. The equipment consisted of an oven for reversion test, and a thermostatically controlled liquid bath for the creep rupture test. Correlation testing on samples had also been undertaken satisfactorily, and PIL then agreed that DPL could market its pipe using the well-advertised HASTI trade mark of PIL. Thus DPL pipe will be marketed as 'Deki-Hasti' HDPE pipe.

It was also disclosed, and confirmed in subsequent discussions with Government of Bhutan, that PIL had signed two agreements with the Government of Bhutan/DPL. One agreement provided that PIL would depute an appropriate staff member as production manager to DPL up to a period of one year, longer if required, so that the Bhutanese manager could receive all necessary training in pipe production. The second agreement provided that PIL would depute an Export Marketing Manager to DPL to train DPL personnel and to assist and develop the potential export market into Eastern India (Assam and related provinces) as there were no indigenous Indian pipe producers in that area. The market potential seems to be good and the Indian Oil Company operating in Assam has plans for piping gas which utilises HDPE pipes. The cost of this service would be 2% of the export sales achieved.

During the period since 1977, a total of 10 persons from PIL have been to Gaylegphug, 8 of whom have been in connection with production of pipes for the drinking water project.

3. FINDINGS

B. UNICEF New Delhi Office

In the unavoidable absence of both Mr. E.A. Marrero, Procurement Officer and of Mr. Rolf Carriere, Regional Programme Officer, discussions took place with Mr. J.C. Etienne, Assistant Procurement Officer and Mr. B.B. Vohra, Programme Officer for Bhutan.

The purpose of the visit was outlined by Mr. H. May and the discussions brought forth the following information:

1. UNICEF had been purchasing HDPE pipes over a number of years for use in the piped drinking water programme to villages in Bhutan.
2. In its tender documents UNICEF had specified that the pipes should be made from HDPE grade GM5010 as well as specifying the ISI 4984 pipe specification. This had brought complaints from international companies, as the type GM 5010 is a polymer compound reference number which is indigenous to Hoechst, and in India with PIL. There are no international specifications for polymer or polymer compounds as the view is taken that it is the final product, namely, 'HDPE pipe for drinking water supply', which needs to be specified. The polymer or polymer compound used should be fully at the choice of the processor, as long as the pipe complies in all respects with the pipe specification. There are internationally many equivalent end-product grades of HDPE polymer freely available, which can be successfully processed to produce pipe to meet the ISI standard.

3. Up to 1983 UNICEF Procurement Office in New Delhi acted in advance of UN approval but in 1984, this year, this facility will no longer be available. The UNICEF H.Q. in Copenhagen has indicated it wants to review the Global bidding operation.

Currently for the period 1982-84, 2.5 million dollars has been allocated for pipe purchases. The next phase after 1984 will be up to end 86/March '87 period. A project proposal has been made for 3 million dollars but a donor needs to be identified before any commitment can be made. UNICEF are hopeful the programme will continue beyond 1986. The Royal Government of Bhutan, it was indicated, are thinking of going up to the year 2000 with piped water supplies. Current usage is at a rate of about 3,000 tons per five years. It was suggested discussions should be undertaken with Mr. Duri NORBU, Director of PWD in Thimphu for more details.

4. The Crown Agents at Bangalore and S.G.S. at Delhi are the two organisations used by UNICEF as inspecting agents for HDPE pipes. It was indicated that beside PIL two other Indian plastics processors had supplied pipes to the project, these were EXOMET and ORISSA PLASTIC. There had been the odd occasion where pipe from PIL did not pass specification.
5. UNICEF were aware of the close links between Deki Polythene Ltd in Bhutan and PIL in India. An old extruder had been updated with technical help from PIL and Deki now claimed they were able to manufacture quality HDPE pipe to specification and had requested UNICEF to place a small trial order to permit them to prove their claim. Samples of pipe have been submitted by UNICEF to their inspecting agents, who had also examined their plant. The results were still awaited. If satisfactory then they will be placed on the potential suppliers list and will have to compete in bidding with other international companies. (Later it was learnt that positive results had been achieved)
6. In response to Mr. May's suggestion that there may be advantage to be gained if UNIDO joined with UNICEF to make a joint approach to AGFUND to become a project donor it was stated that this would be best pursued through contact with Mr. ANPANA PIRACHA, Chief of the Asian Desk in UN New York.

It had earlier been indicated that AGFUND has previously been approached but the contribution was only 70,000 dollars and was utilised in the 82/83 programme.

3. FINDINGS

C. Deki Polythene Ltd. (DPL) in Gaylegphug and Puntsholing

Deki Polythene Ltd. is now 80% Government of Bhutan and 20% Deki Corporation Pvt. Ltd. owned, and the appropriate documents were stated to have now been registered.

Mr. Pema Jumej, known as P.J., is the National Project Manager and is the General Manager of the company. He is an extremely active and capable person who recognises his own weaknesses and has requested training in basic plastics technology and in management. He has been nominated by the Government to undergo training at CIPET, India (Central Institute of Plastics Engineering and Tools) and to participate in the joint UNIDO/Government of Austria Plastics Training Programme at LKT in Vienna, October 1984.

Mr. Afroze Bukht, Managing Director of Deki Corporation Pvt Ltd. has been the prime mover to develop this production capacity for HDPE pipes in Bhutan, and he has been responsible for recruiting key Bhutanese personnel for the project. He recognised the need to develop a team of trained personnel both for production and for marketing, and it was through his initiative that the agreements with PIL were negotiated. This became necessary as the request for UNIDO assistance had been slipping for several years due to many reasons.

Mr. Geden Dorjee is an electrical engineer and has only recently joined DPL. He is also an active person with a very quick uptake of new information and has absorbed much knowledge from his training period at PIL. He will also benefit by additional training at CIPET and at LKT Vienna in October 1984, for which he has been nominated by the Government.

Mr. Ranjit Pakrasi is the Sales Manager for DPL and he has been active in examining the potential export market. He had already taken action to have DPL registered in India with Government Department of Purchasing and Procurement. This is necessary if DPL is to participate in bidding for Indian contracts for pipe. He has experience in India of selling in a different field, but knows the Indian Government routines.

There is at Gaylegphug a good nucleus of personnel to operate the extruder. They are currently guided in their activities by Mr. I.R. Oza who is on deputation as Production Manager from PIL.

The Neptune extruder line has now produced some HDPE pipe which complies with the Indian Standard specification*. The plant has been inspected by the Crown Agents on behalf of UNICEF, and they have tested the pipe produced. They have confirmed that it passes the specification. P.J. has been to New Delhi and has obtained a trial order from UNICEF for 20,000 US dollars to enable the plant to demonstrate that it can consistently produce pipe to specification. This is an important step forward in this production development.

* IS.4984: 1978

The extruder and plant have been examined. It is well laid out in a suitable building. The extruder is of old design with a pulley drive. This may give slippage under load and could give difficulties of controlling pipe dimensions. The extruder has several moving parts which require mechanical guards to be fitted in the interests of safety. Electrical wiring to some of the heaters also requires attention from the safety aspect of open circuits. Sizing dies require internal polishing and checking as they are currently of a rough internal surface. The support pulleys for the finished pipe need to be increased in number, or an angled support slide substituted, to prevent curvature in the finished pipe of large diameters. The granulator equipment is under-powered which necessitates pre-cutting of pipe prior to feeding into the granulator.

The plant control instruments for checking pipe, and for testing need to be increased. Currently there is only a vernier caliper for measuring pipe. A screw micrometer and a dial micrometer will be required. A ovality tester will also be required. The oven is satisfactory for reversion tests. The apparatus for creep rupture testing over a period of 48 hours currently suffers from frequent burn-outs of the heated elements. This matter has been drawn to the attention of PIL by this consultant.

The extruder performs satisfactorily as shown by the fact that pipe to specification has been produced. However this can only be achieved by constant operators attention. Output is low and is currently estimated at 100 tons per year. Presently the plant is operated on dayshift basis only, and this is a normal practice while personnel are in the early learning stages of operation and production. However, three shift working on 6 day per week basis is essential if an economic production of pipe is to be achieved.

During the course of this visit there were a number of power out-offs in Gayleghug. Electric power is supplied to this area from India and supply continuity is therefore outside the direct control of the Bhutanese Government. Apart from its effect on production it also effects the creep rupture test which needs an uninterrupted supply during the 48 hour test period. Provision of a diesel generator set is therefore judged to be an essential component in the project to enable the extruder line, testing equipment and factory lighting to operate effectively.

Water supply is pumped to an elevated tank situated close to the building. This also requires electric power.

The building is located in a field site of 1.5 ha and there is ample room for expansion to seven bays of same size as the existing building. There is an approach road to the building completed, and pipes are stored outside. For the project a new transformer will need to be fitted to provide the power required. It was stated that this will not present any problems, and this work will be undertaken by the Government.

Raw material - HDPE black compound - would be purchased in the international market for UNICEF contract as it is based on US dollars. Current international price of HDPE is about 1050 US dlrs cif Gayleghpur and price trends currently are upward. Price of HDPE from PIL India (only supplier) is currently equivalent of 2.600 US dollars but can be purchased by the Government of Bhutan in rupees. The high price is partly due to a 50% excise duty, and partly arises from the small size of the production plant at PIL. Excise duty is rebatable for exports. However there is an inter-governmental agreement between Bhutan and India whereby the latter government makes an annual fixed payment to the Government of Bhutan representing notationally repayment of all rebatable excise duties. The financial benefit of the excise rebate does not therefore directly reach DPL and the imported HDPE needs to be costed in at its full price.

The only price differential between DPL and PIL pipes would therefore be the price difference due to transport. This can be a considerable factor since a distance of about 1800 miles would be involved. With the existing plant it is doubtful if an economic production could be achieved to compete with PIL. The need for a modern extrusion line is therefore necessary if the export market is to be successfully exploited and the present project would provide this facility.

D. Thimphu

Discussions took place with UNDP office, Ministry of Trade, Industries and Mines, the Department of Trade and Industry, the Planning Commission and with visiting representatives of UNICEF.

These wide ranging discussions took place over a three day period which enabled a revised draft version of the project document to be prepared, terms of reference drafted and a short list of potential bidders prepared. Subject to editorial corrections these were agreed at the Round-up Meeting on 24 May 1984. The following points emerged during the various discussions:-

1. The Government regards this as an important project. They see it as a means of generating foreign currency as well as extending the industrialisation process. They would like the support of UNIDO and UNDP for the project and stressed that time is of the essence.
2. Manpower training as a means of achieving technology transfer is an important part of this project. This is already in action with training through PIL, and training scheduled under the Preparatory Assistance programme. The draft Prodoc also reflects the training needs, and there is an 18 m/m training component within the subcontract.

3. The Government accepts that UNICEF have to go to global tender for pipes, and that the only way they can obtain the contract is to bid successfully in such competition. They believe that with modern plant they will be able to achieve this successfully. This view is supported by this consultant.
4. The Government's longterm aim is to use only Bhutanese labour. To operate the project plant 15 personnel will be required. Recruitment has been started and additional personnel are being engaged.
5. Mr. Joseph Christmas of UNICEF, New York office, has visited the present plant at Gaylephug. He confirmed that it had produced pipe which passed specification, that the plant had been inspected by the Crown Agents, and that a trial order of about 20,000 US dollars value had been placed by UNICEF to enable the plant to produce on a long run. He stated that the present plant was very basic and would need to be upgraded. He also indicated that the UNICEF procurement division was now based in Copenhagen and that pipe fittings also formed part of their purchases.

Maintenance of water supply lines is a major problem in Bhutan and this will become pronounced as it is intended to make each village responsible for its own water pipe maintenance. 75% of failures are due to breakages of joints or deliberately cut/split pipes. As villagers cannot undertake butt welding, he has been examining alternatives and now recommends the Yorkshire coupling PE Ol for pipes up to 50 mm diameter. Analysis of pipe diameters used has shown that only 3.16% are above 50 mm.

UNICEF have only in more recent years become interested in sanitation schemes. He was currently evaluating sewage needs. It was indicated that the first step would be the provision of latrines and pull-flush systems and the use of VIDP for one storey buildings. The vent pipes and long drop laterals would require 4 inch (200 mm) pipe. Normally PVC is used, the possible use of HDPE pipe would need consideration. The Asian Development Bank also have an interest in funding development of sanitation.

6. The Government indicated that Oxfam had shown an interest in providing raw materials for HDPE pipes some years ago. It was agreed that P.J. would follow up to see if interest was still active.
7. The technical considerations of the project were discussed in detail and appropriate justifications were built into the Prodoc. A separate note on justifications was prepared which high-lighted some specific points.

8. The view was taken that this project is only the start of a plastics industry in Bhutan. The need for an injection moulding machine, and suitable moulds for production of fittings was a natural extension of this process. Mr. May indicated it may be possible to obtain donor funds through UNIDF or CNDF but they would be tied, i.e., the equipment would have to be purchased from the donor country. It was possible that Switzerland may be interested, but it was made clear that it generally took 18 to 24 months before a decision is reached by a potential donor. The Government agreed that UNIDO should pursue any possible alternative sources of funding.
9. It was agreed that the Preparatory Assistance budget should be incorporated into the budget of the revised draft Prodoc. This has been completed.
10. The Government confirmed that foreign currency would be made available for spares and maintenance after the project is completed thus ensuring the production capacity remains operational.
11. The diversity of the extrusion process was outlined by the consultant. The extruder(s) could also produce sections by using appropriately shaped dies. By introducing a different type of take-off equipment the extruder could produce blown low density polyethylene (LDPE) film which could be used in foodstuff packaging applications (improvement of health and hygiene) as well as in agricultural applications to improve both yields and quality of agricultural produce. All these applications would require a few years for development so a backward integration process would be advisable. Starting with import of film of known quality and undertaking a programme of application development would be a first step. It is estimated that the cost of the alternative take-off equipment including a bag making machine would be about \$0,000 US dollars.
12. The financing of the project was discussed at the round-up meeting. Mr. Dar, Resident Representative UNDP, stated that as Mr. May had indicated the possibility of obtaining donor funds the use of IPF funds should be a fund of last resource. This proposal was resisted by Mr. May on the grounds that the Government had stressed that time was of the essence in this project. The Government agreed that if IPF was utilised for funding then other projects would suffer, but requested that the position should be carefully and urgently examined by UNDP office. It was agreed that the Prodoc should be sent to UNDP New York for approval and that in the interim two month period UNIDC would informally sound out prospective subcontract bidders. Training would proceed as scheduled as this was covered by the Preparatory Assistance budget. By end July a definite decision by the Government would be required regarding funding the project from IPF otherwise the momentum started would be severely restricted and the delivery of equipment, as requested by DPL, in the first quarter of 1985 would not

be possible. Mr. Klein, Deputy Resident Representative UNDP, suggested that if a donor could be found by UNIDO the question of joint participation (IPF/donor funds) should be considered, but as it may take 18 to 24 months to obtain a decision from a donor this would delay the start of the project. The possibility of starting the project on IPF funding and the subsequent joining of a potential donor at a later stage in the project was also discussed.

It was finally agreed that the Planning Commission will write to UNDP to officially request project funding from IPF and the Resident Representative, Mr. Dar, would submit the project document to UNDP Headquarters in New York for approval. It was expected this would take about 8 weeks (end of July). In the interim period UNDP Thimphu would urgently examine the implications of using IPF funding and would advise the Government of the effects this might have on current on-going projects. Mr. Dar indicated it may mean closing an existing project and the Government accepted this would have to be considered. At the same time Mr. May undertook to make some soundings of possible donors to determine if alternative or co-funding might be possible. This exercise would need to be completed before the end of July if project momentum was to be maintained.

E. Follow-up Activities

UNIDO

- a) Mr. May will sound out potential donors for funding project or as co-funders. He will inform UNDP Thimphu the results of this exercise before end of July 1984.
- b) Mr. May will consider making a joint approach with UNICEF for AGFUND to be a project donor for UNICEF Bhutan project. Contact will be made through Mr. Akzana Piracha, Chief of the Asia desk, UN New York.
- c) PAC, in consultation with Chemical Industries Branch to approach informally prospective bidders to determine more accurately contract schedule and verify suitability of Government building design. (Note : a detailed drawing of the current building is included in the feasibility study prepared by Polyolefins Industries Ltd. under UNIDIO contract 29 June 1981. The new building will be similar)
- d) Maintain constant contact with UNDP Thimphu to ensure minimum delays in all activities particularly the submission of project document to UNDP Headquarters.
- e) Continue examination of financing certain components using alternative fund sources.

E. Follow-up Activities (contd.)

UNDP

- a) To assess in conjunction with Planning Commission various alternatives for re-allocating funds from other IPF projects.
- b) To continue to investigate with the Ministry/Planning Commission the possibility of financing some of the project components with separate projects, e.g. Manpower development, ensuring however that such measures are not detrimental to the integrated approach agreed upon.
- c) To submit the revised draft prodoc DP/BHU/83/025/C/01/37 with UNDP inputs of 872,750 US dollars to UNDP headquarters for approval.
- d) Ensure a final decision on project funding is reached not later than end of July 1984 and ensure UNIDO is urgently advised.

GOVERNMENT

- a) Continue examination of possible re-allocation of IPF funds to HDPE pipe project.
- b) Continue market investigations into potential market possibilities outside Bhutan for pipes produced after internal requirements have been met.
- c) To provide dimensional construction drawings relating to Gaylegphug site.
- d) To make a final decision on project funding not later than end of July 1984 to ensure project momentum can be maintained.

F. LIST OF PERSONS WITH WHOM DISCUSSIONS TOOK PLACE

Mr. Raj Kumar Dar, Resident Representative, UNDP
Mr. C. Klein, Deputy Resident Representative, UNDP
Ms. Patricia Francheschinis, JPO, UNDP
Mr. Vgen Namgyal, Joint Director, Department of Trade + Industry
Dasho C. Dorji, General Director, Department of Industries + Mines
Dasho Lam Pemjor, Deputy Minister of Planning
Mr. Pama Wangdi, Deputy Secretary Planning Division
Mr. Vgen Tshering, Deputy Director, Planning Commission
Mr. Tshering Wangda, Deputy Secretary Ministry of Trade Industry + Mines
Mr. Jam Yang Lhendup, Attache Department of Industry + Mines
Mr. Tshering Yonten, Attache Ministry of Trade Industry + Mines
Mr. D.K. Chhetri, Director, Economic Division, Ministry of Foreign Affairs
Mr. Yeshey Zimba, Managing Director, Royal Monetary Authority

Dr. Joseph Christmas, Senior Adviser (Water + Sanitation)
UNICEF, New York
Mr. Ragnor Schonborg, Consultant, UNICEF
Mr. Jean C. Etienne, Assistant Procurement Officer, UNICEF, New Delhi
Mr. B.B. Vofra, Programme Officer, UNICEF, New Delhi
Dr. Dhuldhoya, Managing Director, Polyolefins Industries Ltd., Bombay
Mr. B.C. Gosalia, Vice President, Polyolefins Industries Ltd., Bombay
Mr. A.R. Laddha, Marketing Manager, Polyolefins Industries Ltd., Bombay
Mr. M. K. Hussein, SIDFA, UNDP, New Delhi
Mr. Marka, UNDP, New Delhi

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Thanks are expressed to Mr. A. Bakht, Managing Director, Deki Corporation Pvt Ltd. and also to Mr. Pema Juney, General Manager, DPL for their very kind assistance and generous hospitality shown to the mission at Gaylegphug, Puntsholing and in Thimphu.

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